104-6.4.6.3 Inspection and Maintenance: Inspect all silt fences in accordance with any applicable permit. If the project does not have a permit, inspect within 24 hours after each rain event and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, repair or replace silt fences in accordance with the Contract Documents or as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately 1/2 the height of the silt fence or as directed by the Engineer. Shape any remaining sediment deposits to conform with the finished grade and prepare the area for turf in accordance with Section 570.

104-6.4.7 Floating Turbidity Barriers and Staked Turbidity Barriers: Furnish, install, maintain, and remove floating turbidity barriers in accordance with the applicable permits, the manufacturer's directions, and the Contract Documents. The Contractor may need to deploy turbidity barriers around isolated areas of concern (such as, seagrass beds, coral communities) both within as well as outside the project limits. The Engineer will identify such areas. Place the barriers prior to the commencement of any work that could impact the area of concern. Ensure that the type of barrier used and the deployment and maintenance of the barrier will minimize dispersion of turbid waters from the project. The Engineer may approve alternate methods or materials.

Install and maintain turbidity barriers to avoid or minimize the degradation of the water quality of the surrounding waters and minimize damage to areas where the floating barriers are installed.

104-6.4.8 Inlet Protection System: Furnish and install inlet protection systems as shown in the Contract Documents.

104-6.4.9 Rolled Erosion Control Products (RECPs):

104-6.4.9.1 General: Install RECPs in locations where temporary protection from erosion is needed. Two common applications are described below.

1. Use RECPs composed of natural or synthetic fiber mats, plastic sheeting, or netting as protection against erosion, when directed by the Engineer, during temporary pauses in construction caused by inclement weather or other circumstances. Remove the material when construction resumes.

2. Use RECPs as erosion control blankets, at locations shown in the Plans, to facilitate plant growth while permanent grassing is being established. For the purpose described, use non-toxic, biodegradable, natural or synthetic woven fiber mats. Install erosion control blankets capable of sustaining a maximum design velocity of 6.5 ft/sec as determined from tests performed by Utah State University, Texas Transportation Institute or an independent testing laboratory approved by the Department. Submit to the Engineer, certified test reports from the manufacturer showing that the erosion control blankets meet the requirements of this Specification. Certification must be attested, by a person having legal authority to bind the manufacturing company. Also, furnish two 4 by 8 inch samples for product identification. The manufacturers test records shall be made available to the Department upon request. Leave the material in place, as installed, to biodegrade.

104-6.4.10 Chemical Treatment: Provide chemical treatment in accordance with the Contract Documents. Chemical treatment may be used to clarify turbid or sediment laden water that does not meet state water quality standards or to supplement other erosion and

sediment control devices to aid in their performance. The contractor must provide the required toxicity testing information in accordance with the Contract Documents to the Engineer for review and acceptance prior to using any chemical treatment on the project site.

104-6.5 Removal of Temporary Erosion Control Devices: In general, remove or incorporate into the soil any temporary erosion control devices upon incorporation of the permanent erosion control devices into the project. The Engineer may direct that temporary devices be left in place.

104-7 Maintenance of Erosion and Sediment Control Devices.

104-7.1 General: Provide routine maintenance of permanent and temporary erosion and sediment control devices, at no expense to the Department, until the project is complete and accepted. If reconstruction or replacement of erosion and sediment control devices is necessary due to the Contractor's negligence or carelessness or, in the case of temporary erosion and sediment control devices, improper installation, lack of maintenance, excessive wear, design-life exceedance or failure by the Contractor to install permanent erosion control devices as scheduled, the Contractor shall repair or replace such erosion control devices at no expense to the Department. If reconstruction of permanent or temporary erosion and sediment control devices is necessary due to factors beyond the control of the Contractor, the Department will pay for replacement under the appropriate Contract pay item or items.

Inspect all erosion and sediment control devices at least once every seven calendar days and within 24 hours of the end of a storm event that is 0.50 inches or greater. Maintain all erosion and sediment control devices as required in the Stormwater Pollution Prevention Plan, the Contractor's Erosion and Sediment Control Plan, and if applicable, as specified in the State of Florida Department of Environmental Protection Generic Permit for Stormwater Discharge from Large and Small Construction Activities.

104-8 Protection During Suspension of Contract Time.

Initiate stabilization measures within seven calendar days upon suspension of construction activities. If it is necessary to suspend the construction operations for any appreciable length of time, shape the disturbed areas to facilitate stormwater runoff and construct earthen berms along the top edges of embankments to intercept stormwater runoff. Provide temporary slope drains in areas that are highly erodible to avoid pollution of surface waters, wetlands, groundwater, or property beyond the project limits. Locate slope drains at intervals of approximately 500 feet and stabilize by paving or covering with waterproof materials. Should such preventive measures fail, immediately take action as necessary to effectively prevent erosion and siltation. During suspension of operations, the Engineer may direct the Contractor to perform additional erosion and sediment control work as necessary.

104-9 Method of Measurement.

When separate items for temporary erosion control devices are included in the Contract, the quantities to be paid for will be:

1. the area, in square yards, of rolled erosion control products;
2. the length, in feet, of runoff control structures, measured along the surface of the work constructed;
3. the number of sediment containment systems constructed and accepted;
4. the number of sediment containment system cleanouts accomplished and accepted;

5. the length, in feet, of sediment barriers;
6. the length, in feet, of floating turbidity barrier;
7. the length, in feet, of staked turbidity barrier;
8. the number of inlet protection systems, for existing inlets;
9. the area, in square yards, of chemical treatment;
10. the number of floc logs or drums of product for chemical treatment;

Upon acceptance by the Engineer, the quantity of floating turbidity barriers, sediment barriers, staked turbidity barriers, and inlet protection devices will be paid for regardless of whether materials are new, used, or relocated from a previous installation on the project. Protection of newly constructed inlets and drainage systems is incidental to their installation. No separate payment will be made for temporary erosion control devices used to protect newly constructed drainage systems.

104-10 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including construction and routine maintenance of temporary erosion control devices.

Any additional costs resulting from compliance with the requirements of this Section, other than construction, routine maintenance, and removal of temporary erosion control devices, will be included in the Contract unit prices for the item or items to which such costs are related. Temporary sod used as a temporary erosion control device in accordance with 104-6.4.2 will be paid for under Section 570.

Separate payment will not be made for the cost of constructing temporary earth berms along the edges of the roadways to prevent erosion during grading and subsequent operations. The Contractor shall include these costs in the Contract prices for grading items.

In case of repeated failure on the part of the Contractor to control erosion, pollution, or siltation, the Engineer reserves the right to employ outside assistance or to use the Department's own forces to provide the necessary corrective measures. Any such costs incurred, including engineering costs, will be charged to the Contractor and appropriate deductions made from the monthly progress estimate.

Payment will be made under:

Item No. 104- 1-	Artificial Coverings/ Rolled Erosion Control Products - per square yard.
Item No. 104- 6-	Slope Drains (Temporary)/ Runoff Control Structures - per foot.
Item No. 104- 7-	Sediment Basins/ Containment Systems - each.
Item No. 104- 9-	Sediment Basin/ Containment system Cleanouts - each.
Item No. 104- 10-	Sediment Barriers - per foot
Item No. 104- 11-	Floating Turbidity Barrier - per foot.
Item No. 104- 12-	Staked Turbidity Barrier - per foot.
Item No. 104- 18-	Inlet Protection System - each.
Item No. 104- 19-	Chemical Treatment - per square yard.
Item No. 104- 20-	Chemical Treatment (floc logs, drums of product) - each.

SECTION 105
CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS

105-1 General.

105-1.1 Quality Control Documentation:

105-1.1.1 Submission of Materials Certification and Reporting Test Results: Submit certifications prior to placement of materials. Report test results at completion of the test and meet the requirements of the applicable Specifications.

105-1.1.2 Databases: Obtain access to the Department's databases prior to testing and material placement. Database access information is available through the Department's website. Enter all required and specified documentation and test results into the Department's databases.

105-1.1.3 Worksheets: Make available to the Department, when requested, worksheets used for collecting test information. Ensure the worksheets at a minimum contain the following:

1. Project Identification Number,
2. Time and Date,
3. Laboratory Identification and Name,
4. Training Identification Numbers (TIN) and initials,
5. Record details as specified within the test method.

105-1.1.4 Earthwork Records System: Record QC test results directly into the Earthwork Records System (ERS) section of the Department's database. If authorized by the Engineer due to ERS inaccessibility in the field, collect the data in the field on Department approved forms and enter the data in the ERS section of the Department's database. Submit the original forms by uploading into the Department's database.

105-1.2 Inspections to Assure Compliance with Acceptance Criteria:

105-1.2.1 General: The Department is not obligated to make an inspection of materials at the source of supply, manufacture, or fabrication. Provide the Engineer with unrestricted entry at all times to such parts of the facilities that concern the manufacture, fabrication, or production of the ordered materials. Bear all costs incurred in determining whether the material meets the requirements of these Specifications.

105-1.2.2 Quality Control (QC) Inspection: Provide all necessary inspection to assure effective QC of the operations related to materials acceptance. This includes but is not limited to sampling and testing, production, storage, delivery, construction and placement. Ensure that the equipment used in the production and testing of the materials provides accurate and precise measurements in accordance with the applicable Specifications. Maintain a record of all inspections, including but not limited to, date of inspection, results of inspection, and any subsequent corrective actions taken. Make available to the Department the inspection records, when requested.

105-1.2.3 Notification of Placing Order: Order materials sufficiently in advance of their incorporation in the work to allow time for sampling, testing and inspection. Notify the Engineer prior to placing orders for materials.

Submit to the Engineer a fabrication schedule for all items requiring commercial inspection at least 30 days before beginning fabrication. These items include steel bridge components, moveable bridge components, pedestrian bridges, castings, forgings, structures erected either partially or completely over the travelled roadway or mounted on

bridges as overhead traffic signs (some of these may be further classified as cantilevered, overhead trusses, or monotubes) or any other item identified as an item requiring commercial inspection in the Contract Documents.

105-2 Additional Requirements for Lump Sum Projects.

Prepare and submit to the Engineer a project-specific list of material items and quantities to be used on the project as a Job Guide Schedule in the same format as the current Sampling, Testing, and Reporting Guide 21 calendar days prior to commencement of construction. Submit up-to-date quantities for the items on the Job Guide Schedule to the Engineer with each monthly progress estimate. The Department may not authorize payment of any progress estimate not accompanied by updated Job Guide Schedule quantities. Maintain the Job Guide Schedule throughout the project including the quantity placed since the previous submittal, and total to date quantity and any additional materials placed. Do not commence work activities that require testing until the Job Guide Schedule has been reviewed and accepted by the Engineer. At final acceptance, submit a final Job Guide Schedule that includes all materials used on the project in the same format as the monthly reports.

105-3 Quality Control Program.

Certain operations require personnel with specific qualifications. Certain materials require production under an approved Quality Control (QC) Plan to ensure that these materials meet the requirements of the Contract Documents. Applicable materials include hot mix asphalt, portland cement concrete (structural), earthwork, cementitious materials, timber, steel and miscellaneous metals, galvanized metal products, prestressed and/or precast concrete products, drainage products, and fiber reinforced polymer products. For all applicable materials included in the Contract, submit a QC Plan prepared in accordance with the requirements of this Section to the Engineer. Do not incorporate any of these materials into the project prior to the Engineer's approval of the QC Plan.

Steel and Miscellaneous Metal products, including aluminum, are defined as the metal components of bridges**,** including pedestrian and moveable bridges, overhead and cantilevered sign supports, ladders and platforms, bearings, end wall grates, roadway gratings, drainage items, expansion joints, roadway decking, shear connectors, handrails, galvanized products, fencing, guardrail, light poles, high mast light poles, standard mast arm assemblies and Monotube assemblies, stay in-place forms, casing pipe, strain poles, fasteners, connectors and other hardware.

105-4 Producer Quality Control Program.

105-4.1 General: When accreditation or certification is required, make supporting documents from the two previous inspections performed by the accrediting or certifying agency available to the Department upon request.

Obtain Department approval prior to beginning production. Meet and maintain the approved Producer Quality Control Program requirements at all times. Production of these products without the Department's prior acceptance of the Producer Quality Control Program may result in rejection of the products. Continued approval will be subject to satisfactory results from Department evaluations, including the Independent Assurance program. In cases of non-compliance with the accepted Producer Quality Control Program, identify all affected material and do not incorporate or supply to the Department projects. The following conditions may result in suspension of a Producer Quality Control Program:

1. Failure to timely supply information required.

2. Repeated failure of material to meet Standard Specification requirements.

3. Failure to take immediate corrective action relative to deficiencies in the performance of the Producer Quality Control Program.

4. Certifying materials that are not produced under an accepted Producer Quality Control Program for use on Department projects.

5. Failure to correct any deficiencies related to any requirement of the Producer Quality Control Program, having received notice from the Department, within the amount of time defined in the notice.

105-4.2 Producer Quality Control Program Requirements:

105-4.2.1 Hot Mix Asphalt, Portland Cement Concrete (Structural), Earthwork, Cementitious Materials, Timber, Steel and Miscellaneous Metals, **Galvanized Metal Products, Prestressed and/or Precast Concrete Products, Drainage Products, and Fiber Reinforced Polymer Products Quality Control Program:** Have an accepted Producer Quality Control Program, developed in accordance with this Section, during the production of materials to be used on Department projects.

105-4.2.2 Prestressed Concrete Quality Control Program: Have a current certification from a Department approved precast prestressed concrete plant certification agency and a Department accepted Producer Quality Control Plan, meeting the requirements of this Section. The list of Department approved certification agencies is available on the website of the State Materials Office (SMO).

105-4.2.3 Steel and Miscellaneous Metals Quality Control Program: Have an accepted Producer Quality Control Plan, developed in accordance with this Section and a current American Institute for Steel Construction (AISC) certification, provided that AISC certification program is available for the category of the fabrication products.

105-4.3 Submittal: Depending on the type of products, producers shall submit their proposed Producer Quality Control Programs to the SMO or to the District Materials Office, as described below:

105-4.3.1 State Materials Office (SMO): Producers of cementitious materials, steel and miscellaneous metals, galvanized metal products, aggregates, timber, flexible pipe, and fiber reinforced polymer (FRP) products must submit their proposed Producer Quality Control Program to the SMO for review and acceptance.

105-4.3.2 District Materials Office: Producers of hot mix asphalt, portland cement concrete (structural), earthwork, and precast/prestressed concrete products and must submit their proposed Producer Quality Control Program to the local District Materials Office for acceptance. Producers located outside the State must contact the SMO for address information of the District Materials Office responsible for the review of the proposed Quality Control Program.

105-4.4 Compliance with the Materials Manual:

Producers of Polymer Slurry shall meet the requirements of Section 2.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/implemented/URLinSpecs/Section24V2.shtm.

Producers of Asphalt Emulsion shall meet the requirements of Section 3.4 Volume II of the Department's Materials Manual, which may be viewed at the following URL:

https://www.fdot.gov/programmanagement/implemented/URLinSpecs/Section34V2.shtm.

Producers of Asphalt Binder shall meet the requirements of Section 3.5, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/implemented/URLinspecs/Section35V2.shtm.

Producers of Flexible Pipe shall meet the requirements of Section 6.1, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section61V2.shtm

Producers of Precast Concrete Pipe shall meet the requirements of Section 6.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section62V2.shtm.

Producers of Precast Concrete Drainage Structures shall meet the requirements of Section 6.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section63V2.shtm.

Producers of Precast Prestressed Concrete Products shall meet the requirements of Sections 8.1 and 8.3, Volume II of the Department's Materials Manual, which may be viewed at the following URLs: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section81V2.shtm. https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section83V2.shtm.

Producers of Precast Prestressed Concrete Products using Self Consolidating Concrete shall meet the requirements of Section 8.4, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinspecs/Section84V2.shtm

Producers of Precast/Prestressed Concrete Products using Flowing Concrete shall meet the requirements of Section 8.6, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinspecs/Section86V2.shtm

Producers of Incidental Precast/Prestressed Concrete Products shall meet the requirements of Section 8.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section82V2.shtm.

Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinspecs/Section92V2.shtm.

Producers of Paving Concrete produced by Central Mix Plants shall meet the requirements of Section 9.3, Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section93V2.shtm.

Specialty Engineers preparing, submitting, and implementing Mass Concrete Control Plans shall meet the requirements of Section 9.4 Volume II of the Department's Materials Manual, which may be viewed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinspecs/Section94V2.shtm.

Producers of Structural Steel and Miscellaneous Metal Components shall meet the requirements of Sections 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6 of the Department's Materials Manual, which may be viewed at the following URLs: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section111V2.shtm.

https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section112V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section113V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section114V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section115V2.shtm.
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section116V2.shtm.

Producers of Fiber Reinforced Polymer Composites shall meet the requirements of Section 12-1, Volume II of the Department's Materials Manual, which may be viewed at the following URL:
https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section121V2.shtm.

105-4.5 Producer Quality Control (QC) Plan Review and Acceptance: The Department will respond to the producer within 21 calendar days of receipt of the proposed Producer Quality Control Program. The Department may perform evaluation activities to verify compliance with submitted documents prior to acceptance.

If the Producer Quality Control Program must be revised for any reason, including non-compliance, submit the revision to the Department. The Department will respond to the producer within seven calendar days of receipt of the revised Producer Quality Control Program.

105-4.6 Producer's Quality Control (QC) Plan: Submit detailed policies, methods and procedures to ensure the specified quality of all applicable materials and related production operations. Include other items in addition to these guidelines as necessary.

105-4.6.1 Personnel:

105-4.6.1.1 Qualifications: Submit the Training Identification Numbers (TINs) or any other information which will be traceable to the certification agency's training location and dates for all technicians performing sampling, testing and inspection for both field and laboratory tests. Submit the names of the Construction Training and Qualification Program (CTQP) certifications and other pertinent certifications held and the expiration dates for each certification for each technician. Include employed and subcontracted technicians.

105-4.6.1.2 Level of Responsibility: Identify the primary contact for the Department. Identify roles and responsibilities of various personnel involved in the QC process.

105-4.6.2 Raw Materials:

105-4.6.2.1 Source: Identify the sources of raw materials. Submit locations and plant or mine numbers when applicable.

105-4.6.2.2 Certification: Submit methods of verifying compliance of certification with the Specifications.

105-4.6.2.3 Disposition of Failing Materials: Describe the system for controlling non-conforming materials, including procedures for identification, isolation and disposition.

105-4.6.3 Storage Facilities for Raw Materials: Describe measures and methods, including bedding details, for preventing segregation, contamination and degradation.

Describe methods of identifying individual materials. Where applicable, submit a site plan showing the locations of various materials.

105-4.6.4 Production Equipment: Describe calibration frequencies, maintenance schedule and procedures for production equipment.

105-4.6.5 Plant Requirements:

105-4.6.5.1 Plant Identification: For those facilities producing materials listed in 105-3, submit the mailing address, physical address including county and X,Y (latitude

and longitude) coordinates of the plant, telephone and fax numbers, email address, primary contact at the plant, responsible person in charge, facility number provided by the Department, owner information including parent company, vendor number, designed production capacity, and other information as required.

105-4.6.5.2 Process Control System: Describe the methods and measures established to ensure Contract compliance for the produced materials that are supplemental to the QC sampling and testing program described in the Contract Documents. These methods and measures will include, but are not limited to, inspection schedule, additional sampling and testing, maintenance schedule, etc.

105-4.6.5.3 Loading and Shipping Control: Describe the methods and measures for preventing segregation, contamination and degradation during loading and shipping operations. Describe the methods established for materials to be in compliance with the Specifications at the point of use.

105-4.6.5.4 Types of Products Generated: Describe the products the plant is approved to produce under Department guidelines.

105-4.7 Other Requirements:

105-4.7.1 Submittal of Certification: Submit certifications issued by the plant/Contractor for the applicable products approved by the Department.

105-4.7.2 Statement of Compliance: Include a statement of compliance with all quality requirements set forth by the Department in the Contract Documents and Department manuals.

105-4.7.3 Documentation Storage: Identify location of document storage to enable Department review. Include QC charts, qualification and accreditation records, inspection reports, and other pertinent supporting documents.

105-4.8 Final Manufactured Product - Plant Operations: Describe inspection schedule and methods for identifying defects and non-compliance with the Specifications. Describe corrective actions and methods to resolve them.

105-4.8.1 Storage: When storage of the produced materials is required and it is not defined in the Contract Documents, describe the methods and duration for storage. Include measures and methods for preventing segregation, contamination and degradation during storage.

105-4.8.2 Disposition of Failing Materials: When not described in the Specifications, describe the methods and measures for identifying and controlling the failing materials. Include preventive and corrective measures. Describe disposition of failing materials.

105-4.9 Testing Laboratories: Identify the laboratories performing testing. Ensure that the testing laboratories comply with the Laboratory Qualification Program requirements of this Section or other applicable requirements.

105-4.10 Department Inspection Access: Include a statement in the Quality Control Plan allowing the Department inspectors access to the production facility to perform the inspections of the production process and the products produced for the Department.

105-5 Contractor Quality Control (QC) Plan.

105-5.1 General: Submit the Contractor QC Plan in the Department's database seven days prior to beginning work on any QC material as defined in this Section. The QC Plan may be submitted as a whole or in portions for the work related to the Contract.

Update the QC Plan at least five working days prior to the implementation of any changes.

If at any time the Work is not in compliance with the Contract Documents, the Engineer may suspend operations in accordance with 8-6.1.

105-5.2 Personnel Qualification: Submit the Training Identification Numbers for all technicians performing sampling, testing and inspection for field tests. Include employed and subcontracted technicians.

105-5.3 Production Facilities: Identify the producers of materials listed in 105-4.4 for the project. Include the Department's facility ID number as part of the identification. All producers must have accepted Producer's Quality Control Program and be listed on the Department's Production Facility Listing**.**

105-5.3.1 Structural Concrete Mix Designs: Identify the approved structural concrete mix designs for each structural concrete production facility for review and approval by the Engineer. Do not begin work on the material without the Engineer's approval. The Engineer will review and respond within five calendar days of submittal.

105-5.4 Testing Laboratories: Identify the laboratories performing testing. Ensure that the testing laboratories comply with the Laboratory Qualification Program requirements of this Section.

105-6 Contractor Certification of Compliance.

Provide the Engineer with a notarized monthly certification of compliance with the Contract Documents, to accompany each progress estimate, on a form provided by the Engineer. The Department may not authorize payment of any progress estimate not accompanied by an executed certification document.

Final payment in accordance with 9-8 will not be made until a final notarized certification summarizing all QC exceptions has been submitted.

105-7 Lab Qualification Program.

Testing laboratories participating in the Department's Acceptance Program must have current Department qualification when testing materials that are used on Department projects. In addition, they must have one of the following:

1. Current AASHTO (AAP) accreditation.
2. Inspected on a regular basis per ASTM D3740 for earthwork, ASTM D3666 for asphalt and ASTM C1077 for concrete for test methods used in the Acceptance Program, with all deficiencies corrected, and under the supervision of a Specialty Engineer.
3. Current Construction Materials Engineering Council (CMEC) program accreditation or other independent inspection program accreditation acceptable to the Engineer and equivalent to (1) or (2) above.

After meeting the criteria described above, submit a Laboratory Qualification Application to the Department. The application is available from the Department's website: https://www.fdot.gov/materials/quality/programs/laboratoryqualification/index.shtm. Obtain the Department's qualification prior to beginning testing. The Department may inspect the laboratory for compliance with the accreditation requirements prior to issuing qualification.

Meet and maintain the qualification requirements at all times. Testing without Department's qualification may result in a rejection of the test results. Continued qualifications are subject to satisfactory results from Department evaluations, including Independent Assurance evaluations. In case of suspension or disqualification, prior to resumption of testing, resolve the issues to the Department's satisfaction and obtain reinstatement of qualification. The following conditions may result in suspension of a laboratory's qualified status:

1. Failure to timely supply required information.
2. Loss of accredited status.
3. Failure to correct deficiencies in a timely manner.
4. Unsatisfactory performance.
5. Changing the laboratory's physical location without notification to the accrediting agency and the Engineer.
6. Delays in reporting the test data in the Department's database.
7. Incomplete or inaccurate reporting.
8. Using unqualified technicians performing testing.

Should any qualified laboratory falsify records, the laboratory qualification will be subject to revocation by the Engineer. Falsification of project-related documentation will be subject to further investigation and penalty under State and Federal laws.

It is prohibited for any contract laboratory or staff to perform Contractor QC testing and any other Acceptance Program testing on the same contract.

105-8 Personnel Qualifications.

105-8.1 General: Provide qualified personnel for sampling, testing and inspection of materials and construction activities. Ensure that qualifications are maintained during the course of sampling, testing and inspection.

Construction operations that require a qualified technician must not begin until the Department verifies that the technician is on the CTQP list of qualified technicians. The CTQP lists are subject to satisfactory results from periodic Independent Assurance evaluations.

105-8.2 Quality Control (QC) Manager: Designate a QC Manager who has full authority to act as the Contractor's agent to institute any and all actions necessary to administer, implement, monitor, and as necessary, adjust quality control processes to ensure compliance with the Contract Documents. The QC Manager must speak and understand English. The QC Manager must be on-site at the project on a daily basis or always available upon four hours' notice. Ensure that the QC Manager is qualified as such through the Construction Training and Qualification Program. The QC Manager and the Superintendent must not be the same individual.

Under the direction of the QC Manager, ensure that the QC test data is entered into the Department's database on a daily basis. Use Department approved programs to generate the plots for the ERS. Maintain all QC related reports and documentation for a period of three years from final acceptance of the project. Make copies available for review by the Department upon request.

105-8.3 Temporary Traffic Control (Maintenance of Traffic) Personnel: Worksite Traffic Supervisors, flaggers, and other personnel responsible for work zone related transportation management and traffic control must obtain training and certification in accordance with the Department's Temporary Traffic Control (Maintenance of Traffic) Training Handbook located at the following URL address: https://www.fdot.gov/roadway/TTC/Default.shtm.

Worksite Traffic Supervisors (or designees) and other personnel responsible for the planning and implementation of lane closures must obtain training and certification for the Department's Lane Closure Notification System (LCNS) available at the following URL address: https://info.one.network/fdot-live-link-resources.

105-8.4 Earthwork Quality Control (QC) Personnel:

105-8.4.1 Earthwork Level 1: Ensure the technician who samples the soil and earthwork materials from the roadway project, takes earthwork moisture and density readings, and records those data into the ERS section of the Department's database, holds a CTQP Earthwork Construction Inspection Level 1 qualification.

105-8.4.2 Earthwork Level 2: Ensure the technician responsible for determining the disposition of soil and earthwork materials on the roadway, and for interpreting and meeting Contract Document requirements holds a CTQP Earthwork Construction Inspection Level 2 qualification.

105-8.5 Asphalt Quality Control (QC) Personnel:

105-8.5.1 Plant Technicians: For asphalt plant operations, provide a QC technician, qualified as a CTQP Asphalt Plant Level 2 Technician, available at the asphalt plant at all times when producing mix for the Department. Perform all asphalt plant related testing with a CTQP Asphalt Plant Level 1 Technician. As an exception, measurements of temperature may be performed by someone under the supervision of a CTQP Plant Level 2 technician.

105-8.5.2 Paving Technicians: For paving operations (with the exception of miscellaneous or temporary asphalt), keep a qualified CTQP Asphalt Paving Level 2 Technician on the roadway at all times when placing asphalt mix for the Department, and perform all testing with a CTQP Asphalt Paving Level 1 Technician. As an exception, measurements of cross-slope, temperature, and yield (spread rate) can be performed by someone under the supervision of a CTQP Paving Level 2 Technician at the roadway.

105-8.5.3 Mix Designer: Ensure all mix designs are developed by individuals who are CTQP qualified as an Asphalt Hot Mix Designer.

105-8.5.4 Documentation: Document all QC procedures, inspection, and all test results and make them available for review by the Engineer throughout the life of the Contract. Identify in the asphalt producer's QC Plan the QC Managers and Asphalt Plant Level 2 technicians responsible for the decision to resume production after a quality control failure.

105-8.6 Concrete QC Personnel:

105-8.6.1 Concrete Field Technician - Level 1: Ensure technicians performing plastic property testing on concrete for materials acceptance at the project jobsite possess a CTQP Concrete Field Technician Level 1 qualification. Plastic property testing will include but not be limited to slump, temperature, air content, water-to-cementitious materials ratio calculation, and making and curing concrete cylinders. Duties include initial sampling and testing to confirm specification compliance prior to beginning concrete placements, ensuring timely commencement of initial curing, and providing for the transport of compressive strength samples to the designated laboratories.

105-8.6.2 Self-Consolidating Concrete (SCC) Field Technician - Level 1: Ensure technicians performing plastic property testing on self-consolidating concrete (SCC) for materials acceptance at the project jobsite possess a CTQP Self-Consolidating Concrete (SCC) Field Technician Level I qualification. Plastic property testing will include but not be limited to slump flow, rapid assessment of static segregation resistance, temperature, air content, water-to-cementitious materials ratio calculation, and making and curing SCC cylinders. Duties include initial sampling and testing to confirm specification compliance prior to beginning concrete placements, ensuring timely commencement of initial curing, and providing for the transport of compressive strength samples to the designated laboratories.

105-8.6. 3 Concrete Field Inspector - Level 2: Ensure field inspectors responsible for the quality of concrete being placed on the following structure types are qualified CTQP Concrete Field Inspectors Level 2:

1. Moveable bridges
2. Bridges over a water opening of 1,000 feet or more
3. Bridges with a span of 190 feet or more
4. Cable supported or cable stayed bridges
5. Post-tensioned bridges
6. Steel girder or steel truss bridges
7. Multi-level roadways

With the exception of concrete traffic railing and bridge approach slab placements, a Level 2 Inspector must be present on the jobsite during all concrete placements. Prior to the placement of concrete, the inspector will inspect the element to be cast to ensure compliance with Contract Documents. A Level 2 Inspector's duties may include ensuring that concrete testing, inspection, and curing in the field are performed in accordance with the Contract Documents. The QC Inspector will inform the Verification Inspector of anticipated concrete placements and LOT sizes.

105-8.6. 4 Concrete Laboratory Technician – Level 1: Ensure technicians testing cylinders and recording concrete strength for material acceptance are qualified CTQP Concrete Laboratory Technicians Level 1. Duties include final curing, compressive strength testing, and the recording/reporting of all test data.

105-8.7 Structural Concrete Production Facility Quality Control (QC) Personnel:

Ensure that each portland cement structural concrete production facility (plant), has designated personnel including plant manager of QC, concrete mix designer, concrete batch plant operator, and testing technicians to provide QC inspections and testing.

Upon Department approval, the functions of the above positions may be performed by the same person when it can be demonstrated that the plant's operation and quality of concrete will not be detrimentally affected and personnel have the qualifications required herein.

105-8.7.1 Plant Manager of QC: Ensure that the plant manager of QC has at least three years of concrete related experience and the following training certifications:

1. CTQP Concrete Laboratory Technician - Level 1 certificate.
2. CTQP Concrete Field Technician - Level 1 certificate.
3. Concrete Batch Plant Operator certification in accordance with 105-8.7.4.

As alternatives to these certifications, the Department will accept, one of the following:

a. Prestressed Concrete Institute (PCI) Quality Control Personnel Certification Level III.

b. Precast Concrete Pipe, Box Culverts, Drainage Structures or Incidental Precast Concrete Plants Level II QC Inspector Certifications.

c. National Ready Mixed Concrete Association (NRMCA) Certified Concrete Technologist Level 2.

105-8.7.2 Concrete Mix Designer: Ensure that the concrete mix designer has the CTQP Concrete Laboratory Technician Level 2 certification. As an alternative, the Department will accept any of the following qualifications:

1. PCI Quality Control Personnel Level III Certification, for concrete mix designs of prestressed concrete products.

2. National Ready Mix Concrete Association (NRMCA) Certified Concrete Technologist Level 3.

3. Any of the Level II QC certifications in accordance with 105-8.9.2.2.

105-8.7.3 Qualified Testing Technicians: Ensure that the testing technicians have the following certifications , as appropriate:

1. ACI Concrete Field Testing Technician Grade I, for personnel performing concrete plastic property tests and ACI Self-Consolidating Concrete Testing Technician if testing self-consolidating concrete (SCC).

2. ACI Concrete Strength Testing Technician, for personnel performing tests on hardened properties of concrete.

105-8.7.4 Concrete Batch Plant Operator: Ensure that the concrete batch plant operator has a CTQP Concrete Batch Plant Operator Certification. As an alternative, the Department will accept the following certifications:

a. Precast Concrete Structures Association (PCSA) Batch Plant Operator,

b. NRMCA Certified Concrete Technologist Level 3, or

c. NRMCA Plant Manager Certification.

For dry cast concrete pipe and dry cast drainage structures/box culverts, the Department will accept American Concrete Pipe Association (ACPA) Concrete Pipe/Precast Box Culvert Batch Plant Operator or Quality School Certification.

105-8.8 Prestressed Concrete Plant Quality Control (QC) Personnel: Obtain personnel certifications from Department accredited training providers. The list of Department approved courses and their accredited providers is available on the SMO website at the following URL:https://www.fdot.gov/materials/administration/resources/training/structural/concrete-prestressed.shtm.

Ensure each prestressed concrete plant has an onsite production manager, an onsite plant QC manager, a plant engineer, and adequate onsite QC testing personnel to provide complete QC inspections and testing.

105-8.8.1 Plant QC Manager: Ensure the plant QC manager has at least five years of related experience and the following certifications:

1. ACI Concrete Field Testing Technician Grade I certification.

2. PCI Quality Control Technician/Inspector Level III.

3. CTQP Prestressed Concrete Field Inspector.

105-8.8.2 QC Inspector/Technician: Ensure that the QC inspector/technician has the following certifications:

1. ACI Concrete Field Testing Technician Grade I.

2. PCI Quality Control Technician/Inspector Level II.

3. CTQP Prestressed Concrete Field Inspector.

105-8.8.3 QC Testing Technicians: Ensure technicians performing QC program concrete testing at the plant possess the following qualifications, as appropriate.

1. CTQP Program Concrete Field Technician - Level I, for personnel performing concrete sampling and plastic property testing on concrete.

2. CTQP Program Self-Consolidating Concrete (SCC) Field Technician – Level I, for personnel performing concrete sampling and plastic property testing on SCC.

3. CTQP Concrete Laboratory Technician – Level I, for personnel performing compressive strength testing on concrete.

105-8.8.4 Batch Plant Operator: Ensure that the batch plant operator meets the requirement of 105-8.7.4.

105-8.9 Pipe and Precast Concrete Products Manufacturing Facilities Quality Control (QC) Personnel:

105-8.9.1 General: Obtain personnel certifications from Department accredited training providers. The list of Department approved courses and their accredited providers is available on the SMO website at the following URL: https://www.fdot.gov/materials/administration/resources/training/structural/index.shtm.

105-8.9.2 Precast Concrete Drainage Structures, Precast Concrete Box Culvert, Precast Concrete Pipe, and Incidental Precast Concrete Manufacturing Facilities Quality Control (QC) Personnel:

105-8.9.2.1 Level I Quality Control Inspectors: Ensure that the Level I Inspectors have the following certifications.

105-8.9.2.1.1 Precast Concrete Drainage Technician Level I: PCI Quality Control Technician/Inspector Level I. As an alternative, a Precast Concrete QC Personnel Level I certification in the respective work area will be accepted.

105-8.9.2.1.2 Incidental Precast Concrete Technician Level I: PCI Quality Control Technician/Inspector Level I certification. As an alternative, a Precast Concrete QC Personnel Level I certification in the respective work area will be accepted.

105-8.9.2.1.3 Precast Concrete Pipe Technician Level I: Precast Concrete Pipe Personnel Level I certification. Personnel performing compressive strength testing must possess an ACI Concrete Strength Testing Technician certification.

105-8.9.2.2 Level II Quality Control Inspectors: Ensure that Level II Inspectors have the following certifications.

105-8.9.2.2.1 Precast Concrete Drainage Technician Level II:

1. Precast Concrete Drainage Technician Level I, in accordance with 105-8.9.2.1.1.
2. PCI Quality Control Technician/Inspector Level II certification. As an alternative, a Precast Concrete Quality Control Personnel Level II certification in the respective work area will be accepted.
3. CTQP Concrete Field Technician Level 1, if the plant produces structural concrete in accordance with Section 346.

105-8.9.2.2.2 Incidental Precast Concrete Technician Level II:

1. Incidental Precast Concrete Technician Level I, in accordance with 105-8.9.2.1.2.
2. PCI Quality Control Technician/Inspector Level II. As an alternative, a Precast Concrete QC Personnel Level II certification in the respective work area will be accepted.
3. CTQP Concrete Field Technician Level 1.
4. Level II technicians who will perform quality control of incidental prestressed products must possess a CTQP Prestressed Concrete Field Inspector certification.

105-8.9.2.2.3 Precast Concrete Pipe Technician Level II:

1. Precast Concrete Pipe Technician Level I, in accordance with 105-8.9.2.1.3.

2. Precast Concrete Pipe Personnel Certification Level II.

105-8.9.2.3 Plant Quality Control Manager: Ensure that the QC manager has a minimum of two years construction related experience in the specific work area and has the following certifications:

105-8.9.2.3.1 Precast Concrete Drainage Facilities:

Precast Concrete Drainage Technician Level II in accordance with 105-8.9.2.2.1.

105-8.9.2.3.2 Incidental Precast Concrete Facilities:

1. Incidental Precast Concrete Technician Level II in accordance with 105-8.9.2.2.2.

2. CTQP Prestressed Concrete Field Inspector, if the plant produces incidental prestressed products.

105-8.9.2.3.3 Precast Concrete Pipe Facilities:

Precast Concrete Pipe Technician Level II in accordance with 105-8.9.2.2.3.

105-8.9.2.4 Additional Requirements for Quality Control (QC) Personnel of Incidental Precast Concrete Manufacturing Facilities:

105-8.9.2.4.1 Testing Personnel: Ensure testing technicians meet the requirement of 105-8.8.3.

105-8.9.2.4.2 Batch Plant Operator: Ensure the batch plant operator meets the requirement of 105-8.7.4.

105-8.9.2.5 Additional Requirements for Quality Control (QC) Personnel of Precast Concrete Drainage Structures and Box Culverts Manufacturing Facilities:

105-8.9.2.5.1 Testing Personnel: Ensure the testing technicians meet the requirements of 105-8.7.3.

105-8.9.2.5.2 Batch Plant Operator: Ensure the batch plant operator meets the requirement of 105-8.7.4.

105-8.10 Supervisory Personnel – Post-Tensioned and Movable Bridge Structures:

105-8.10.1 General: Provide supervisory personnel meeting the qualification requirements only for the post-tensioned and movable bridge types detailed in this Article. Submit qualifications to the Engineer at the pre-construction conference. Do not begin construction until the qualifications of supervisory personnel have been approved by the Engineer.

105-8.10.2 Proof of License or Certification: Submit a copy of the Professional Engineer license current and in force issued by the state in which registration is held. The license must be for the field of engineering that the construction work involves such as Civil, Electrical or Mechanical. Under certain circumstances Florida registration may be required.

Submit a copy of the license issued by the State of Florida for tradesmen that require a license indicating that the license is in force and is current. Submit a copy of the certification issued by the International Society of Automation for each Certified Control Systems Technician.

105-8.10.3 Experience Record: Submit the following information for supervisory personnel to substantiate their experience record. The supervisor (project engineer,

superintendent/manager or foreman) seeking approval must provide a notarized certification statement attesting to the completeness and accuracy of the information submitted. Submit the following experience information for each individual seeking approval as a supervisor:

Project owner's name and telephone number of an owner's representative, project identification number, state, city, county, highway number and feature intersected.

Detailed descriptions of each bridge construction experience and the level of supervisory authority during that experience. Report the duration in weeks, as well as begin and end dates, for each experience period.

The name, address and telephone number of an individual that can verify that the experience being reported is accurate. This individual should have been an immediate supervisor unless the supervisor cannot be contacted in which case another individual with direct knowledge of the experience is acceptable.

105-8.10.4 Concrete Post-Tensioned Segmental Box Girder Construction: Ensure the individuals filling the following positions meet the minimum requirements as follows:

105-8.10.4.1 Project Engineer-New Construction: Ensure the project engineer is a registered Professional Engineer with five years of bridge construction experience. Ensure a minimum of three years of experience is in segmental box girder construction engineering and includes a minimum of one year in segmental casting yard operations and related surveying, one year in segment erection and related surveying, including post-tensioning and grouting of longitudinal tendons and a minimum of one year as the project engineer in responsible charge of segmental box girder construction engineering. Ensure this individual is present at the site of construction, at all times while segmental box girder construction or segment erection is in progress.

105-8.10.4.2 Project Engineer-Repair and Rehabilitation: Ensure the project engineer is a registered Professional Engineer with five years of bridge construction experience. Ensure a minimum of three years of experience is in segmental box girder construction engineering and includes one year of post-tensioning and grouting of longitudinal tendons and a minimum of one year as the project engineer in responsible charge of segmental box girder rehabilitation engineering or segmental box girder new construction engineering.

105-8.10.4.3 Project Superintendent/Manager-New Construction: Ensure the project superintendent/manager has a minimum of ten years of bridge construction experience or is a registered Professional Engineer with five years of bridge construction experience. Ensure that a minimum of three years of experience is in segmental box girder construction operations and includes a minimum of one year in the casting yard operations and related surveying, one year in segment erection and related surveying including post-tensioning and grouting of longitudinal tendons and a minimum of one year as the project superintendent/manager in responsible charge of segmental box girder construction operations. Ensure this individual is present at the site of construction, at all times while segmental box girder construction or segment erection is in progress.

105-8.10.4.4 Project Superintendent/Manager-Repair and Rehabilitation: Ensure the project superintendent/manager has a minimum of five years of bridge construction experience or is a registered Professional Engineer with three years of bridge construction experience. Ensure that a minimum of two years of experience is in segmental box girder construction operations and includes a minimum of one year of experience performing post-tensioning and grouting of longitudinal tendons and a minimum of one year as the project

superintendent/manager in responsible charge of segmental box girder rehabilitation operations or segmental box girder new construction operations.

105-8.10.4.5 Foreman-New Construction: Ensure that the foreman has a minimum of five years of bridge construction experience with two years of experience in segmental box girder operations and a minimum of one year as the foreman in responsible charge of segmental box girder new construction operations. Ensure this individual is present at the site of construction, at all times while segmental box girder construction or segment erection is in progress.

105-8.10.4.6 Foreman-Repair and Rehabilitation: Ensure the foremen has a minimum of five years of bridge construction experience with two years of experience in segmental box girder operations and a minimum of one year as the foreman in responsible charge of segmental box girder rehabilitation operations or segmental box girder new construction operations.

105-8.10.4.7 Geometry Control Engineer/Manager: Ensure that the geometry control engineer/manager for construction of cast-in-place box segments is a registered Professional Engineer with one year of experience, a non-registered Engineer with three years of experience or a registered Professional Land Surveyor with three years of experience in geometry control for casting and erection of cast-in-place box segments. Credit for experience in cast-in-place box girder geometry control will be given for experience in precast box girder geometry control but not vice versa.

Ensure that the geometry control engineer/manager for precast box segments is a registered Professional Engineer with one year of experience or non-registered with three years of experience in casting yard geometry control of concrete box segments.

The geometry control engineer/manager must be responsible for and experienced at implementing the method for establishing and maintaining geometry control for segment casting yard operations and segment erection operations and must be experienced with the use of computer programs for monitoring and adjusting theoretical segment casting curves and geometry. This individual must be experienced at establishing procedures for assuring accurate segment form setup, post-tensioning duct and rebar alignment and effective concrete placement and curing operations as well as for verifying that casting and erection field survey data has been properly gathered and recorded. Ensure this individual is present at the site of construction, at all times while cast-in-place segmental box girder construction is in progress or until casting yard operations and segment erection is complete.

105-8.10.4.8 Surveyor: Ensure that the surveyor in charge of geometry control surveying for box segment casting and/or box segment erection has a minimum of one year of bridge construction surveying experience. Ensure this individual is present at the site of construction, at all times while segmental box girder construction or segment erection is in progress.

105-8.10.5 Movable Bridge Construction: Ensure the individual filling the following positions meet the minimum requirements as follows:

105-8.10.5.1 Electrical Journeyman: Ensure the electrical journeyman holds, an active journeyman electrician's license and has at least five years' experience in industrial electrical work, or is a certified control systems technician. A certified control systems technician will not be permitted to perform electrical power work including, but not limited to, conduit and wire-way installation or power conductor connection. Ensure the electrical

journeyman has successfully completed the installation of one similar movable bridge electrical system during the last three years.

105-8.10.5.2 Control Systems Engineer and Mechanical Systems Engineer: Ensure the control systems engineer and mechanical systems engineer are both registered Professional Engineers with a minimum of 10 years supervisory experience each in movable bridge construction. Ensure the engineers have working knowledge of the movable bridge leaf motion control techniques, mechanical equipment and arrangements specified for this project. Ensure that each engineer has been in responsible control of the design and implementation of at least three movable bridge electrical control and machinery systems within the past 10 years of which, at least one of the three bridges was within the last three years. Ensure that a minimum of one of the three bridge designs incorporated the same type of leaf motion control and machinery systems specified for this project.

105-8.10.6 Concrete Post-Tensioned Other Than Segmental Box Girder Construction: Ensure the individual filling the following positions meet the minimum requirements as follows:

105-8.10.6.1 Project Engineer: Ensure the project engineer is a registered Professional Engineer with five years of bridge construction experience. Ensure that a minimum of three years of experience is in concrete post-tensioned construction. Ensure that the three years of experience includes experience in girder erection, safe use of cranes, stabilization of girders; design of false work for temporary girder support, post-tensioning and grouting operations, and a minimum of one year as the project engineer in responsible charge of post-tensioning related engineering responsibilities.

105-8.10.6.2 Project Superintendent/Manager: Ensure the project superintendent/manager has a minimum of ten years of bridge construction experience or is a registered Professional Engineer with five years of bridge construction experience and has a minimum of three years of supervisory experience in girder erection, safe use of cranes, stabilization of girders; design of falsework for temporary girder support post-tensioning, grouting operations and a minimum of one year as the project superintendent/manager in responsible charge of post-tensioning related operations.

105-8.10.6.3 Foreman: Ensure the foremen has a minimum of five years of bridge construction experience with two years of experience in post-tensioning related operations and a minimum of one year as the foreman in responsible charge of post-tensioning related operations.

105-8.10.7 Post-Tensioning (PT) and Filler Injection Personnel Qualifications: Perform all stressing and filler injection operations in the presence of the Engineer and with personnel meeting the qualifications of this article. Coordinate and schedule all PT and filler injection activities to facilitate inspection by the Engineer.

105-8.10.7.1 Post-Tensioning: Perform all PT field operations under the direct supervision of a Level 2 CTQP Qualified PT Technician who must be present at the site of the post-tensioning work during the entire duration of the operation. For the superstructures of bridges having concrete post-tensioned box or I girder construction, provide at least two CTQP Qualified PT Technicians, Level 1 or 2, on the work crew. The supervisor of the work crew, who must be a Level 2 CTQP Qualified PT Technician, may also be a work crew member, in which case, the supervisor shall count as one of the two CTQP qualified work crew members. For PT operations other than the superstructures of post-tensioned box or I girder construction, perform all PT operations under the direct supervision of a Level 2 CTQP Qualified PT Technician who

must be present at the site of the PT work during the entire duration of the operation. Work crew members are not required to be CTQP qualified.

105-8.10.7.2 Grouting: Perform all grouting field operations under the direct supervision of a Level 2 CTQP Qualified Grouting Technician who must be present at the site of the grouting work during the entire duration of the operation. For the superstructures of bridges having concrete post-tensioned box or I girder construction, provide at least two CTQP Qualified Grouting Technicians, Level 1 or 2, on the work crew. The supervisor of the work crew, who must be a Level 2 CTQP Qualified Grouting Technician, may also be a work crew member, in which case, the supervisor shall count as one of two CTQP qualified work crew members. For grouting operations other than the superstructures of post-tensioned box or I girder construction, perform all grouting operations under the direct supervision of a Level 2 CTQP Qualified Grouting Technician who must be present at the site of the grouting work during the entire duration of the operation. Work crew members are not required to be CTQP qualified.

Perform all vacuum grouting operations under the direct supervision of a crew foreman who has been trained and has experience in the use of vacuum grouting equipment and procedures. Submit the crew foreman's training and experience records to the Engineer for approval prior to performing any vacuum grouting operation.

105-8.10.7.3 Flexible Filler Injection: Perform all filler injection operations under the direct supervision of a filler injection foreman who has American Segmental Bridge Institute (ASBI) certification in the flexible filler process. Provide at least two CTQP Qualified Grouting Technicians with ASBI certification in the flexible filler process, one of whom must be a Level 2 CTQP Qualified Grouting Technician. Both technicians must be present at the site of the flexible filler injection work during the entire duration of the operation.

Provide a filler injection quality control (QC) inspector who has ASBI certification in the flexible filler process. The filler injection QC inspector must be present at the site of the flexible filler injection work during the entire duration of the operation.

Verifiable experience performing injection of similar flexible filler on at least two projects is acceptable in lieu of ASBI certification in the flexible filler process.

Perform all flexible filler repair operations under the direct supervision of a crew foreman who has been trained and has verifiable experience in the use of vacuum flexible filler repair equipment and procedures. Submit the crew foreman's training and experience records to the Engineer prior to performing any flexible filler operation.

105-8.10.8 Failure to Comply with Bridge Qualification Requirements: Make an immediate effort to reestablish compliance. If an immediate effort is not put forth as determined by the Engineer, payment for the bridge construction operations requiring supervisors to be qualified under this Specification will be withheld up to 60 days. Cease all bridge construction and related activities (casting yard, etc.) if compliance is not met within 60 days, regardless of how much effort is put forth. Resume bridge construction operations only after written approval from the Engineer stating that compliance is reestablished.

105-8.11 Signal Installation Inspector: Provide an inspector trained and certified by the International Municipal Signal Association (IMSA) as a traffic signal inspector to perform all signal installation inspections. Use only Department approved signal inspection report forms during the signal inspection activities. Ensure all equipment, materials, and hardware is in compliance with Department Specifications and verify that all equipment requiring certification is listed on the Department's Approved Product List (APL). Submit the completed signal inspection report forms, certified by the IMSA traffic signal inspector to the Engineer.

The Department's approved inspection report forms are available at the following URL: http://www.fdot.gov/traffic/.

105-8.12 Structural Steel and Miscellaneous Metals Fabrication Facility Quality Control Personnel: Ensure each fabrication facility has an onsite production manager, an onsite facility manager for QC, a plant engineer, and onsite QC inspectors/technicians to provide complete QC inspections and testing.

Ensure that the facility manager for QC and QC inspectors/technicians meet the certification requirements set forth in the latest version of AASHTO/NSBA Steel Bridge Collaboration S 4.1, Steel Bridge Fabrication QC/QA Guide Specification, including the years of experience required in Table 105-1 below. The facility manager for QC must meet the requirements of Table 105-1 for every structural steel member type produced by a plant with QC being managed by the facility manager for QC. The facility manager for QC will report directly to the plant manager or plant engineer and must not be the plant production manager nor report to or be the subordinate of the plant production manager. QC inspectors/technicians must be the employees of and must report directly to the facility manager for QC.

Table 105-1
Experience Requirements for QC Inspectors/Technicians
And Facility Manager for Quality Control

Structural Steel Member Type	Minimum Years of Experience Required	
	QC Inspector/Technician	Facility Manager for QC
Rolled beam bridges	1 year	3 years
Welded plate girders (I sections, box sections, etc.)	2 years	4 years
Complex structures, such as trusses, arches, cable stayed bridges, and moveable bridges	3 years	5 years
Fracture critical (FC) members	3 years	5 years

105-8.13 Geotechnical Foundation Services Personnel For Driven Pile Foundations:

105-8.13.1 General: Provide qualified and trained personnel to perform foundation testing, inspection of the construction activities and oversight of the foundation construction operations. Ensure the personnel provided meet the registration and qualification requirements specified herein and these requirements are maintained throughout the duration of the design and construction of the project elements where these personnel are required to work.

Submit qualification statements for the dynamic testing, load testing and non-destructive testing personnel to be used on the project for acceptance by the Engineer. The Department will review these qualification statements, provide comments, or request additional information within 10 working days, excluding weekends and Department observed holidays. Do not begin Construction until the qualifications of supervisory personnel have been accepted by the Engineer. Acceptance of the personnel does not relieve the Contractor of the responsibility for obtaining the required results in the completed work.

105-8.13.2 Dynamic Testing Engineer (DTE): Provide a Dynamic Testing Engineer in responsible charge of the performance of the dynamic load testing of driven piles, evaluation, signal matching and analysis of the dynamic load test data, recommending production pile lengths (when these are to be determined based on test pile information) and

developing the driving criteria. The DTE must be an employee of a firm pre-qualified for Type of Work 9.4.1 in accordance with the Rules of the Department of Transportation, Chapter 14-75. Production pile lengths shall be recommended, and the driving criteria shall be developed by the same engineering firm, and under the same DTE analyzing the dynamic pile testing data. The DTE must be a Professional Engineer registered in the state of Florida with responsible charge experience of geotechnical foundation construction engineering and dynamic testing of driven piles for a period of not less than three years including at least three Department bridge projects. This "responsible charge" experience shall include verifiable experience using the test methods that will be utilized on the project. The DTE must have a rank of Intermediate or higher in the PDCA/PDI Dynamic Measurement and Analysis Proficiency Test or equivalent qualification approved by the Engineer.

105-8.13.3 Dynamic Testing Operator (DTO): Provide a Dynamic Testing Operator (DTO) to perform the dynamic load testing of instrumented piles and test piles in the field. The DTO must have a rank of Intermediate or higher in the PDCA/PDI Dynamic Measurement and Analysis Proficiency Test. When EDCs are used to monitor piles and/or test piles, EDC monitoring shall be performed by an operator who has passed EDC Monitoring Certification as evidenced by a Smart Structures valid Certification Card and ID. The DTO must have experience in geotechnical foundation construction and dynamic testing of driven piles for a period of not less than two years including at least three Department bridge projects. The experience may have been obtained while working under the supervision of another qualified operator. The DTO shall work under the supervision of the DTE.

105-8.13.4 Pile Driving Inspectors: Provide qualified pile driving inspectors, working under the supervision of the DTE, to monitor and record the construction of driven pile foundations. Pile driving inspectors must possess a valid CTQP Pile Driving Inspector qualification.

105-8.13.5 Supervisory Personnel - Pile Driving: Use pile driving superintendents or foremen in responsible charge of pile driving operations, with experience in installing driven piles of similar the type, size and depth proposed for the project and for a period of not less than two years.

SECTION 107
LITTER REMOVAL AND MOWING

107-1 Description.

Provide pickup, removal and disposal of litter within the project limits from the outside edge of travel way to the right of way line. Include the median on divided highways, from the inside edge of travel way to the inside edge of travel way. Litter includes but is not limited to, bottles, cans, paper, tires, tire pieces, lumber, vehicle parts, metal junk, and brush debris.

Mow turf or vegetation within the project limits. Turf consists of grasses planted in accordance with Section 570. Vegetation consists of planted and natural grasses, weeds, and other natural vegetation that have been previously mowed.

107-2 Operation.

107-2.1 Frequency: Begin litter removal and mowing when directed by the Engineer and continue every 30 days, unless otherwise directed by the Engineer. Continue litter removal and mowing until final acceptance in accordance with 5-11. Mow all areas to obtain a uniform height of 6 inches.

After final acceptance, perform litter removal and mowing until new turf is established in accordance with 570-4 at no cost to the Department. Maintain turf and vegetation height between 6 inches and 12 inches. Do not include seed stalk or wildflowers when measuring height.

Perform litter removal prior to and in conjunction with mowing; however, the Engineer may direct litter pickups in addition to those performed in conjunction with mowing.

Do not mow new turf until a healthy root system is established. In designated wildflower areas, avoid cutting wildflowers when in bloom and when re-seeding.

107-2.2 General: Mow shoulders and medians concurrently so that not more than one mile will be left partially mowed at the conclusion of the working day. Mow turf and vegetation on slopes or around appurtenances concurrent with the mowing operation.

In areas saturated with standing water, mow or cut to the surface of the water using hand labor or other specialized equipment when standard equipment will cause damage.

Do not remove turf or other vegetation cuttings from the right-of-way, or rake or pick up the cuttings unless the cuttings are in the traveled ways, bike lanes, or sidewalk; are obstructing drainage structures; or are the result of cleaning the equipment.

107-2.3 Limitations: Maintain traffic in accordance with Section 102. When mowing within four feet of a travel lane, operate the equipment in the same direction of traffic, unless the adjacent lane is closed to traffic due to construction operations.

Perform all work during daylight hours.

107-2.4 Disposal of Litter and Debris: During each litter removal cycle, bag and remove all litter or piles at the end of each working day. Dispose of litter in accordance with applicable local and state laws. Do not store or stockpile litter within the project limits.

107-3 Method of Measurement.

The quantity to be paid will be the project area shown in the Contract Documents, in acres, for each litter removal or mowing cycle completed and accepted. No adjustments will be made to the project area quantity.

107-4 Basis of Payment.

Price and payment will be full compensation for all work specified in this section.

No separate payment will be made for litter removal and mowing after final acceptance.

Payment will be made under:

Item No. 107 - 1- Litter Removal - per acre.

Item No. 107 - 2- Mowing - per acre

SECTION 108
MONITOR EXISTING STRUCTURES

108-1 Description.

Provide settlement, vibration, and groundwater monitoring in accordance with the requirements of this Section. The work required under this Section does not modify the requirements or responsibilities for preservation of existing property from damage in accordance with 7-11.1.

Evaluate the need for, design of, and provide any necessary precautionary features to protect existing structures from damage. Employ construction methods that will not produce damaging vibrations, soil movement, soil loss, or instability of existing structures.

108-2 Construction.

108-2.1 Inspection and Settlement Monitoring:

108-2.1.1 Miscellaneous Structures: When constructing foundations for miscellaneous structures such as sign, signal, lighting, or intelligent transportation system structures, inspect and document the condition of the existing structures shown in the Plans, and survey and monitor for settlement the existing structures shown in the Plans.

108-2.1.2 Structures other than Miscellaneous: When excavating or constructing retaining walls and foundations for bridges, buildings, and structures other than miscellaneous structures, inspect and document the condition of the following existing structures, and survey and monitor for settlement the following existing structures:

1. as shown in the Plans.
2. within a distance of five shaft or auger cast pile diameters, or the estimated depth of drilled shaft or auger cast pile excavation, whichever is greater, measured from the center of these foundation elements.
3. within a distance of three times the depth of any other excavations.
4. within 200 feet of sheet pile installation and extraction operations.
5. within 100 feet of steel soldier pile installation and extraction operations.
6. for projects with pile driving operations, inspect and document the condition of all structures within a distance, in feet, of pile driving operations equal to 0.25 times the square root of the impact hammer energy, in foot-pounds. Survey and monitor for settlement all structures within a distance, in feet, of pile driving operations equal to 0.5 times the square root of the impact hammer energy, in foot-pounds.

108-2.1.3 Roadway Compaction Operations: When performing embankment and asphalt compaction, inspect and document the condition of the following existing structures, and survey and monitor for settlement the following existing structures:

1. as shown in the Plans.
2. within 75 feet of vibratory compaction (in any vibratory mode) operations.

108-2.1.4 Inspection and Documentation Requirements: Inspect and document the condition of the existing structures and all existing cracks with descriptions and pictures using a qualified Specialty Engineer. Submit two reports, signed and sealed by the Specialty Engineer, documenting the condition of the structures. Submit one report before beginning the construction operations that may affect the existing structures such as but not limited to foundation construction, excavations, vibratory compaction, dewatering and retaining wall

construction. Submit the second report documenting the condition of the structures after the construction operations are complete. Include in the reports the Specialty Engineer's assessment of any damage present, and in the event of damage, the Specialty Engineer's assessment of whether the observed damage is the result of the construction operations. Submit both reports to the Engineer. Inspecting and documenting the condition of bridges, sign, signal, lighting, and ITS structures owned by the Department is not required except when shown in the Contract Documents.

The Department will make the necessary arrangements to provide right-of-way entry to the existing structures.

108-2.1.5 Settlement Surveying and Monitoring Requirements: Obtain the Engineer's approval for the number and location of monitoring points. Survey and monitor the settlement of structures, providing +/-0.005 foot accuracy, recording elevations to 0.001 foot:

1. before beginning construction
2. daily, during the driving of any casings, piling, or sheeting,
3. daily, during compaction
4. daily, during foundation drilling
5. weekly, for two weeks after stopping pile driving
6. during excavation
7. during blasting
8. or, as directed by the Engineer

Upon either detecting movement of 0.010 feet or damage to the structure, immediately stop the construction operations affecting the structure, backfill any open excavations, notify the Engineer and submit a corrective action plan for acceptance by the Engineer. Submit settlement monitoring records to the Engineer on a weekly basis.

108-2.2 Vibration Monitoring: When shown in the Contract Documents, employ a Specialty Engineer to provide a system which will continuously monitor and record ground vibration levels near the structures shown in the Plans during the operation of any equipment causing vibrations or during blasting operations. Provide vibration monitoring equipment capable of detecting velocities of 0.01 inches per second or less. Obtain the Engineer's approval of the number and locations of the monitoring points and install the system per the Specialty Engineer's recommendations. Submit the vibration records to the Engineer within 24 hours of performing the monitoring activity.

Upon either detecting vibration levels reaching 0.5 inches per second or damage to the structure, immediately stop the source of vibrations, backfill any open excavations, notify the Engineer and submit a corrective action plan for acceptance by the Engineer.

108-2.3 Groundwater Monitoring: When shown in the Contract Documents, install a piezometer at the right-of-way line and near any existing structure that may be affected by dewatering operations, or as directed by the Engineer. Monitor the piezometer and record the groundwater elevation level each day that dewatering activities are performed and for one week after activities have ceased, or on a schedule approved by the Engineer. Notify the Engineer of any groundwater lowering near the structure of 12 inches or more.

108-3 Method of Measurement.

The quantities to be paid for will be lump sum, completed and accepted. No separate payment will be made for the design, furnishing, construction, and removal of precautionary features, such as but not limited to sheeting, shoring, or bracing, installed for protection of existing structures.

108-4 Basis of Payment.

Price and payment will be full compensation for all work and materials specified in this Section.

Payment will be made under:

Item No. 108- 1	Monitor Existing Structures - Inspection and Settlement Monitoring - lump sum.
Item No. 108- 2	Monitor Existing Structures - Vibration Monitoring - lump sum.
Item No. 108- 3	Monitor Existing Structures - Groundwater Monitoring - lump sum.

SECTION 110
CLEARING AND GRUBBING

110-1 Description.

Clear and grub within the areas shown in the Plans. Remove and dispose of all trees, stumps, roots and other such protruding objects, buildings, structures, appurtenances, existing flexible asphalt pavement, and other facilities necessary to prepare the area for the proposed construction. Remove and dispose of all product and debris not required to be salvaged or not required to complete the construction.

Perform miscellaneous work necessary for the complete preparation of the overall project site as specified in 110-10.

110-2 Standard Clearing and Grubbing.

110-2.1 Work Included: Completely remove and dispose of all buildings, timber, brush, trees, stumps, roots, rubbish, debris, existing flexible pavement and base, drainage structures, culverts, and pipes. Remove all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas.

Perform standard clearing and grubbing within the following areas:

1. All areas where excavation is to be done, including borrow pits, lateral ditches, right-of-way ditches, etc.
2. If constructing over an existing road, remove existing asphalt pavement. If shown in the Contract Documents, remove existing pavement base.
3. All areas where roadway embankments will be constructed.
4. All areas where structures will be constructed, including pipe culverts and other pipe lines.

110-2.2 Depths of Removal of Roots, Stumps, and Other Debris: In all areas where excavation is to be performed, or roadway embankments are to be constructed, remove roots and other debris to a depth of 12 inches below the ground surface. Remove roots and other debris from all excavated material to be used in the construction of roadway embankment or roadway base. Plow the surface to a depth of at least 6 inches, and remove all roots thereby exposed to a depth of at least 12 inches. Completely remove and dispose of all stumps within the roadway right-of-way.

Remove all roots, etc., protruding through or appearing on the surface of the completed excavation within the roadway area and for structures, to a depth of at least 12 inches below the finished excavation surface.

Remove or cut off all stumps, roots, etc., below the surface of the completed excavation in borrow pits, material pits, and lateral ditches.

In borrow and material pits, do not perform any clearing or grubbing within 3 feet inside the right-of-way line.

Within all other areas where standard clearing and grubbing is to be performed, remove roots and other debris projecting through or appearing on the surface of the original ground to a depth of 12 inches below the surface, but do not plow or harrow these areas.

110-2.3 Boulders: Remove any boulders encountered in the roadway excavation (other than as permitted under the provisions of 120-7.2) or found on the surface of the ground. When approved by the Engineer place boulders in neat piles inside the right of way. The Contractor

may stockpile boulders encountered in Department-furnished borrow areas, which are not suitable for use in the embankment construction, within the borrow area.

110-2.4 Asbestos Containing Materials (ACM) Not Identified Prior to the Work: When encountering or exposing any condition indicating the presence of asbestos, cease operations immediately in the vicinity and notify the Engineer, in accordance with 110-6.5.

110-3 Selective Clearing and Grubbing.

110-3.1 General: Remove and dispose of vegetation, obstructions, etc., as shown in the Plans. Provide acceptable fill material, and grade and compact holes or voids created by the removal of the stumps. Perform all selective clearing and grubbing in accordance with ANSI A300.

No staging, storing, stockpiling, parking or dumping will be allowed in selective clearing and grubbing areas. Only mechanical equipment related to selective clearing and grubbing activities will be allowed in selective clearing and grubbing areas. Protect trees to remain from trunk, branch and root damage.

110-3.2 Protection of Plant Preservation Areas: Areas to remain natural may be designated in the Plans. No clearing and grubbing, staging, storage, stockpiling, parking or dumping is allowed in these areas. Do not bring equipment into these areas.

110-3.3 Tree Protection Barrier: Construct a tree protection barrier in accordance with Standard Plans Index 110-100 and the Plans. Maintain barrier for duration of the Contract.

110-3.4 Tree Root and Branch Pruning: When pruning cuts or root pruning to existing trees are shown in the Plans, work is to be supervised on site by an International Society of Arboriculture (ISA) Certified Arborist and performed in accordance with ANSI A300.

110-3.5 Tree Removal: Remove trees as shown in the Plans.

110-4 Protection of Property Remaining in Place.

Protect property to remain in place in accordance with 7-11.

110-5 Removal of Buildings.

110-5.1 Parts to be Removed: Completely remove all parts of the buildings, including utilities, plumbing, foundations, floors, basements, steps, connecting concrete sidewalks or other pavement, septic tanks, and any other appurtenances, by any practical manner which is not detrimental to other property and improvements.

Remove utilities to the point of connection to the utility authority's cut-in. After removing the sewer connections to the point of cut-in, construct a concrete plug at the cut-in point, as directed by the Engineer, except where the utility owners may elect to perform their own plugging. Contact the appropriate utility companies prior to removal of any part of the building to ensure disconnection of services.

Submit demolition schedule 15 working days before beginning any demolition or renovation of a building.

110-5.2 Removal by Others: Where buildings within the area to be cleared and grubbed are so specified to be removed by others, remove and dispose of any foundations, curtain walls, concrete floors, basements or other foundation parts which might be left in place after such removal of buildings by others.

110-6 Removal of Existing Bridges.

110-6.1 General: The work under this Article includes bridges, as defined in 1-3.

Remove and dispose of the materials from existing bridges. Remove

1. those bridges and approach slabs, or portions of bridges, shown in the Plans to be removed,

2. those bridges and approach slabs, or portions of bridges, found within the limits of the area to be cleared and grubbed, and directed by the Engineer to be removed,

3. those bridges and approach slabs, or portion of bridges, which are necessary to be removed in order to complete the work, and

4. other appurtenances or obstructions which may be designated in the Contract Documents to be included as an item of payment for the work under this Article.

Submit schedule information and demolition plan for approval 15 working days before beginning any demolition or renovation of any structures.

110-6.2 Method of Removal:

110-6.2.1 General: Remove the structures in such a way so as to leave no obstructions to any proposed new bridge or to any waterways. Pull, cut off, or break off pilings to the requirements of the permit or other Contract Documents, or if not specified, not less than 2 feet below the finished graded surface. In the event that the Plans indicate channel excavation to be done by others, consider the finished graded surface as the limits of such excavation. For materials which are to remain the property of the Department or are to be salvaged for use in temporary bridges, avoid damage to such materials, and entirely remove all bolts, nails, etc. from timbers to be so salvaged. Mark structural steel members for identification as directed.

110-6.2.2 Removal of Steel Members with Hazardous Coatings: Submit to the Engineer for approval the "Contractor's Lead in Construction Compliance Program", QP2 certification from the Society for Protective Coatings (SSPC) from the firm actually removing and disposing of these steel members before any members are disturbed.

Vacuum power tool clean any coated steel member to bare metal as defined by SSPC-SP11 a minimum of 4 inches either side of any area to be heated (e.g. torch cutting, sawing, grinding, etc.) in accordance with 29 CFR 1926.354. Abrasive blasting is prohibited.

110-6.3 Partial Removal of Bridges: On concrete bridges to be partially removed and widened, remove concrete by manually or mechanically operated pavement breakers, by concrete saws, by chipping hammers, or by hydro-demolition methods. Do not use explosives. Where concrete is to be removed to neat lines, use concrete saws or hydro-demolition methods capable of providing a reasonably uniform cleavage face. If the equipment used will not provide a uniform cut without surface spalling, first score the outlines of the work with small trenches or grooves. For all demolition methods, submit for review and approval of the Engineer, a demolition plan that describes the method of removal, equipment to be used, types of rebar splices or couplers, and method of straightening or cutting rebar. In addition, for hydro-demolition, describe the method for control of water or slurry runoff and measures for safe containment of concrete fragments that are thrown out by the hydro-demolition machine.

110-6.4 Authority of U.S. Coast Guard: For bridges in navigable waters, when constructing the project under authority of a U.S. Coast Guard permit, the U.S. Coast Guard may inspect and approve the work to remove any existing bridges involved therein, prior to acceptance by the Department.

110-6.5 Asbestos Containing Materials (ACM) Not Identified Prior to the Work: When encountering or exposing any condition indicating the presence of asbestos, cease operations immediately in the vicinity and notify the Engineer.

Make every effort to minimize the disturbance of the ACM. Immediately provide provisions for the health and safety of all jobsite personnel and the public that may be exposed to

any ACM. Provisions shall meet all applicable Federal, State, and Local Rules and Regulations regarding potentially hazardous conditions due to ACM.

The Engineer will notify the District Contamination Impact Coordinator (DCIC) who will engage the services of the Department's Contamination Assessment/Remediation Contractor (CAR). Provide access to the potential contamination area. Preliminary investigation by the CAR Contractor will determine the course of action necessary for site security and the steps necessary to resolve the contamination issue.

The CAR Contractor will perform an asbestos survey to delineate the asbestos areas, and identify any staging or holding areas that will be needed for assessment or abatement of the asbestos material.

The CAR Contractor will maintain jurisdiction over activities within areas contaminated with ACM including staging and holding areas. The CAR Contractor will be responsible for the health and safety of workers within these delineated areas. Provide continuous access to these areas for the CAR Contractor and representatives of regulatory or enforcement agencies having jurisdiction.

Coordinate with the CAR Contractor and Engineer to develop a work plan with projected completion dates for the final resolution of the contamination, in coordination with any regulatory agencies as appropriate. Use the work plan and schedule as a basis for planning the completion of all work efforts. The Engineer may grant Contract Time extensions according to the provisions of 8-7.3.2.

Cooperate with the CAR Contractor to expedite integration of the CAR Contractor's operations into the construction project. Adjustments to quantities or to Contract unit prices will be made according to work additions or reductions on the part of the Prime Contractor in accordance with 4-3.

The Engineer will inform the Prime Contractor when operations may resume in the affected area.

110-7 Removal of Existing Concrete.

Remove and dispose of existing Portland cement concrete pavement, sidewalk, slope pavement, ditch pavement, curb, and curb and gutter, etc., where shown in the Plans.

Remove all gravity walls, noise/sound walls, retaining walls, MSE walls, perimeter walls, and roadway concrete barriers, where shown in the Plans. All ancillary elements of these concrete features being removed including, but not limited to, base, leveling pads, copings, reinforcing steel or straps, footings, edgedrains, etc, are incidental and included in the cost of the removal.

110-8 Ownership of Materials.

Except as may be otherwise specified in the Contract Documents, take ownership of all buildings, structures, appurtenances, and other materials removed and dispose of them in accordance with 110-9.

110-9 Disposal of Materials.

110-9.1 General: Either stack materials designated to remain the property of the Department in neat piles within the right-of-way, load onto the Department's vehicles, or deliver to location designated in the Plans.

Dispose of timber, stumps, brush, roots, rubbish, and other material resulting from clearing and grubbing in areas and by methods meeting the applicable requirements of all Federal, State and Local Rules and Regulations. Do not block waterways by the disposal of debris.

With the approval of the Engineer, wood chips may be evenly distributed to a depth of no more than one inch in designated areas in the Department's right-of-way.

110-9.2 Burning Debris: Where burning of such materials is permitted, perform all such burning in accordance with the applicable Federal, State and Local rules and regulations. Perform all burning at locations where trees and shrubs adjacent to the cleared area will not be harmed.

110-9.3 Timber and Crops: The Contractor may sell any merchantable timber, fruit trees, and crops that are cleared under the operations of clearing and grubbing for his own benefit, subject to the provisions of 7-1.2, which may require that the timber, fruit trees, or crops be burned at or near the site of their removal, as directed by the Engineer. The Contractor is liable for any claims which may arise pursuant to the provisions of this Subarticle.

110-9.4 Disposal of Treated Wood: Treated wood must be handled and disposed of properly during removal. Treated wood should not be cut or otherwise mechanically altered in a manner that would generate dust or particles without proper respiratory and dermal protection. The treated wood must be disposed of in at least a lined solid waste facility or through recycling/reuse. Treated wood shall not be disposed by burning or placement in a construction and demolition (C&D) debris landfill.

110-9.5 Hazardous Materials/Waste: Handle, transport, and dispose of hazardous materials/waste in accordance with all Federal, State, and Local Rules and Regulations including, but not limited to, the following:

1. SSPC Guide 7
2. Federal Water Pollution Control Act, and
3. Resource Conservation and Recover Act (RCRA).

Accept responsibility for the collection, sampling, classification, packaging, labeling, accumulation time, storage, manifesting, transportation, treatment and disposal of hazardous materials/waste, both solid and liquid. Separate all solid and liquid waste and collect all liquids used at hygiene stations and handle as hazardous materials/waste. Obtain written approval from the Engineer for all hazardous materials/waste stabilization methods before implementation.

Obtain an EPA/FDEP Hazardous Waste Identification Number (EPA/FDEP ID Number) before transporting and/or disposal of any hazardous materials/waste.

List the Department as the generator for hazardous materials/waste resulting from removal or demolition of Department materials.

Submit the following for the Engineers' approval before transporting, treatment or disposal of any hazardous materials/waste:

1. Name, address and qualifications of the transporter,
2. Name, address and qualifications of the treatment facility,
3. Proposed treatment and/or disposal of all Hazardous Materials/Waste.
4. EPA/FDEP Hazardous Waste Identification Number Application Form.
5. Manifest forms.

Transport all hazardous materials/waste in accordance with applicable Federal, State, and Local Rules and Regulations including, but not limited to, the 40 CFR 263 Standards.

Submit all final Hazardous Materials/Waste manifest/bills of lading and certificates of disposal to the Engineer within 21 days of each shipment.

110-9.5.1 Steel Members with Hazardous Coating: Dispose of steel members with hazardous coating in one of the following manners:

1. Deliver the steel members and other hazardous waste to a licensed recycling or treatment facility capable of processing steel members with hazardous coating.

2. Deliver the steel members with hazardous coating to a site designated by the Engineer for use as an offshore artificial reef. Deliver any other hazardous materials/waste to a licensed hazardous materials/waste recycling treatment facility.

Dismantle and/or cut steel members to meet the required dimensions of the recycling facility, treatment facility or offshore artificial reef agency.

All compensation for the cost of removal and disposal of hazardous materials/waste will be included in the Cost of Removal of Existing Structures.

110-9.5.2 Certification of Compliance: Submit certification of Compliance from the firm actually removing and disposing of the hazardous materials/waste stipulating, the hazardous materials/waste has been handled, transported and disposed of in accordance with this Specification. The Certification of Compliance shall be attested to by a person having legal authority to bind the company.

Maintain all records required by this Specification and ensure these records are available to the Department upon request.

110-10 Miscellaneous Operations.

110-10.1 Water Wells Required to be Plugged: Fill or plug all water wells within the right-of-way, including areas of borrow pits and lateral ditches, that are not to remain in service, in accordance with applicable Federal, State, and Local Rules and Regulations.

Cut off the casing of cased wells at least 12 inches below the existing surface or 12 inches below the elevation of the finished graded surface, whichever is lower. Water wells, as referred to herein, are defined either as artesian or non-artesian, as follows:

1. An artesian well is an artificial hole in the ground from which water supplies may be obtained and which penetrates any water-bearing rock, the water in which is raised to the surface by natural flow or which rises to an elevation above the top of the water-bearing bed. Artesian wells are further defined to include all holes drilled as a source of water that penetrate any water-bearing beds that are a part of the artesian water system of Florida, as determined by representatives of the applicable Water Management District.

2. A non-artesian (water-table) well is a well in which the source of water is an unconfined aquifer. The water in a non-artesian well does not rise above the source bed.

110-10.2 Leveling Terrain: Within the areas between the limits of construction and the outer limits of clearing and grubbing, fill all holes and other depressions, and cut down all mounds and ridges. Make the area of a sufficient uniform contour so that the Department's subsequent mowing and cutting operations are not hindered by irregularity of terrain. Perform this work regardless of whether the irregularities were the result of construction operations or existed originally.

110-10.3 Mailboxes: When the Contract Documents require furnishing and installing mailboxes, permit each owner to remove the existing mailbox. Work with the Local Postmaster to develop a method of temporary mail service for the period between removal and installation of the new mailboxes. Install the mailboxes in accordance with the Standard Plans.

110-11 Method of Measurement.

110-11.1 Clearing and Grubbing: The quantity to be paid for will be the lump sum quantity.

110-11.2 Selective Clearing and Grubbing: The quantity to be paid will be the plan quantity area in acres designated for Selective Clearing and Grubbing. The quantity to be paid for Tree Protection Barrier will be the linear foot measurement as shown in the Plans. Tree Root, Branch Pruning, and Tree Removal will be paid per each tree. Tree Removal per each will not be used where Clearing and Grubbing or Selective Clearing and Grubbing per acre is used.

110-11.3 Removal of Existing Bridges: The quantity to be paid for will be the lump sum quantity or quantities for the specific structures, or portions of structures to be removed.

110-11.4 Removal of Existing Concrete:

The quantity to be paid for will be the number of square yards of existing concrete elements, acceptably removed and disposed of, as specified. The quantity will be determined by actual measurement along the surface of the element before its removal. Measurements for appurtenances which have irregular surface configurations, such as curb and gutter, steps, and ditch pavement, will be the area as projected to an approximate horizontal plane. Where the removal of pavement areas is necessary only for the construction of box culverts, pipe culverts, storm sewers, inlets, manholes, etc., these areas will not be included in the measurements.

Area measurements for walls will be based on exposed vertical face measurements times the horizontal length of the wall.

110-11.5 Plugging Water Wells: The quantity to be paid for will be the number of water wells plugged, for each type of well (artesian or non-artesian).

110-11.6 Mailboxes: The quantity to be paid for will be the number of mailboxes acceptably furnished and installed.

110-11.7 Delivery of Salvageable Material to the Department The quantity to be paid for will be the Lump Sum quantity for delivery of salvageable materials to the Department, as indicated in the Plans.

110-11.8 General: In each case, except as provided below, where no item of separate payment for such work is included in the proposal, all costs of such work will be included in the various scheduled items in the Contract, or under specific items as specified herein below or elsewhere in the Contract.

110-12 Basis of Payment.

110-12.1 Clearing and Grubbing:

110-12.1.1 Lump Sum Payment: Price and payment will be full compensation for all clearing and grubbing required for the roadway right-of-way and for lateral ditches, channel changes, or other outfall areas, and any other clearing and grubbing indicated, or required for the construction of the entire project, including all necessary hauling, furnishing equipment, equipment operation, furnishing any areas required for disposal of debris, leveling of terrain and the landscaping work of trimming, etc.

Where construction easements are specified in the Plans and the limits of clearing and grubbing for such easements are dependent upon the final construction requirements, no adjustment will be made in the lump sum price and payment, either over or under, for variations from the limits of the easement defined in the Plans.

110-12.1.2 When No Direct Payment is Provided: When no item for clearing and grubbing is included in the proposal, the Contractor shall include the cost of any work of clearing and grubbing which is necessary for the proper construction of the project in the

Contract price for the structure or other item of work for which such clearing and grubbing is required. The Contractor shall include the cost of all clearing and grubbing which might be necessary in pits or areas from which base material is obtained in the Contract price for the base in which such material is used. The clearing and grubbing of areas for obtaining stabilizing materials, where required only for the purpose of obtaining materials for stabilizing, will not be paid for separately.

110-12.2 Selective Clearing and Grubbing: Price and payment will be full compensation for all selective clearing and grubbing, including all necessary hauling, furnishing equipment, Certified Arborist, equipment operation, furnishing any areas required for disposal of debris, leveling of terrain, root pruning and tree protection.

110-12.3 Removal of Existing Bridges: Price and payment will be full compensation for all work of removal and disposal of the designated bridges.

When direct payment for the removal of existing bridges is not provided in the proposal, the Contractor shall include the cost of removing all bridges in the Contract price for clearing and grubbing or, if no item of clearing and grubbing is included, in the compensation for the other items covering the new bridge being constructed.

110-12.4 Removal of Existing Concrete: Price and payment will be full compensation for performing and completing all the work of removal and satisfactory disposal.

When no separate item for this work is included, the Contractor shall include the costs of this work in the Contract price for the item of clearing and grubbing or for the pipe or other structure for which the concrete removal is required.

110-12.5 Plugging Water Wells: Price and payment will be full compensation for each type of well acceptably plugged.

If a water well requiring plugging is encountered and the Contract contains no price for plugging wells of that specific type, the plugging of such well will be paid for as unforeseeable work.

110-12.6 Mailboxes: Price and payment will be full compensation for all work and materials required, including supports and numbers.

110-12.7 Delivery of Salvageable Material to the Department: Price and payment will be full compensation for all work required for delivery of the materials to the Department.

110-12.8 Payment Items: Payment will be made under:

Item No. 110- 1-	Clearing and Grubbing - lump sum.
Item No. 110- 2-	Selective Clearing and Grubbing Area - acre.
Item No. 110- 3-	Removal of Existing Bridges - lump sum.
Item No. 110- 4-	Removal of Existing Concrete - per square yard.
Item No. 110- 5-	Plugging Water Wells (Artesian) - each.
Item No. 110- 6-	Plugging Water Wells (Non-Artesian) - each.
Item No. 110- 7-	Mailbox (Furnish and Install) - each.
Item No. 110- 21	Tree Protection Barrier - per linear foot.
Item No. 110- 22	Tree Root and Branch Pruning - per each tree.
Item No. 110- 23	Tree Removal - per each tree.
Item No. 110- 86-	Delivery of Salvageable Material to FDOT - lump sum.

SECTION 120
EXCAVATION AND EMBANKMENT

120-1 Description.

120-1.1 General: Excavate and construct embankments as required for the roadway, ditches, channel changes and borrow material. Use suitable excavated material or authorized borrow to prepare subgrades and foundations. Construct embankments in accordance with Standard Plans, Index 120-001. Compact and dress excavated areas and embankments.

Meet the requirements of Section 110 for excavation of material for clearing and grubbing and Section 125 for excavation and backfilling of structures and pipe. Material displaced by the storm sewer or drainage structure system is not included in the earthwork quantities shown in the Contract Documents.

The existing surface may be a combination of the following:

1. The original unpaved ground line;
2. The bottom of the existing pavement;
3. The bottom of existing features removed by clearing and grubbing;
4. The bottom of the existing base, if the base is to be removed.

The finished graded surface includes the completed grades of side slopes, unpaved shoulders, and the bottom of the base for flexible or rigid pavement.

120-1.2 Unidentified Areas of Contamination: When encountering or exposing any abnormal condition indicating the presence of contaminated materials, cease operations immediately in the vicinity and notify the Engineer. The presence of tanks or barrels; discolored earth, metal, wood, ground water, etc.; visible fumes; abnormal odors; excessively hot earth; smoke; or other conditions that appear abnormal may indicate the presence of contaminated materials and must be treated with extreme caution.

Make every effort to minimize the spread of contamination into uncontaminated areas. Immediately provide for the health and safety of all workers at the job site and make provisions necessary for the health and safety of the public that may be exposed to any potentially hazardous conditions. Ensure provisions adhere to all applicable laws, rules or regulations covering potentially hazardous conditions and will be in a manner commensurate with the gravity of the conditions.

The Engineer will notify the District Contamination Impact Coordinator (DCIC) who will coordinate selecting and tasking the Department's Contamination Assessment/Remediation Contractor (CAR). Provide access to the potentially contaminated area. Preliminary investigation by the CAR Contractor will determine the course of action necessary for site security and the steps necessary under applicable laws, rules, and regulations for additional assessment and/or remediation work to resolve the contamination issue.

The CAR Contractor will delineate the contamination areas, any staging or holding area required; and, in cooperation with the Prime Contractor and Engineer, develop a work plan that will provide the CAR Contractor's operations schedule with projected completion dates for the final resolution of the contamination issue.

The CAR Contractor will maintain jurisdiction over activities inside any outlined contaminated areas and any associated staging holding areas. The CAR Contractor will be responsible for the health and safety of workers within the delineated areas. Provide continuous

access to these areas for the CAR Contractor and representatives of regulatory or enforcement agencies having jurisdiction.

Both Contractors will use the schedule as a basis for planning the completion of both work efforts. The Engineer may grant the Contract Time extensions according to the provisions of 8-7.3.2.

Cooperate with the CAR Contractor to expedite integration of the CAR Contractor's operations into the construction project. The Prime Contractor is not expected to engage in routine construction activities, such as excavating, grading, or any type of soil manipulation, or any construction processes required if handling of contaminated soil, surface water or ground water is involved. All routine construction activities requiring the handling of contaminated soil, surface water or groundwater will be by the CAR Contractor. Adjustments to quantities or to Contract unit prices will be made according to work additions or reductions on the part of the Prime Contractor in accordance with 4-3.

The Engineer will direct the Prime Contractor when operations may resume in the affected area.

120-2 Classifications of Excavation.

120-2.1 General: The Department may classify excavation specified under this Section for payment as any of the following: regular excavation, subsoil excavation, lateral ditch excavation, and channel excavation.

If the proposal does not show subsoil excavation or lateral ditch excavation as separate items of payment, include such excavation under the item of regular excavation.

If the proposal shows lateral ditch excavation as a separate item of payment, but does not show channel excavation as a separate item of payment, include such excavation under the item of lateral ditch excavation. Otherwise, include channel excavation under the item of regular excavation.

120-2.2 Regular Excavation: Regular excavation includes roadway excavation and borrow excavation, as defined below for each.

120-2.2.1 Roadway Excavation: Roadway excavation consists of the excavation and the utilization or disposal of all materials necessary for the construction of the roadway, ditches, channel changes, etc., except for removal of existing pavement as defined in Section 110.

120-2.2.2 Borrow Excavation: Borrow excavation consists of the excavation and utilization of material from authorized borrow pits, including only material that is suitable for the construction of roadway embankments or of other embankments covered by the Contract.

A Cost Savings Initiative Proposal (CSIP) submittal based on using borrow material from within the project limits will not be considered.

120-2.3 Subsoil Excavation: Subsoil excavation consists of the excavation and disposal of muck, clay, rock, or any other material that is unsuitable in its original position and that is excavated below the existing surface. For pond and ditches that identify the placement of a blanket material, the existing surface is template as the bottom of the blanket material. Subsoil excavation also consists of the excavation of all suitable material within the above limits as necessary to excavate the unsuitable material. Consider the limits of subsoil excavation indicated in the Plans as being particularly variable, in accordance with the field conditions actually encountered.

The quantity of material required to replace the excavated material and to raise the elevation of the roadway to the bottom of the template will be paid for under embankment or borrow excavation (Truck Measure).

120-2.4 Lateral Ditch Excavation: Lateral ditch excavation consists of all excavation of inlet and outlet ditches to structures and roadway, changes in channels of streams, and ditches parallel to the roadway right-of-way. Dress lateral ditches to the grade and finished graded surface shown in the Plans.

120-2.5 Channel Excavation: Channel excavation consists of the excavation and satisfactory disposal of all materials from within the limits of the channel as shown in the Plans.

120-3 Preliminary Soils Investigations.

When the Plans contain the results of a soil survey, do not assume such data is a guarantee of the depth, extent, or character of material present.

120-4 Removal of Unsuitable Materials and Existing Roads.

120-4.1 Subsoil Excavation: Where muck, rock, clay, or other material within the limits of the roadway is unsuitable in its original position, excavate such material to the depths shown in the Plans as the removal limits or as indicated by the Engineer, and backfill with suitable material. Where the removal of plastic soils is required, meet a construction tolerance, of plus or minus 0.2 foot in depth and plus or minus 6 inches (each side) in width.

120-4.2 Construction over Existing Old Road: Where a new roadway is to be constructed over an old one, completely remove the existing flexible and Portland cement concrete pavement for the entire limits of the width and depth in accordance with Section 110. Compact disturbed material in accordance with Section 120 or 160, whichever material applies. If indicated in the Plans, remove the existing base in accordance with Section 110.

120-5 Disposal of Surplus and Unsuitable Material.

120-5.1 Ownership of Excavated Materials: Dispose of surplus and excavated materials as shown in the Plans or, if the Plans do not indicate the method of disposal, take ownership of the materials and dispose of them outside the right-of-way.

120-5.2 Disposal of Muck on Side Slopes: As an exception to the provisions of 120-5.1, when approved by the Engineer, in rural undeveloped areas, the Contractor may place muck (A-8 material) on the slopes, or store it alongside the roadway, provided there is a clear distance of at least 6 feet between the roadway grading limits and the muck, and the Contractor dresses the muck to present a neat appearance. In addition, the Contractor may also dispose of this material by placing it on the slopes in developed areas where, in the opinion of the Engineer, this will result in an aesthetically pleasing appearance and will have no detrimental effect on the adjacent developments. Where the Engineer permits the disposal of muck or other unsuitable material inside the right-of-way limits, do not place such material in a manner which will impede the inflow or outfall of any channel or side ditches. The Engineer will determine the limits adjacent to channels within which such materials may be disposed.

120-5.3 Disposal of Paving Materials: Unless otherwise noted, take ownership of paving materials, such as paving brick, asphalt block, concrete slab, sidewalk, curb and gutter, etc., excavated in the removal of existing pavements, and dispose of them outside the right-of-way. If the materials are to remain the property of the Department, place them in neat piles as directed. Existing base materials that are removed may be incorporated in the stabilized portion

of the subgrade in accordance with Section 160. If the construction sequence allows, incorporate all existing base material into the project as allowed by the Contract Documents.

120-5.4 Disposal Areas: Where the Contract Documents require disposal of excavated materials outside the right-of-way, and the disposal area is not indicated in the Contract Documents, furnish the disposal area without additional compensation.

Provide areas for disposal of removed paving materials out of sight of the project and at least 300 feet from the nearest roadway right-of-way line of any State maintained road. If the materials are buried, disregard the 300-foot limitation.

120-6 Borrow.

120-6.1 Materials for Borrow: Do not open borrow pits until the Engineer has approved their location.

Prior to the purchase or use of any borrow pit materials, provide the Engineer with a written certification of borrow pit compliance meeting the requirements of Section 337.0262, Florida Statutes.

Do not provide borrow materials that are polluted as defined in Chapter 376 of the Florida Statutes (oil of any kind and in any form, gasoline, pesticides, ammonia, chlorine, and derivatives thereof, excluding liquefied petroleum gas) in concentrations above any local, State, or Federal standards.

Prior to placing any borrow material that is the product of soil incineration, provide the Engineer with a copy of the Certificate of Materials Recycling and Post Burn Analysis showing that the material is below all allowable pollutant concentrations.

120-6.2 Furnishing of Borrow Areas: To obtain the Engineer's approval to use an off-site construction activity area that involves excavation such as a borrow pit or local aggregate pit, request in writing, a review for -cultural resources involvement. Send the request to the Division of Historical Resources (DHR), Department of State, State Historic Preservation Officer, Tallahassee, FL. As a minimum, include in the request the Project Identification Number, the County, a description of the property with Township, Range, Section, etc., the dimensions of the area to be affected, and a location map. Do not start any work at the off-site construction activity area prior to receiving clearance from the DHR that no additional research is warranted.

For certain locations, the DHR will require a Cultural Resources Assessment (CRA) Survey before approval can be granted. When this is required, secure professional archaeological services to complete an historical and archaeological survey report. Submit the report to the DHR and to the Department. The Engineer will determine final approval or rejection of off-site construction activity areas based on input from the DHR.

Before receiving approval or before use of borrow areas, obtain written clearance from the Engineer concerning compliance with the Federal Endangered Species Act and other Wildlife Regulations as specified in 7-1.4 and Section 4(f) of the USDOT Act as specified in 7-1.8.

The Department will adjust Contract Time in accordance with 8-7 for any suspension of operations required to comply with this Article. The Department will not accept any monetary claims due to delays or loss of off-site construction activity areas.

Except where the Plans specifically call for the use of a particular borrow or dredging area, the Contractor may substitute borrow or dredging areas of his own choosing provided the Engineer determines the materials from such areas meet the Department's standards and other requirements for stability for use in the particular sections of the work in which it is to be placed, and the Contractor absorbs any increase in hauling or other costs. Stake the corners of

the proposed borrow area and provide the necessary equipment along with an operator in order for the Engineer to investigate the borrow area. The Engineer will determine test locations, collect samples, and perform tests to investigate the proposed borrow area based on soil strata and required soil properties. The Engineer will approve use of materials from the proposed area based on test results and project requirements. Final acceptance of materials will be based on Point of Use Test as described in 6-1.2.4.

Before using any borrow material from any substitute areas, obtain the Engineer's approval, in writing, for the use of the particular areas, and, where applicable, ensure that the Engineer has surveyed the surface. Upon such written approval by the Engineer, consider the substitute areas as designated borrow areas.

When furnishing the dredging or borrow areas, supply the Department with evidence that the necessary permits, rights, or waivers for the use of such areas have been secured.

Do not excavate any part of a Contractor furnished borrow area which is less than 300 feet from the right-of-way of the project or any State Road until the Engineer has approved a plan for landscaping and restoring the disturbed area. Perform this landscaping and land restoration at no expense to the Department, prior to final acceptance of the project. Do not provide a borrow area closer than 25 feet to the right-of-way of any state road. In Department furnished borrow pits, do not excavate material within 5 feet of adjacent property lines.

Upon completion of excavation, neatly shape, dress, grass, vegetate, landscape, and drain all exposed areas including haul roads, as necessary so as not to present an objectionable appearance.

Meet the requirements of Section 104 when furnishing borrow areas, regardless of location.

120-6.3 Borrow Material for Shoulder Build-up: When indicated in the Plans, furnish borrow material with a specific minimum bearing value, for building up of existing shoulders. Blend materials as necessary to achieve this specified minimum bearing value prior to placing the materials on the shoulders. Take samples of this borrow material at the pit or blended stockpile. Include all costs of providing a material with the required bearing value in the Contract unit price for borrow material.

120-6.4 Haul Routes for Borrow Pits: Provide and maintain, at no expense to the Department, all necessary roads for hauling the borrow material. Where borrow area haul roads or trails are used by others, do not cause such roads or trails to deteriorate in condition.

Arrange for the use of all non-public haul routes crossing the property of any railroad. Incur any expense for the use of such haul routes. Establish haul routes which will direct construction vehicles away from developed areas when feasible, and keep noise from hauling operations to a minimum. Advise the Engineer in writing of all proposed haul routes.

120-6.5 Authorization for Use of Borrow: When the item of borrow excavation is included in the Contract, use borrow only when sufficient quantities of suitable material are not available from roadway and drainage excavation, to properly construct the embankment, subgrade, and shoulders, and to complete the backfilling of structures. Do not use borrow material until so ordered by the Engineer, and then only use material from approved borrow pits.

120-7 Materials for Embankment.

120-7.1 Use of Materials Excavated from the Roadway and Appurtenances: Assume responsibility for determining the suitability of excavated material for use on the project in

accordance with the applicable Contract Documents. Consider the sequence of work and maintenance of traffic phasing in the determination of the availability of this material.

120-7.2 General Requirements for Embankment Materials: Construct embankments of acceptable material including reclaimed asphalt pavement (RAP), recycled concrete aggregate (RCA) and Portland cement concrete rubble, but containing no muck, stumps, roots, brush, vegetable matter, rubbish, reinforcement bar or other material that does not compact into a suitable and enduring roadbed. Do not use RAP or RCA in the top 3 feet of slopes and shoulders that are to be grassed or have other type of vegetation established. Do not use RAP or RCA in stormwater management facility fill slopes or permitted wetland impact areas.

Remove all waste material designated as undesirable. Use material in embankment construction in accordance with Plans or as the Engineer directs.

Complete the embankment using maximum particle sizes (in any dimension) as follows:

1. In top 12 inches: 3-1/2 inches (in any dimension).
2. 12 to 24 inches: 6 inches (in any dimension).
3. In the depth below 24 inches: not to exceed 12 inches (in any dimension) or the compacted thickness of the layer being placed, whichever is less.

Spread all material so that the larger particles are separated from each other to minimize voids between them during compaction. Compact around these rocks in accordance with 120-9.2.

When and where approved by the Engineer, the Contractor may place larger rocks (not to exceed 18 inches in any dimension) outside the 1:2 slope and at least 4 feet or more below the bottom of the base. Compact around these rocks to a firmness equal to that of the supporting soil. Construct grassed embankment areas in accordance with 120-9.2.5. Where constructing embankments adjacent to bridge end bents or abutments, do not place rock larger than 3-1/2 inches in diameter within 3 feet of the location of any end-bent piling.

120-7.3 Materials Used at Pipes, Culverts, etc.: Construct embankments over and around pipes, culverts, and bridge foundations with selected materials.

120-8 Embankment Construction.

120-8.1 General: Construct embankments in sections of not less than 300 feet in length or for the full length of the embankment. Do not construct another LOT over an untested LOT without the Engineer's approval in writing.

For construction of mainline pavement lanes, turn lanes, ramps, parking lots, concrete box culverts and retaining wall systems, a LOT is defined as a single lift of finished embankment not to exceed 500 feet.

For construction of shoulder-only areas, shared use paths, and sidewalks areas, a LOT is defined as a single lift of finished embankment not to exceed 2000 feet.

Isolated compaction operations will be considered as separate LOTs. For multiple phase construction, a LOT shall not extend beyond the limits of the phase.

120-8.2 Dry Fill Method:

120-8.2.1 General: Construct embankments to meet the compaction requirements in 120-9 and in accordance with the acceptance program requirements in 120-10.

As far as practicable, distribute traffic over the work during the construction of embankments so as to cover the maximum area of the surface of each layer.

Construct embankment using the dry fill method whenever normal dewatering equipment and methods can accomplish the needed dewatering.

120-8.2.1.1 Maximum Compacted Lift Thickness Requirements:
Construct the embankment in successive layers with lifts up to a maximum listed in Table 120-1 below based on the embankment material classification group.

Table 120-1			
Group	AASHTO Soil Class	Maximum Lift Thickness	Thick Lift Control Test Section Requirements
1	A-3	12 inches	Not Needed
	A-2-4 (No. 200 Sieve ≤ 15%)		
2	A-1	6 inches without Control Test Section	Maximum of 12 inches per 120-8.2.1.2
	A-2-4 (No. 200 Sieve > 15%)		
	A-2-5, A-2-6, A-2-7, A-4, A-5, A-6		
	A-7 (Liquid Limit < 50)		

120-8.2.1.2 Thick Lift Requirements: For embankment materials classified as Group 2 in Table 120-1 above, the option to perform thick lift construction in successive layers of not more than 12 inches compacted thickness may be used after meeting the following requirements:

1. Notify the Engineer and obtain approval in writing prior to beginning construction of a test section. Demonstrate the possession and control of compacting equipment sufficient to achieve density required by 120-10.2 for the full depth of a thicker lift.
2. Construct a test section of the length of one full LOT of not less than 500 feet.
3. Perform five Quality Control (QC) tests at random locations within the test section.
   a. All five QC tests and a Department Verification test must meet the density required by 120-10.2.
   b. Identify the test section with the compaction effort and soil classification in the Department's Earthwork Records System (ERS).
4. Obtain Engineer's approval in writing for the compaction effort after completing a successful test section.

In case of a change in compaction effort or soil classification, failing QC test or when the QC tests cannot be verified, construct a new test section. The Contractor may elect to place material in 6 inches compacted thickness at any time. Construct all layers approximately parallel to the centerline profile of the road.

The Engineer reserves the right to terminate the Contractor's use of thick lift construction. Whenever the Engineer determines that the Contractor is not achieving satisfactory results, revert to the 6-inch compacted lifts.

120-8.2.1.3 Equipment and Methods: Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps and trenching/digging machinery. Provide normal dewatering methods including, but not limited to, constructing shallow surface drainage trenches/ditches, using sand blankets, sumps and siphons.

When normal dewatering does not adequately remove the water, the Engineer may require the embankment material to be placed in the water or on low swampy ground in accordance with 120-9.2.3.

120-8.2.2 Placing in Unstable Areas: When depositing fill material in water, or on low swampy ground that will not support the weight of hauling equipment, construct the embankment by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. Once sufficient material has been placed so that the hauling equipment can be supported, construct the remaining portion of the embankment in layers in accordance with the applicable provisions of 120-9.2.2.

120-8.2.3 Placing on Steep Slopes: When constructing an embankment on a hillside sloping more than 20 degrees from the horizontal, before starting the fill, deeply plow or cut steps into the surface of the existing slope on which the embankment is to be placed.

120-8.2.4 Placing Outside the Standard Minimum Slope: The standard minimum slope is defined as the plane described by a one (vertical) to two (horizontal) slope downward from the roadway shoulder point or the gutter line, in accordance with Standard Plans, Index 120-001 and 120-002. Where material that is unsuitable for normal embankment construction is to be used in the embankment outside the standard minimum slope, place such material in layers of not more than 18 inches in thickness, measured loose. The Contractor may also place material which is suitable for normal embankment, outside such standard minimum slope, in 18 inch layers. Maintain a constant thickness for suitable material placed within and outside the standard minimum slope, unless placing in a separate operation.

120-8.3 Hydraulic Method:

120-8.3.1 Method of Placing: When the hydraulic method is used, as far as practicable, place all dredged material in its final position in the embankment by such method. Place and compact any dredged material that is reworked or moved and placed in its final position by any other method, as specified in 120-9.2. Baffles or any other form of construction may be used if the slopes of the embankments are not steeper than indicated in the Plans. Remove all timber used for temporary bulkheads or baffles from the embankment, and fill and thoroughly compact all voids. When placing fill on submerged land, construct dikes prior to beginning of dredging, and maintain the dikes throughout the dredging operation.

120-8.3.2 Excess Material: Do not use any excess material placed outside the prescribed slopes or below the normal high-water table to raise the fill areas. Remove only the portion of this material required for dressing the slopes.

120-8.3.3 Protection of Openings in Embankment: Maintain openings in the embankments at the bridge sites. Remove any material which invades these openings or existing channels without additional compensation to provide the same existing channel depth as before the construction of the embankment. Do not excavate or dredge any material within 200 feet of the toe of the proposed embankment.

120-8.4 Reclaimed Asphalt Pavement (RAP) Method:

120-8.4.1 General: Use only RAP material stored at facilities with an approved Florida Department of Environmental Protection Stormwater permit or transferred directly from a milling project to the Department project. Certify the source if RAP material is from an identifiable Department project. Do not use RAP material in the following areas: construction areas that are below the seasonal high groundwater table elevation; MSE Wall backfill; underneath MSE Walls or the top 6 inches of embankment.

Prior to placement, submit documentation to the Engineer for his approval, outlining the proposed location of the RAP material.

120-8.4.2 Soil and RAP Mixture: Place the RAP material at the location and spread uniformly, using approved methods to obtain a maximum layer thickness of 4 inches. Mix this 4-inch maximum layer of RAP with a loose soil layer 8 to 10 inches thick. After mixing, meet all embankment utilization requirements of Standard Plans, Index 120-001 for the location used. The total RAP and other embankment material shall not exceed 12 inches per lift after mixing and compaction if the Contractor can demonstrate that the density of the mixture can be achieved. Perform mixing using rotary tillers or other equipment meeting the approval of the Engineer. The Engineer will determine the order in which to spread the two materials. Mix both materials to the full depth. Ensure that the finished layer will have the thickness and shape required by the typical section. Demonstrate the feasibility of this construction method by successfully completing a 500-foot long test section.

120-8.4.3 Alternate Soil and RAP Layer Construction: Construct soil in 6-inch to 12-inch compacted lifts and RAP in alternate layers with 6-inch maximum compacted lifts. Use soil with a minimum LBR value of 40 to prevent failure during compaction of the overlying RAP layer. Demonstrate the feasibility of this construction method by successfully completing a 500-foot long test section.

120-9 Compaction Requirements.

120-9.1 Moisture Content: Compact the materials at a moisture content such that the specified density can be attained. If necessary to attain the specified density, add water to the material, or lower the moisture content by manipulating the material or allowing it to dry, as is appropriate.

120-9.2 Compaction of Embankments:

120-9.2.1 General: Uniformly compact each layer, using equipment that will achieve the required density, and as compaction operations progress, shape and manipulate each layer as necessary to ensure uniform density throughout the embankment.

120-9.2.2 Compaction Over Unstable Foundations: Where the embankment material is deposited in water or on low swampy ground, and in a layer thicker than 12 inches (as provided in 120-8.2.2), compact the top 6 inches (compacted thickness) of such layer to the density as specified in 120-10.2.

120-9.2.3 Compaction Where Plastic Material Has Been Removed: Where unsuitable material is removed and the remaining surface is of the A-4, A-5, A-6, or A-7 Soil Groups (see AASHTO M 145), as determined by the Engineer, compact the surface of the excavated area by rolling with a sheepsfoot roller exerting a compression of at least 250 psi on the tamper feet, for the full width of the roadbed (subgrade and shoulders). Perform rolling before beginning any backfill and continue until the roller feet do not penetrate the surface more than 1 inch. Do not perform such rolling where the remaining surface is below the normal water table and covered with water. Vary the procedure and equipment required for this operation at the discretion of the Engineer.

120-9.2.4 Compaction of Grassed Shoulder Areas: For the upper 6-inch layer of all shoulders which are to be grassed, since no specific density is required, compact only to the extent needed for planting.

120-9.2.5 Compaction of Grassed Embankment Areas: Do not compact the outer layers of any embankments where plant growth will be established. Leave this layer in a loose condition to a minimum depth of 6 inches for the subsequent seeding or planting

operations. Do not place RAP or RAP blended material within the top 12 inches of areas to be grassed.

120-9.3 Compaction for Pipes, Culverts, etc.: Compact the backfill of trenches to the densities specified for embankment or subgrade, as applicable, and in accordance with the requirements of 125-9.2.

Thoroughly compact embankments over and around pipes, culverts, and bridges in a manner which will not place undue stress on the structures, and in accordance with the requirements of 125-9.2.

120-9.4 Compaction of Subgrade: If the Plans do not provide for stabilizing, compact the subgrade in both cuts and fills, to the density specified in 120-10.2. For cut areas, determine Standard Proctor Maximum Density in accordance with FM 1-T099 at a frequency of one per mile or when there is a change in soil type, whichever occurs first. For undisturbed soils, do not apply density requirements where constructing paved shoulders 5 feet or less in width.

Where trenches for widening strips are not of sufficient width to permit the use of standard compaction equipment, perform compaction using vibratory rollers, trench rollers, or other type compaction equipment approved by the Engineer.

Maintain the required density until the base or pavement is placed on the subgrade.

120-10 Acceptance Program.

120-10.1 General Requirements:

120-10.1.1 Equipment Comparison: Before initial production, perform an initial three-way density gauge comparison with Verification and Independent Assurance (IA) gauges to validate QC and Verification gauges. When comparing the wet density between two density gauges, three sets of calculations must be performed (IA to QC, IA to Verification, and QC to Verification) within the same test hole and same test depth. Ensure that the difference between any two wet densities does not exceed the tolerances listed in Table 120-2. Repair, calibrate, or replace any gauge that does not compare favorably with the IA gauge.

Table 120-2

Condition	Comparison Type	Manufacturer	Tolerance
Condition 1: When both gauges in the comparison are Nuclear Density Gauges (NDG)	NDG to NDG	Same Manufacturer	2 lb/ft^3
	NDG to NDG	Different Manufacturer	3 lb/ft^3
Condition 2: When one of the gauges in the comparison is a Low-Activity Nuclear Density Gauge (L-NDG)	L-NDG to L-NDG	Same Manufacturer	2 lb/ft^3
	L-NDG to L-NDG	Different Manufacturer	3 lb/ft^3
	NDG to L-NDG	Same/Different Manufacturer	

Ensure the equipment intended to determine the moisture content of soils by Speedy moisture tester in accordance with FM 5-507 has been calibrated and visually inspected by the Engineer.

To validate additional nuclear density gauges, perform a two-way comparison analysis between the QC nuclear gauge and the Verification nuclear gauge any time a nuclear gauge is first brought to the project or returns from annual calibration/repair. At least one of the nuclear gauges in the two-way comparison analysis must have been previously

validated in a comparison. Repair or replace any QC gauge that does not compare favorably with a validated Verification gauge at any time during the remainder of the project. Calibrate all gauges annually.

120-10.1.2 Initial Production LOT: Before construction of any production LOT, prepare a 500-foot initial control section consisting of one full LOT. Notify the Engineer in writing at least 24 hours prior to production of the initial control section. Perform all QC tests required in 120-10.1.4 with the Engineer present. Do not begin constructing another LOT until successfully completing the initial production LOT.

If the QC test result fails the density requirements of 120-10.2, correct the areas of non-compliance. The QC and Verification tests will then be repeated.

120-10.1.3 Density over 105%: When a QC computed dry density results in a value greater than 105% of the applicable Proctor maximum dry density, the Engineer will perform an Independent Verification (IV) density test within 5 feet. If the IV density results in a value greater than 105%, the Engineer will investigate the compaction methods, examine the applicable Standard Proctor Maximum Density and material description. The Engineer may collect and test an IV Standard Proctor Maximum Density sample for acceptance in accordance with the criteria of 120-10.2.

120-10.1.4 Quality Control (QC) Tests:

120-10.1.4.1 Standard Proctor Maximum Density Determination: Determine the QC standard Proctor maximum density and optimum moisture content by sampling and testing the material in accordance with the specified test method listed in 120-10.2.

120-10.1.4.2 Density Testing Requirements: Ensure compliance to the requirements of 120-10.2 by Nuclear Density testing in accordance with FM 1-T310. Determine the in-place moisture content for each density test in accordance with FM 1-T310, FM 5-507 (Speedy Moisture), or ASTM D-4643 (Microwave Oven), whichever is applicable.

120-10.1.4.3 Soil Classification: Perform soil classification tests on the sample collected in 120-10.1.4.1, in accordance with AASHTO T88, T89, T90, and FM 1-T267. Classify soils in accordance with AASHTO M145 in order to determine compliance with embankment utilization requirements as specified in Standard Plans, Index 120-001.

120-10.1.5 Department Verification: The Engineer will conduct Verification tests in order to accept all materials and work associated with 120-10.1.4. The Engineer will verify the QC results if they meet the Verification Comparison Criteria, otherwise the Engineer will implement Resolution procedures.

The Engineer will select test locations, including Station, Offset, and Lift, using a random number generator, based on the LOTs under consideration. Each Verification test evaluates all work represented by the QC testing completed in those LOTs.

In addition to the Verification testing, the Engineer may perform additional Independent Verification (IV) testing. The Engineer will evaluate and act upon the IV test results in the same manner as Verification test results.

When the project requires less than four QC tests per material type, the Engineer reserves the right to accept the materials and work through visual inspection.

120-10.1.6 Reduced Testing Frequency: Obtain the Engineer's written approval for the option to reduce density testing frequency to one test every two LOTs if Resolution testing was not required for 12 consecutive verified LOTs, or if Resolution testing was required, but the QC test data was upheld and all substantiating tests are recorded in the ERS.

Generate random numbers based on the two LOTs under consideration. When QC test frequency is reduced to one every two LOTs, obtain the Engineer's approval to place more than one LOT over an untested LOT. Assure similar compaction efforts for the untested LOTs. If the Verification test fails, and QC test data is not upheld by Resolution testing, the QC testing will revert to the original frequency of one QC test per LOT. Do not apply reduced testing frequency in construction of shoulder-only areas, shared use paths, sidewalks, and first and last lift.

120-10.1.7 Payment for Resolution Tests: If the Resolution laboratory results compare favorably with the QC results, the Department will pay for Resolution testing. No additional compensation, either monetary or time, will be made for the impacts of any such testing.

If the Resolution laboratory results do not compare favorably with the QC results, the costs of the Resolution testing will be deducted from monthly estimates. No additional time will be granted for the impacts of any such testing.

120-10.2 Acceptance Criteria: Obtain a minimum QC density of 100% of the standard Proctor maximum density as determined by FM 1-T099, with the following exceptions: embankment constructed by the hydraulic method as specified in 120-8.3; material placed outside the standard minimum slope as specified in 120-8.2.4 except when a structure is supported on existing embankment; and other areas specifically excluded herein.

120-10.3 Additional Requirements:

120-10.3.1 Frequency: Conduct QC sampling and testing at a minimum frequency listed in Table 120-3 below. The Engineer will perform Verification sampling and tests at a minimum frequency listed in Table 120-3 below.

Table 120-3

Test Name	Quality Control	Verification	Verification of Shoulder-Only Areas, Shared Use Paths, and Sidewalks
Standard Proctor Maximum Density	One per soil type	One per soil type	One per soil type
Density	One per LOT	One per four LOTS and for wet conditions, the first lift not affected by water	One per two LOTs
Soil Classification and Organic Content	One per Standard Proctor Maximum Density	One per Standard Proctor Maximum Density	One per Standard Proctor Maximum Density

120-10.3.2 Test Selection and Reporting: Determine test locations including stations and offsets, using the random number generator approved by the Engineer. Record data directly in the ERS section of the Department's database. Do not use notepads or worksheets to record data for later transfer to the ERS. Notify the Engineer upon successful completion of QC testing on each LOT prior to placing another lift on top.

120-10.4 Verification Comparison Criteria and Resolution Procedures:

120-10.4.1 Standard Proctor Maximum Density Determination: The Engineer will verify the QC results if the results compare within 4.5 lb/ft^3 of the Verification test result.

Otherwise, the Engineer will take one additional sample of material from the soil type in question. The State Materials Office (SMO) or an AASHTO accredited laboratory designated by the SMO will perform Resolution testing. The material will be sampled and tested in accordance with FM 1-T099.

The Engineer will compare the Resolution test results with the QC test results. If all Resolution test results are within 4.5 lb/ft^3 of the corresponding QC test results, the Engineer will use the QC test results for material acceptance purposes for each LOT with that soil type. If the Resolution test result is not within 4.5 lb/ft^3 of the Contractor's QC test, the Verification test result will be used for material acceptance purposes.

120-10.4.2 Density Testing: When a Verification or IV density test fails the acceptance criteria, perform an equipment comparison analysis using the same test hole and same test depth in accordance with 120-10.1.1. If the equipment compares favorably, then retest the site within a 5-foot radius of the failing Verification's test. Otherwise, repair, calibrate, or replace density gauge in accordance with 120-10.1.1.

If the QC retest meets the acceptance criteria, the Engineer will accept those LOTs in question. Otherwise, rework and retest the LOT. The Engineer will perform new verification testing. Record the equipment comparison data and the QC test results in the ERS section of the Department's database.

120-10.4.3 Soil Classification: The Engineer will verify the QC test results if the Verification and the QC test results both match the soil utilization symbol listed in Standard Plans, Index 120-001. Otherwise, the Engineer will test the sample retained for Resolution testing. The SMO or an AASHTO accredited laboratory designated by the SMO will perform the Resolution testing. The material will be sampled and tested in accordance with AASHTO T 88, T 89, and T 90, and classified in accordance with AASHTO M 145.

The Engineer will compare the Resolution test results with the QC test results. If the Resolution test matches the QC soil utilization symbol, the Engineer will use the QC soil utilization symbol for material acceptance purposes. If the Resolution test result does not match the Contractor's QC soil utilization symbol, the Verification test results will be used for material acceptance purposes.

120-10.4.4 Organic Content: The Engineer will verify the QC test results if the Verification test results satisfy the organic content test criteria in Standard Plans, Index 120-001. Otherwise, the Engineer will test the sample retained for Resolution testing. The SMO or an AASHTO accredited laboratory designated by the SMO will perform Resolution testing. The material will be sampled and tested in accordance with FM 1-T 267. If the Resolution test results satisfy the required criteria, material of that soil type will be verified and accepted. If the Resolution test results do not meet the required criteria, reject the material and reconstruct with acceptable material.

120-10.5 Disposition of Defective Materials: Assume responsibility for removing and replacing all defective material, as defined in Section 6.

Alternately, submit an Engineering Analysis Scope in accordance with 6-4 to determine the disposition of the material.

120-11 Maintenance and Protection of Work.

While construction is in progress, maintain adequate drainage for the roadbed at all times. Maintain a shoulder at least 3 feet wide adjacent to all pavement or base construction in order to provide support for the edges.

Maintain all earthwork construction throughout the life of the Contract and take all reasonable precautions to prevent loss of material from the roadway due to the action of wind or water. Repair, at no expense to the Department except as otherwise provided herein, any slides, washouts, settlement, subsidence, or other mishap which may occur prior to final acceptance of the work. Perform maintenance and protection of earthwork construction in accordance with Section 104.

Maintain all channels excavated as a part of the Contract work against natural shoaling or other encroachments to the lines and grades, shown in the Plans, until final acceptance of the project.

120-12 Construction.

120-12.1 Construction Tolerances: Shape the surface of the earthwork to conform to the lines and grades as shown in the Plans. In final shaping of the surface of earthwork, maintain a tolerance of 0.3 foot above or below the finished graded surface with the following exceptions:

1. Shape the surface of shoulders to within 0.1 foot of the finished graded surface shown in the Plans.
2. Shape the earthwork to match adjacent pavement, curb, sidewalk, structures, etc.
3. Shape the bottom of conveyance ditches so that the ditch impounds no water.
4. When the work does not include construction of base or pavement, shape the entire roadbed (shoulder point to shoulder point) to within 0.1 foot above or below the Plan finished graded surface.
5. When the work includes permitted linear stormwater management facilities, shape the swales and ditch blocks to within 0.1 foot of the finished graded surface shown in the Plans.

Ensure that the shoulder lines do not vary horizontally more than 0.3 foot from the true lines shown in the Plans.

120-12.2 Operations Adjacent to Pavement: Carefully dress areas adjacent to pavement areas to avoid damage to such pavement. Complete grassing of shoulder areas prior to placing the final wearing course. Do not manipulate any embankment material on a pavement surface.

When shoulder dressing is underway adjacent to a pavement lane being used to maintain traffic, exercise extreme care to avoid interference with the safe movement of traffic.

120-13 Method of Measurement.

120-13.1 General: When payment for excavation is on a volumetric basis, the quantity to be paid for will be the volume, in cubic yards. The material will be measured in its original position by field survey or by photogrammetric means as designated by the Engineer, unless otherwise specified under the provisions for individual items.

Where subsoil excavation extends outside the lines shown in the Plans or authorized by the Engineer including allowable tolerances, and the space is backfilled with material obtained in additional authorized roadway or borrow excavation, the net fill, plus shrinkage allowance, will be excluded from the quantity of roadway excavation or borrow excavation to be paid for, as applicable.

The quantity of all material washed, blown, or placed beyond the limits of the finished graded surface will be determined by the Engineer and will be excluded from the quantity of roadway excavation or borrow excavation to be paid for, as applicable.

Subsoil excavation that extends outside the lines shown in the Plans or authorized by the Engineer including allowable tolerances will be excluded from the quantity to be paid for as subsoil excavation.

120-13.2 Roadway Excavation: The measurement will include only the net volume of material excavated between the original ground line or finished graded surface of an existing roadbed, as applicable, and the finished surface of new pavement, except that the measurement will also include all unavoidable slides which may occur in connection with excavation classified as roadway excavation.

The pay quantity will be the plan quantity provided that the excavation was accomplished in substantial compliance with the plan dimensions and subject to the provisions of 9-3.2 and 9-3.4. On designated 3-R Projects, regular excavation will be paid for at the Contract lump sum price provided that the excavation was accomplished in substantial compliance with the plan dimension.

120-13.3 Borrow Excavation: Measurement will be made on a loose volume basis, measured in trucks or other hauling equipment at the point of dumping on the road. If measurement is made in vehicles, level the material to facilitate accurate measurement.

Unsuitable material excavated from borrow pits where truck measurement is provided for and from any borrow pits furnished by the Contractor, will not be included in the quantity of excavation to be paid for.

120-13.4 Lateral Ditch Excavation: The measurement will include only material excavated within the lines and grades indicated in the Plans or as directed by the Engineer. The measurement will include the full length shown in the Plans or directed by the Engineer and acceptably completed. Excavation included for payment under Section 125 will not be included in this measurement.

The pay quantity will be the plan quantity provided that the excavation was accomplished in substantial compliance with the plan dimensions and subject to the provisions of 9-3.2 and 9-3.4.

120-13.5 Channel Excavation: The measurement will include only material excavated within the lines and grades indicated in the Plans or in accordance with authorized Plan changes. The measurement will include the full length shown in the Plans including any authorized changes thereto.

If shoaling occurs subsequent to excavation of a channel and the Engineer authorized the shoaled material to remain in place, the volume of any such material remaining within the limits of channel excavation shown in the Plans will be excluded from the measured quantity of channel excavation.

120-13.6 Subsoil Excavation: The measurement will include only material excavated within the lines and grades indicated in the Plans (including the tolerance permitted therefore) or as directed by the Engineer.

When no item for subsoil excavation is shown in the Contract but subsoil excavation is subsequently determined to be necessary, such unanticipated subsoil excavation will be paid for as provided in Article 4-4.

120-13.7 Embankment: The quantity will be at the plan quantity. Where payment for embankment is not to be included in the payment for the excavation and is to be paid for on a cubic yard basis for the item of embankment, the measurement will include material placed within the limits of the existing surface, to the finished graded surface as shown in the Plans, Standard Plans Index 120-001, or directed by the Engineer. Where embankment is constructed

over an existing road, the embankment measurement will include only the material actually placed up to the finished graded surface. If there are authorized changes in plan dimensions or if errors in plan quantities are detected, plan quantity will be adjusted as provided in 9-3.2.

Any overrun or underrun of plan quantity for subsoil excavation which results in a corresponding increase or decrease in embankment will be considered as an authorized plan change for adjustment purposes as defined in 9-3.2.2.

No payment will be made for embankment material used to replace unsuitable material excavated beyond the lines and grades shown in the Plans or ordered by the Engineer.

In no case will payment be made for material allowed to run out of the embankment on a flatter slope than indicated on the Plans. The Contractor shall make his own estimate on the volume of material actually required to obtain the pay section.

120-14 Basis of Payment.

120-14.1 General: Prices and payments for the various work items included in this Section will be full compensation for all work described herein, including excavating, dredging, pumping, hauling, placing, and compacting; dressing the surface of the earthwork; maintaining and protecting the complete earthwork.

The Department will not allow extra compensation for any reworking of materials. The Department will compensate for the cost of grassing or other permanent erosion control measures directed by the Engineer as provided in the Contract.

120-14.2 Excavation:

120-14.2.1 Items of Payment: When no classification of material is indicated in the Plans, and bids are taken only on regular excavation, the total quantity of all excavation specified under this Section will be paid for at the Contract unit price for regular excavation.

When separate classifications of excavation are shown in the proposal, the quantities of each of the various classes of materials so shown will be paid for at the Contract unit prices per cubic yard for regular excavation, lateral ditch excavation, subsoil excavation, and channel excavation, as applicable, and any of such classifications not so shown will be included under the item of regular excavation (except that if there is a classification for lateral ditch excavation shown and there is no classification for channel excavation, any channel excavation will be included under the item of lateral ditch excavation). As an exception on designated projects, regular excavation will be paid for at the Contract lump sum price.

120-14.2.2 Basic Work Included in Payments: Prices and payments will be full compensation for all work described under this Section, except for any excavation, or embankment which is specified to be included for payment under other items. Such prices and payments will include hauling; any reworking that may be necessary to accomplish final disposal as shown in the Plans; the dressing of shoulders, ditches and slopes; removal of trash, vegetation, etc., from the previously graded roadway where no item for clearing and grubbing is shown in the Plans; and compacting as required.

120-14.2.3 Additional Depth of Subsoil Excavation: Where subsoil excavation is made to a depth of 0 to 5 feet below the depth shown in the Plans, such excavation will be paid for at the unit price bid.

Where subsoil excavation is made to a depth greater than 5 feet, and up to 15 feet, deeper than the depth shown in the Plans, such excavation will be paid for at the unit price bid plus 25% of such unit price. Additional extra depth, more than 15 feet below such plan depth, will be considered as a change in the character of the work and will be paid for as unforeseeable work.

Where no subsoil excavation is shown in a particular location on the original Plans, payment for extra depth of subsoil will begin 5 feet below the lowest elevation on the finished graded surface.

120-14.2.4 Borrow Excavation: When the item of borrow excavation is included in the Contract, price and payment will also include the cost of furnishing the borrow areas and any necessary clearing and grubbing thereof, the removal of unsuitable material that it is necessary to excavate in order to obtain suitable borrow material, and also the costs incurred in complying with the provisions of 120-6.3.

120-14.2.5 Materials Excluded from Payment for the Excavation: No payment for excavation will be made for any excavation covered for payment under the item of embankment.

No payment will be made for the excavation of any materials which is used for purposes other than those shown in the Plans or designated by the Engineer. No payment will be made for materials excavated outside the lines and grades given by the Engineer, unless specifically authorized by the Engineer. As an exception, in operations of roadway excavation, all slides and falls of insecure masses of material beyond the regular slopes that are not due to lack of precaution on the part of the Contractor, will be paid for at the Contract unit price for the material involved. The removal of slides and falls of material classified as lateral ditch excavation or as subsoil excavation will not be paid for separately, but will be included in the Contract unit price for the pay quantity of these materials, measured as provided in 120-14.

120-14.3 Embankment:

120-14.3.1 General: Price and payment will be full compensation for all work specified in this Section, including all material for constructing the embankment, all excavating, dredging, pumping, placing and compacting of material for constructing the embankment complete, dressing of the surface of the roadway, maintenance and protection of the completed earthwork, and the removal of rubbish, vegetation, etc., from the roadway where no clearing and grubbing of the area is specified in the Plans. Also, such price and payment, in each case, will specifically include all costs of any roadway, lateral ditch, or channel excavation, unless such excavation is specifically shown to be paid for separately, regardless of whether the materials are utilized in the embankment.

120-14.3.2 Excluded Material: No payment will be made for the removal of muck or overburden from the dredging or borrow areas. No payment will be made for embankment material used to replace muck or other unsuitable material excavated beyond the lines and grades shown in the Plans or ordered by the Engineer.

120-14.3.3 Clearing and Grubbing: No payment will be made for any clearing and grubbing of the borrow or dredging areas. Where no clearing and grubbing of such areas is specified in the Plans, the cost of any necessary clearing and grubbing will be included in the Contract unit or lump sum price for Embankment.

120-14.3.4 Cost of Permits, Rights, and Waivers: Where the Contractor provides borrow or dredging areas of his own choosing, the cost of securing the necessary permits, rights or waivers will be included in the Contract price for embankment.

120-14.4 Payment Items: Payment will be made under:

Item No. 120-	1-	Regular Excavation - per cubic yard.
Item No. 120-	2-	Borrow Excavation - per cubic yard.
Item No. 120-	3-	Lateral Ditch Excavation - per cubic yard.

Item No. 120- 4-	Subsoil Excavation - per cubic yard.
Item No. 120- 5-	Channel Excavation - per cubic yard.
Item No. 120- 6-	Embankment - per cubic yard.
Item No. 120- 71-	Regular Excavation (3-R Projects) - lump sum.

SECTION 121
FLOWABLE FILL

121-1 Description.

Furnish and place flowable fill as an alternative to compacted soil as approved by the Engineer. Applications for conventional flowable fill include beddings; encasements; closures for tanks and pipes; and general backfill for trenches, embankments and walls. Applications for cellular concrete flowable fill include beddings; encasements; closures for tanks and pipes; and general backfill for embankments and walls.

121-2 Materials.

Meet the following requirements:

Fine Aggregate[(1)]	Section 902
Portland Cement	Section 921
Water	Section 923
Admixtures[(2)]	Section 924
Ground Tire Rubber (GTR)[(3)]	Section 919
Supplementary Cementitious Materials	Section 929
Preformed Foam	ASTM C869

1. Any clean fine aggregate with 100% passing a 3/8-inch mesh sieve and not more than 15% passing a No. 200 sieve may be used.

2. High air generators or foaming agents may be used in lieu of conventional air entraining admixtures and shall be added at jobsite and mixed in accordance with the manufacturer's recommendation. GTR may reduce the amount of high air generators or foaming agents used.

3. GTR may replace up to 20% of the fine aggregate.

121-3 Mix Design.

Conventional flowable fill is a mixture of portland cement, coal ash, fine aggregate, admixture and water. Flowable fill contains a low cementitious content for reduced strength development. Cellular concrete flowable fill is a low density concrete made with cement, water and preformed foam to form a hardened closed cell foam material. Cellular concrete flowable fill may also contain fine aggregate, supplementary cementitious materials and admixtures.

Submit mix designs to the Engineer for approval. Table 121-1 below has suggested mix guides for excavatable, non-excavatable and cellular concrete flowable fill:

Table 121-1			
	Excavatable	Non-Excavatable	Cellular Concrete
Cement	75-100 lb/yd^3	75-150 lb/yd^3	Min 150 lb/yd^3
Supplementary Cementitious Materials	None	150-600 lb/yd^3	Optional
Water	*	*	*
Air**	5-35%	5-15%	****
28 Day Compressive Strength**	Maximum 100 psi	Minimum 125 psi	Minimum 80 psi
Unit Weight **	90-110 lb/ft^3	100-125 lb/ft^3	20-80 lb/ft^3
Fine Aggregate	***	***	Optional

*Mix designs shall produce a consistency that will result in a flowable self-leveling product at time of placement.
**The requirements for percent air, compressive strength and unit weight are for laboratory designs only and are not intended for jobsite acceptance requirements.
***Fine Aggregate shall be proportioned to yield 1 yd^3.
****In cellular concrete, preformed foam shall be proportioned at the job site to yield 1 yd^3 in accordance with the design requirements.

121-4 Production and Placing.

Use flowable fill manufactured at a production facility that meets the requirements of 347-3. Deliver flowable fill using concrete construction equipment. Revolution counter are waived. Place flowable fill by chute, pumping or other methods approved by the Engineer. Tremie flowable fill through water. Cellular concrete flowable fill may not be placed within three feet of the bottom elevation for roadway base courses.

121-5 Construction Requirements.

Use straps, soil anchors or other approved means of restraint to ensure correct alignment when flowable fill is used as backfill for pipe or where flotation or misalignment may occur.

Protect flowable fill from freezing for a period of 36 hours after placement.

Place flowable fill to the designated fill line without vibration or other means of compaction. Do not place flowable fill during inclement weather, e.g. rain or ambient temperatures below 40ºF. Take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Provide the means to confine the material within the designated space.

121-6 Acceptance.

Acceptance of flowable fill will be based on the following documentation and a minimum temperature of flowable fill at the point of delivery of 50ºF.

Submit a delivery ticket to the Engineer for each load of flowable fill delivered to the worksite. Ensure that each ticket contains the following information:

1. Project designation,
2. Date,
3. Time,
4. Class and quantity of flowable fill,
5. Actual batch proportions,
6. Free moisture content of aggregates,
7. Quantity of water withheld.

Leave the fill undisturbed until the material obtains sufficient strength. Sufficient strength is 35 psi penetration resistance as measured using a hand held penetrometer in

accordance with ASTM C403. Provide a hand held penetrometer to measure the penetration resistance of the hardened flowable fill.

121-7 Basis of Payment.

When the item of flowable fill is included in the Contract, payment will be made at the Contract unit price per cubic yard. Such price and payment will include all cost of the mixture, in place and accepted, determined as specified above. No measurement and payment will be made for material placed outside the neat line limits or outside the adjusted limits, or for unused or wasted material.

Payment will be made under:

Item No. 121- 70- Flowable Fill - per cubic yard.

SECTION 125
EXCAVATION FOR STRUCTURES AND PIPE

125-1 Description.

Excavate for box culverts, pipes, retaining walls, headwalls for pipes and drains, catch basins, drop inlets, manholes, and similar structures. Construct and remove cofferdams, sheeting, bracing, etc.; pump or otherwise dewater foundations; remove and dispose of any existing structures or portions of structures not covered by other items in the Contract, including foundations, abutments, piers, wings, and all other materials, obstructions, etc., found necessary to clear the site for the proposed work; backfill, dispose of surplus material, and perform final cleaning, as may be necessary for the proper execution of the work. This Section does not include excavation for bases or pavements, curbs, curb and gutter, valley gutter, ditch pavement, or rubble gutter.

125-1.1 Trench Excavation Safety System and Shoring, Special (Trench Excavation): When performing trench excavation in excess of 5 feet in depth, comply with the Occupational Safety and Health Administration's (OSHA) trench safety standards, 29 CFR 1926, Subpart P, and all subsequent revisions or updates adopted by the Department of Labor and Employment Security. Ensure that trench boxes are wide enough to accommodate compaction and density testing.

Submission of bid and subsequent execution of the Contract will serve as certification that all trench excavation in excess of 5 feet in depth will be in compliance with Section 553.62, Florida Statutes.

Consider all available geotechnical information when designing the trench excavation safety system.

Consider these and any more stringent trench safety standards as minimum Contract requirements.

125-2 Classification.

Consider all materials excavated as unclassified and as excavation regardless of the material encountered.

125-3 Cofferdams.

125-3.1 Construction:

125-3.1.1 Methods: Construct all foundations by open excavation, and shore, brace, or protect the foundation openings with cofferdams. Provide cofferdams or cribs for foundation construction below the bottom of the footings. Provide sufficient clearance in the cofferdam interiors to permit construction of forms and inspection of their exteriors, and for pumping equipment.

125-3.1.2 Protection of Concrete: Construct cofferdams to protect green concrete against damage from a sudden rising of the water and to prevent damage by erosion. Do not leave timber or bracing in cofferdams or cribs that extend into the substructure masonry except where permitted in writing by the Engineer.

125-3.1.3 Placing in the Dry: For placing footings in the dry, the Engineer may require cofferdam sheeting to be driven to an elevation 6 feet below the elevation of the bottom of the footings and require sufficient pumping equipment to dewater and maintain the cofferdam in a comparatively dry condition.

125-3.1.4 Working Drawings: For substructure work, submit drawings showing the proposed method of cofferdam construction and other details left to choice or not fully shown in the Plans. Obtain the Engineer's approval of the type and clearance of cofferdams, insofar as such details affect the character of the finished work. For other details of design that do not affect the character of the finished work, assume responsibility for the successful construction of the work. Retain a Professional Engineer, registered in the State of Florida, to prepare the above construction drawing, and keep a signed and sealed copy on hand at the site at all times.

125-3.2 Removal: Unless otherwise provided, remove cofferdams or cribs, with all sheeting and bracing, after completion of the substructure without disturbing or marring the finished masonry.

125-4 Excavation.

125-4.1 Requirements for all Excavation: Perform all excavation to foundation materials, satisfactory to the Engineer, regardless of the elevation shown in the Plans. Remove rock, boulders or other hard lumpy or unyielding material to a depth of 12 inches below the bottom of pipes and box culverts elevations. Remove muck or other soft material to the depth indicated in the Plans or as directed by the Engineer.

125-4.2 Earth Excavation:

125-4.2.1 Foundation Material other than the Rock: When masonry is to rest on an excavated surface other than rock, take special care to avoid disturbing the bottom of the excavation, and do not remove the final foundation material to grade until just before placing the masonry. In case the foundation material is soft or mucky, the Engineer may require excavation to a greater depth and to backfill to grade with approved material.

125-4.2.2 Foundation Piles: Where foundation piles are used, complete the excavation of each pit before driving the piles. After the driving is completed, remove all loose and displaced material, leaving a smooth, solid, and level bed to receive the masonry.

125-4.2.3 Removal of Obstructions: Remove boulders, logs, or any unforeseen obstacles encountered in excavating. Compensation will be in accordance with the requirements of 4-3.

125-4.3 Rock Excavation: Clean all rock and other hard foundation material, remove all loose material, and cut all rock to a firm surface. Either level, step vertically and horizontally, or serrate the rock, as may be directed by the Engineer. Clean out all seams, and fill them with concrete or mortar.

125-4.4 Pipe Trench Excavation: Excavate trenches for pipes to the elevation of the bottom of the pipe and to a width sufficient to provide adequate working room. Remove soil not meeting the classification specified as suitable backfill material in 125-8.3.2.2, to a depth of 4 inches below the bottom of the pipe elevation. Where the soils permit, ensure that the trench sides are vertical up to at least the mid-point of the pipe.

For pipe lines placed above the existing surface, place and compact the embankment, prior to excavation of the trench, to an elevation at least 2 feet above the top of the pipe and to a width equal to four pipe diameters, and then excavate the trench to the required grade.

For pipe trenches utilizing trench boxes, ensure that the trench box used is of sufficient width to permit thorough tamping of bedding material under and around the pipes as specified in 125-8.1.6.

Do not disturb the installed pipe and its embedment when moving trench boxes. Move the trench box carefully to avoid excavated wall displacement or damage. As the trench

box is moved, fill any voids left by the trench box and continuously place and compact the backfill material adjacent to and all along the side of the trench box walls to fill any voids created by the trench box.

125-5 Preservation of Channel.

125-5.1 General: Unless shown in the Plans, do not excavate outside of caissons, cribs, cofferdams, or sheet piling, and do not disturb the natural stream bed adjacent to the structure. If excavating or dredging at the site of the structure before sinking caissons, cribs, or cofferdams, complete the foundation and backfill all such excavations to the existing surface or other required elevation, with material satisfactory to the Engineer.

125-5.2 Removal of Excavated Materials: Do not allow materials that are deposited adjacent to the stream area to infiltrate the water areas. Leave the stream in its original condition.

125-6 Disposal of Surplus.

Use suitable excavated materials for backfilling over or around the structure. Dispose of unsuitable materials. Meet the disposal requirements pertaining to water pollution contained in Section 104 and in 7-1.1.

125-7 Pumping.

Pump from the interior of any foundation enclosure in such manner as to preclude the possibility of any portion of the concrete materials being carried away. Do not pump while placing concrete, or for a period of at least 24 hours thereafter, unless using a suitable pump separated from the concrete work by a watertight wall.

125-8 Backfilling.

125-8.1 General Requirements for Structures and Pipe:

125-8.1.1 General: Backfill in the dry whenever normal dewatering equipment and methods can accomplish the needed dewatering. A LOT is defined as one lift of backfill material placement, not to exceed 500 feet in length or a single run of pipe connecting two successive structures, whichever is less. Backfill for structures and pipe compacted in one operation will be considered as one LOT within the cover zone. Backfill around structures compacted separately from the pipe will be considered as separate LOTs. Backfill on each side of the pipe for the first lift will be considered a separate LOT. Backfill on opposite sides of the pipe for the remaining lifts will be considered separate LOTs, unless the same compactive effort is applied. Same compactive effort is defined as the same type of equipment (make and model) making the same number of passes on both sides of the pipe. For multiple phase backfill, a LOT shall not extend beyond the limits of the phase.

When placing backfill within trench box each lift of backfill is considered a LOT. Placement of backfill within trench box limits will be considered a complete operation before trench box is moved for next backfill operation. When the trench box is moved for next backfill operation this will start new LOTs for each lift. Follow the density testing frequency in 125-9.3.1.

125-8.1.2 Equipment and Methods: Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps, wellpoints and header pipe and trenching/digging machinery. Provide normal dewatering methods including, but not limited to, constructing shallow surface drainage trenches/ditches, using sand blankets, perforated pipe drains, sumps and siphons.

125-8.1.3 Backfill Materials: Backfill to the existing surface or subgrade surface of openings made for structures, with a sufficient allowance for settlement. The Engineer may require that the material used for this backfill be obtained from a source entirely apart from the structure. Use only material accepted by the Engineer. Maintain a clearance of at least 1 foot of clean select soil between recycled concrete aggregate (RCA) and aluminum or metalized drainage pipe.

Do not allow heavy construction equipment to cross over culvert or storm sewer pipes until placing and compacting backfill material to the finished graded surface or to an elevation at least 4 feet above the crown of the pipe.

125-8.1.4 Use of A-7 Material: In the backfilling of trenches, A-7 material may be used from a point 12 inches above the top of the pipe up to the elevation shown in the Standard Plans as the elevation for undercutting of A-7 material.

125-8.1.5 Time of Placing Backfill: Do not place backfill against any masonry or concrete abutment, wingwall, or culvert until the Engineer has given permission to do so, and in no case until the masonry or concrete has been in place seven days or until the specified 28 day compressive strength occurs.

125-8.1.6 Placement and Compaction: Place the material in horizontal layers not exceeding 6 inches compacted thickness, in depth above water level, behind abutments, wingwalls and end bents or end rest piers, under the haunches of the pipes and around box culverts and all structures including pipe culverts. When the backfill material is deposited in water, compact as specified in 125-8.2.5 and 125-8.3.4.

125-8.1.6.1 Thick Lift Requirements: The Contractor may elect to place material in thicker lifts of no more than 12 inches compacted thickness above the Soil Envelope if the embankment material is classified as Group 1 in the table below. If the embankment material is classified as Group 2 in the table below and the Contractor chooses to place material in thicker lifts of no more than 12 inches compacted thickness above the soil envelope then the Contractor must demonstrate with a successful test section that density can be achieved. Thick lift around structures is only allowed above the soil envelope of the connecting pipe. Notify the Engineer in writing prior to beginning construction of a test section. Construct a test section of the length of one LOT. Perform five quality control (QC) tests at random locations within the test section. All five tests must meet the density required by 125-9.2 and be verified by the Department. Identify the test section with the compaction effort and soil classification in the Earthwork Records System (ERS) section of the Department's database. In case of a change in compaction effort or soil classification, construct a new test section. When a QC test fails the requirements of 125-9.2 or when the QC tests cannot be verified, construct a new test section. The Contractor may elect to place material in 6 inches compacted thickness at any time.

Table 125-1					
Group	AASHTO Soil Class	Maximum Lift Thickness		Thick Lift Control Test Section Requirements	
		Within Cover Zone	Above Soil Envelope	Within Cover Zone	Above Soil Envelope
1	A-3 A-2-4 (No. 200 Sieve ≤ 15%)	6 inches	12 inches	N/A	Not Needed
2	A-1 A-2-4 (No. 200 Sieve > 15%) A-2-5, A-2-6, A-2-7, A-4, A-5, A-6 A-7 (Liquid Limit < 50)	6 inches without control test section		N/A	Maximum of 12 inches per 120-8.2.1.2

125-8.2 Additional Requirements for Structures Other than Pipe:

125-8.2.1 Density: Where the backfill material is deposited in water, obtain a 12 inch layer of comparatively dry material, thoroughly compacted by tamping, before verifying the layer and density requirements. Meet the requirements of 125-9.2.

125-8.2.2 Box Culverts: For box culverts over which pavement is to be constructed, compact around the structure to an elevation not less than 12 inches above the top of the structure, using rapid-striking mechanical tampers.

125-8.2.3 Other Limited Areas: Compact in other limited areas using mechanical tampers or approved hand tampers, until the cover over the structure is at least 12 inches thick. When hand tampers are used, deposit the materials in layers not more than 4 inches thick using hand tampers suitable for this purpose with a face area of not more than 100 square inches. Take special precautions to prevent any wedging action against the masonry, and step or terrace the slope bounding the excavation for abutments and wingwalls if required by the Engineer.

125-8.2.4 Culverts and Piers: Backfill around culverts and piers on both sides simultaneously to approximately the same elevation.

125-8.2.5 Compaction Under Wet Conditions: Where wet conditions do not permit the use of mechanical tampers, compact using hand tampers. Use only A-3 material for the hand tamped portions of the backfill. When the backfill has reached an elevation and condition such as to make the use of the mechanical tampers practical, perform mechanical tamping in such manner and to such extent as to transfer the compaction force into the sections previously tamped by hand.

125-8.3 Additional Requirements for Pipe Greater than 12 Inches Inside Diameter:

125-8.3.1 General: Trenches for pipe may have up to four zones that must be backfilled.

Lowest Zone: The lowest zone is backfilled for deep undercuts up to within 4 inches of the bottom of the pipe.

Bedding Zone: The zone above the lowest zone is the bedding zone. Usually it will be the backfill which is the 4 inches of soil below the bottom of the pipe. When rock or other hard material has been removed to place the pipe, the bedding zone will be the 12 inches of soil below the bottom of the pipe.

Cover Zone: The next zone is backfill that is placed after the pipe has been laid and will be called the cover zone. This zone extends to 12 inches above the top of the pipe. The cover zone and the bedding zone are considered the Soil Envelope for the pipe.

Top Zone: The top zone extends from 12 inches above the top of the pipe to the base or final grade.

125-8.3.2 Material:

125-8.3.2.1 Lowest Zone: Backfill areas undercut below the bedding zone of a pipe with coarse sand, or other suitable granular material, obtained from the grading operations on the project, or a commercial material if no suitable material is available.

125-8.3.2.2 Soil Envelope: In both the bedding zone and the cover zone of the pipe, backfill with materials classified as A-1, A-2, or A-3. Material classified as A-4 may be used if the pipe is concrete pipe.

125-8.3.2.3 Top Zone: Backfill the area of the trench above the soil envelope of the pipe with materials allowed on Standard Plans, Index 120-001.

125-8.3.3 Compaction:

125-8.3.3.1 Lowest Zone: Compact the soil in the lowest zone to approximately match the density of the soil in which the trench was cut.

125-8.3.3.2 Bedding Zone: If the trench was not undercut below the bottom of the pipe, loosen the soil in the bottom of the trench immediately below the approximate middle third of the outside diameter of the pipe.

If the trench was undercut, place the bedding material and leave it in a loose condition below the middle third of the outside diameter of the pipe. Compact the outer portions to meet the density requirements of the acceptance criteria. Place the material in lifts no greater than 6 inches (compacted thickness).

125-8.3.3.3 Cover Zone: Before placing the cover zone material, lay pipe according to Section 430. Excavate for pipe bells before laying pipe. Place the material in 6 inch layers (compacted thickness), evenly deposited on both sides of the pipe, and compact with mechanical tampers suitable for this purpose. Hand tamp material below the pipe haunch that cannot be reached by mechanical tampers. Meet the requirements of in 125-9.2.

125-8.3.3.4 Top Zone: Place the material in layers not to exceed 12 inches in compacted thickness. Meet the requirements of the density acceptance criteria.

125-8.3.4 Backfill Under Wet Conditions: Where wet conditions are such that dewatering by normal pumping methods would not be effective, the procedure outlined below may be used when specifically authorized by the Engineer in writing. The Department will pay for any select material which is not available from the grading as Unforeseeable Work. The Department will not pay for select material that might be used by the Contractor for his own convenience instead of dewatering.

The Department will permit the use of granular material below the elevation at which mechanical tampers would be effective, but only material classified as A-3. Place and compact the material using timbers or hand tampers until the backfill reaches an elevation such that its moisture content will permit the use of mechanical tampers. When the backfill has reached such elevation, use normally acceptable backfill material. Compact the material using mechanical tampers in such manner and to such extent as to transfer the compacting force into the material previously tamped by hand.

The Department will permit the use of coarse aggregate below the elevation at which mechanical tampers would be effective. Use coarse aggregate as specified in

Section 901 for Aggregate Size Number 89, 8, 78, 7, 68, 6, or 57. Place the coarse aggregate such that it will be stable and firm. Fully wrap the aggregate with a layer of Type D-4 filter fabric, as specified in Section 985. Do not place coarse aggregate within 4 feet of the ends of the trench or ditch. Use normally accepted backfill material at the ends.

125-9 Acceptance Program.

125-9.1 General Requirements: Meet the requirements of 120-10, except replace the requirements of 120-10.1.6 with 125-9.1.1, 120-10.2 with 125-9.2, and 120-10.3 with 125-9.3.

125-9.1.1 Reduced Testing Frequency: Obtain the Engineer's approval in writing for the option to reduce density testing frequency to one test every two LOTs or one every four LOTs for trench box operations if the following requirements are met:

1. Resolution testing was not required for six consecutive verified LOTs.
2. Resolution testing was required for any of the six consecutive verified LOTs, but QC test data was upheld.

Identify the substantiating tests in the ERS section of the Department's database and notify the Engineer in writing prior to starting reduced frequency of testing. Generate random numbers for selecting test locations for the LOTs under consideration. When QC test frequency is reduced, obtain the Engineer's approval in writing to place more than one LOT over an untested LOT. Do not apply reduced testing frequency for the first and last lift of pipe. Assure similar compaction efforts for the untested sections. If the Verification test fails, and QC test data is not upheld by Resolution testing the QC testing will revert to the original frequency.

125-9.2 Acceptance Criteria:

125-9.2.1 Density: Obtain a minimum QC density in any LOT of 100% of the Standard Proctor maximum density as determined by FM 1-T099 or the requirements of 125-8.3.3.1 when applicable. When the cover height below the bottom of base under asphalt pavement, below concrete pavement, or below unpaved ground, exceeds 15 inches, compact the pipe backfill in the cover zone to a density of at least 95% of the Standard Proctor maximum density as determined by FM 1-T099.

For density requirements around drainage structures, obtain a minimum QC density in any LOT of 100% of the Standard Proctor maximum density as determined by FM 1-T099 for a distance of one pipe diameter but not less than 3 feet from the outside face of the structure.

125-9.2.2 Exceptions to Structures and Pipe Density Requirements: Compact the backfill to a firmness approximately equal to that of the soil next to the pipe trench in locations outside the plane described by a one (vertical) to two (horizontal) slope downward from the roadway shoulder point or the gutter line in accordance with Standard Plans, Index 120-001 or 120-002. Apply 125-9.2.1 when compacting side-drain pipe backfill under driveways serving a property that is not a single residential lot.

125-9.3 Additional Requirements:

125-9.3.1 Frequency: Conduct Standard Proctor maximum density sampling and testing at a minimum frequency of one test per soil type. The summary of tests and frequency is shown in Table 125-2 below.

Table 125-2		
Test Name	Quality Control	Verification
Standard Proctor Maximum Density	One per soil type	One per soil type
Density	One per LOT	One per four consecutive LOTs and for wet conditions, the first lift not affected by water
Soil Classification and Organic Content	One per Standard Proctor Maximum density	One per Standard Proctor Maximum density

125-10 Verification Comparison Criteria and Resolution Procedures.

Meet the requirements of 120-10.4.

125-11 Site Restoration.

Wherever the existing site is disturbed solely for the purpose of constructing or removing box culverts, pipes, inlets, manholes, etc., completely replace and restore the site to the Engineer's satisfaction, without additional compensation.

125-12 Cleaning Up.

Upon completion of the work, leave the structure and all adjacent areas in a neat and presentable condition, clear up all temporary structures, rubbish and surplus materials and leave the space under the structure unobstructed and in such shape that drift will not collect nor scour or be induced. Pile all material from existing structures that have been removed neatly on the bank, unless otherwise directed by the Engineer. Pull false work piling unless the Engineer permits it to be cut or broken off in which case it will be cut or broken off at least 2 feet below the finished grade or stream bed.

125-13 Method of Measurement.

No separate measurement or payment will be made for work under this Section.

125-14 Basis of Payment.

Payment for excavation of bridge structures will be made under Section 120. Payment for excavation of drainage system items will be incidental to those items.

SECTION 145
GEOSYNTHETIC REINFORCEMENT

145-1 Description.

This Section specifies the construction requirements for geosynthetic used in geosynthetic reinforced soil slopes, geosynthetic reinforced foundations over soft soils, and geosynthetic reinforced embankment. Furnish and place geosynthetic and any associated facing material or drainage blankets.

145-2 Responsibility.

Construct the geosynthetic reinforced feature, including materials, method, and installation based on information provided in the Contract Documents and the geosynthetic supplier's recommendations. Submit shop drawings in accordance with Section 5 showing the details and distribution of the selected geosynthetic that meet the design shown in the Plans. Alternate designs optimizing the selected geosynthetic materials must be in accordance with Chapter 263 of the FDOT Design Manual.

145-3 Materials.

145-3.1 Geosynthetic Materials: Use geosynthetic materials meeting the requirements of Section 985 and listed on the Approved Product List (APL). Ensure the geosynthetic materials received at the job site are in unopened shipping packages and the packages are clearly labeled with the manufacturer's name, product name, style number, roll dimension and LOT number, otherwise, the Engineer will reject the material. Store geosynthetic materials in accordance with the manufacturer's instructions ensuring to protect the geosynthetic material from physical damage, debris, and temperatures greater than 140° F. Prevent mud, fluid concrete, asphalt, or other deleterious materials from coming in contact with the geosynthetic materials that could impact the performance of the geosynthetic material. Replace geosynthetic materials with defects, tears, punctures, flaws, deterioration, or other damage at no additional cost to the Department.

145-3.2 Geosynthetic Reinforced Soil Slopes:

145-3.2.1 Backfill Materials: Use only free draining backfill material in the reinforced fill volume as shown in the Plans meeting the following gradation limits as determined in accordance with AASHTO T 27 and FM 1-T011:

Table 145-1	
Sieve Size	Percent Passing
3-1/2 inches	100
3/4 inch	70 to 100
No. 4	30 to 100
No. 40	15 to 100
No. 100	5 to 65
No. 200	0 to 15

Do not use backfill material containing more than an average of 2.0% by weight of organic material, as determined by FM 1-T267 and by averaging the test results for three randomly selected, representative samples from each stratum or stockpile of a particular material.

Consider the stratum or stockpile unsuitable for construction of the reinforced fill volume if an individual test value exceeds 3.0%.

Use backfill material with a maximum plasticity index of 6 as determined by AASHTO T 90, and a maximum liquid limit of 15 as determined by AASHTO T 89. Use backfill material with a pH between 5.0 and 10.0 as determined by FM 5-550. For polyester geosynthetic reinforcement, use backfill material with a pH between 5.0 and 9.0.Do not use soil cement or lime stabilized backfill unless approved by the Engineer.

145-3.2.2 Slope Face Treatment: For reinforced soil slopes, provide slope face material, if applicable, as shown in the Plans and listed on the APL.

145-3.3 Geosynthetic Reinforced Foundations Over Soft Soils: Use backfill material meeting the requirements of Section 120, all Contract Documents, and any other applicable specification requirements. Meet the pH criteria specified in 145-3.2.1 as determined by FM 5-550.

145-3.4 Geosynthetic Reinforced Embankment: Use backfill material meeting the requirements of Section 120 for Embankment, Section 160 for Stabilization, Section 200 for Rock Base, and Section 204 for Graded Aggregate Base, all Contract Documents, and any other applicable specification requirements. Meet the pH criteria specified in 145-3.2.1 as determined by FM 5-550.

145-4 Construction Requirements.

145-4.1 General: Obtain from the geosynthetic supplier, technical instructions, guidance in preconstruction activities, and on-site technical assistance during construction. Submit a copy of any instructions provided by the supplier to the Engineer prior to beginning installation.

145-4.2 Geosynthetic Reinforced Soil Slopes:

145-4.2.1 Foundation Preparation: Excavate to the limits shown in the Contract Documents. Remove all existing vegetation and all unsuitable foundation materials. Prepare the foundation in accordance with Section 110 and 120, except as noted herein.

Proof-roll the graded area with a vibratory roller weighing a minimum of 8 tons or a sheepsfoot roller, where appropriate, exerting a compression of at least 250 psi on the tamper foot for at least five passes in the presence of the Engineer or as directed by the Engineer. Remove and replace any soft or loose foundation subsoils that are incapable of sustaining the required proof rolling. Excavate to suitable foundation materials, satisfactory to the Engineer, regardless of the elevation shown in the Plans. Remove all loose and disintegrated rock or thin strata.

Ensure the proof-rolled ground surfaces are uniform, smooth, and free of abrupt changes in slope, debris, and irregularities that might damage the reinforcement. Promptly repair and restore to their original condition any areas outside the limits of disturbance shown in the Plans which are damaged as part of this work at no expense to the Department. Make every possible effort to avoid such damage.

145-4.2.2 Geosynthetic Placement: Place the geosynthetic at the proper elevation, location and orientation as shown in the Plans. In general, place the geosynthetic used for slope stabilization such that its primary direction of tensile strength is perpendicular to the plan face of the slope. Pull the geosynthetic material tight and secure it as necessary to lay flat against the soil prior to fill placement.

Place adjacent rolls of geosynthetic to maintain 100% horizontal coverage at the face of the slope. When placing geosynthetic for curved embankments, do not allow less than 50% horizontal coverage or an unreinforced horizontal spacing greater than 3 feet at the end

of the reinforcement farthest from the face of the slope. Do not allow vertical spacing of the geosynthetic layers to exceed the spacing shown in the shop drawings.

Do not make any splices or seams in the primary direction of tensile strength in the geosynthetic without approval of the Engineer. When splices in the primary direction are approved, make splices full width of the geosynthetic strip by using a similar material with similar strength. Use a splice mechanism that allows a minimum of 95% load transfer from piece to piece of geosynthetic. Make only one splice per length of geosynthetic. Do not place splices within 6 feet of the slope face, within 6 feet below top of slope, or horizontally adjacent to another splice.

Place only that amount of geosynthetic material, including facing and drainage material, which will be covered in a single days' production.

Do not operate equipment directly on the geosynthetic. Operate equipment such that no turning movements occur on the areas where geosynthetic is in place with less than 12 inches of fill cover. Fill and compact ruts of more than 3 inches in depth as they develop. Replace or repair any rejected geosynthetic at no additional cost to the Department.

145-4.2.3 Backfill Placement: Perform work in accordance with an approved QC Plan meeting the requirements of 105-3. A LOT is defined as a single lift of finished embankment not to exceed 500 feet in length. Maintain uniform moisture content of the backfill material prior to and during compaction throughout each layer of material. Use backfill material having a placement moisture content within 2% on the dry side of optimum. Do not place wet backfill with moisture content greater than optimum in the fill. Spread backfill material over the geosynthetic in the direction of geosynthetic overlaps. Do not stockpile backfill materials on the installed geosynthetic. Avoid construction procedures or equipment which, in the opinion of the Engineer, will cause excessive mudwaving.

Uniformly compact each layer, using equipment that will achieve the required density. Compact the backfill using either smooth wheel or rubber tire rollers. Do not use sheepsfoot, grid rollers, or other types of equipment employing a foot. At the end of each day's operation, slope the backfill surface to permit runoff of rainwater away from the slope face, or provide some other positive drainage. Do not exceed the maximum allowable lift thickness in Section 120.

145-4.2.4 Repairs: Repair geosynthetic damaged during or after installation only after the supplier establishes that the interior and exterior stability is not affected and after obtaining the Engineer's approval. Make such repairs as follows:

Remove all backfill material from the damaged area of the reinforcement geosynthetic plus an additional 4 feet in all directions beyond the limits of damage. Place a patch consisting of the same material as the reinforcement geosynthetic over the damaged area in accordance with the supplier's recommendation. Overlap the undamaged reinforcement geosynthetic with the patch a minimum of 3 feet in all directions. Then replace and compact backfill material in accordance with 145-4.2.3.

145-4.2.5 Slope Face Treatment: Place the slope face treatment at the elevation and location shown in the Plans and are listed on the APL, if applicable.

145-4.3 Geosynthetic Reinforced Foundations Over Soft Soils: This subsection specifies requirements for geosynthetic used to improve embankment stability by strengthening and increasing the embankment stiffness.

145-4.3.1 Preparation: For some applications involving reinforcement of soft in situ soils, the Engineer may require that some vegetation be left in place. If directed in the Plans

or by the Engineer, cut trees to within 6 inches of the existing surface, and leave the stumps in place. Remove fallen trunks, limbs, etc. greater than 3 inches in diameter.

145-4.3.2 Backfill Placement: Use materials meeting the requirements of 145-3.3. Perform work in accordance with an approved QC Plan meeting the requirements of 105-3 and Section 120 for Embankment, all Contract Documents, and any other applicable specification requirements.

145-4.3.3 Geosynthetic Placement: Meet the requirements of 145-4.2.2 except as noted herein. Position and orient the geosynthetic over prepared surfaces with the machine direction perpendicular to the embankment alignment. Place a geotextile filter of a type recommended by the designer of the geosynthetic system under the reinforcement geosynthetic.

Cut and overlap geosynthetic as necessary to accommodate curves. Overlaps shall be a minimum of 3 feet, unless specified otherwise in the Contract Documents for a particular application. Make any overlaps in geosynthetic in the same direction that embankment will be spread. Ensure geosynthetic sections do not separate at overlaps during construction. Pull the geosynthetic material tight by hand to a tension that removes all slack and wrinkles or as recommended by the supplier. To reduce overlaps, the geosynthetic material may be sewn together in accordance with the supplier's recommendations. Sew the seams with thread meeting the chemical requirements and minimum seam strength requirements for the application.

145-4.3.4 Repairs: Meet the requirements of 145-4.2.4.

145-4.4 Geosynthetic Reinforced Embankment: This subsection specifies requirements for geosynthetic used to provide structural support of traffic loads over the life of the pavement. This reinforcement application involves a relatively shallow flexible pavement substructure (embankment/subgrade/base profile) that is constructed over unsuitable soils that are at or near the ground surface.

145-4.4.1 Preparation: Remove all existing vegetation and all unsuitable foundation materials as shown in the Plans. Prepare the foundation in accordance with Section 110 and 120 or to the limits shown in the Contract Documents.

145-4.4.2 Backfill Placement: Use materials meeting the requirements of 145-3.4. Perform work in accordance with an approved QC Plan meeting the requirements of 105-3, Section 120 for Embankment, Section 160 for Stabilization, Section 200 for Rock Base, and Section 204 for Graded Aggregate Base, all Contract Documents, and any other applicable specification requirements. Spread backfill material over the reinforcement geosynthetic in the direction of the geosynthetic overlaps. Place the first lift of backfill materials over the reinforcement geosynthetic to a minimum thickness of 4 inches. Place backfill material in a manner to avoid any damage or disturbance to the geosynthetic reinforcement material

145-4.4.3 Geosynthetic Placement: Meet the requirements of 145-4.3.3.

145-4.4.3 Repairs: Meet the requirements of 145-4.2.4.

145-5 Certification.

For geosynthetic materials, submit to the Engineer the product label with the manufacturer's name, product name, style number, roll dimension and LOT number at least fourteen days prior to placement. In addition, provide two 8-inch by 10-inch samples of geosynthetic materials for product identification to the Engineer. The acceptance of the geosynthetic material is subject to the approval of the State Materials Office (SMO).

For backfill materials, submit to the Engineer a signed and sealed certification by a Professional Engineer registered in the State of Florida, that the pH meets the requirements of 145-3.

145-6 Acceptance Program.

145-6.1 General Requirements:

145-6.1.1 Equipment Comparison: Meet the requirements of 120-10.1.1.

145-6.1.2 Initial Production LOT: Meet the requirements of 120-10.1.2 except as modified herein.

145-6.1.3 Density over 105%: Meet the requirements of 120-10.1.3 except as modified herein.

145-6.2 Quality Control Tests:

145-6.2.1 Geosynthetic Reinforced Soil Slopes:

145-6.2.1.1 Maximum Density Determination: Collect enough material to split and create three separate samples. Determine test locations, including stations and offsets, using the Random Number generator approved by the Department. Retain the Verification and Resolution samples for the Department until the Engineer accepts the LOTs represented by the samples. Determine modified Proctor maximum density and optimum moisture content by sampling and testing the material in accordance FM 1-T 180.

When compacting A-3 or A-2-4 materials to meet the optional acceptance criteria in 145-6.2.1.4, determine the maximum density in accordance with FM 1-T099.

145-6.2.1.2 Soil Classification and Organic Content Testing: Perform soil classification tests on the sample collected in 145-6.2.1.1, in accordance with AASHTO T 27 and FM 1-T011, AASHTO T89, AASHTO T90, and FM 1-T267. Classify the soil in accordance with AASHTO M145 to determine compliance with soil utilization requirements as specified in Standard Plans, Index 120-001. Meet the testing parameters set forth in 145-3.2.1.

145-6.2.1.3 pH Testing: Perform pH testing in accordance with FM 5-550 and meet the pH test criteria set forth in 145-3.2.1.

145-6.2.1.4 Density Testing Requirements: Meet the requirements of 120-10.1.4.2 except as modified herein. For select backfill, obtain a density in each LOT of at least 95% of the maximum density as determined by FM 1-T180.

Alternatively, for A-3 and A-2-4 backfill materials, obtain a minimum density of 100% of the standard Proctor maximum dry density as determined by FM 1-T099.

The combined width from both reinforced fill volume and retained fill material may be considered the same LOT if both volumes comprise the same material and both are compacted with the same procedure, lift thickness, equipment, and compacting effort.

145-6.2.1.5 Frequency: Conduct sampling and testing at a minimum frequency listed in the table below. The Engineer will perform verification sampling and tests at a minimum frequency listed in the table below.

Table 145-2		
Test Name	Quality Control (QC)	Verification
Maximum Density	One per soil type	One per soil type
Density	One per LOT	One per four LOTs
Soil Classification, Gradation, LL & PI	One per soil type	One per soil type
Organic Content	One per soil type	One per soil type
pH	One per soil type	One per soil type

145-6.2.1.6 Test Selection and Reporting: Determine test locations including stations and offsets, using the random number generator approved by the Engineer. Do not use notepads or worksheets to record data for later transfer into the Earthwork Records System (ERS) section of the Department's database. Notify the Engineer upon successful completion of QC testing on each LOT.

145-6.2.2 Geosynthetic Reinforced Foundation Over Soft Soils: Meet the acceptance criteria for backfill and compaction requirements for embankment material in accordance with Section 120, all Contract Documents, and any other applicable specification requirements. In addition to the requirements of the applicable earthwork material, test for pH in accordance with FM 5-550 and meet the pH test criteria set forth in 145-3.2.1.

145-6.2.3 Geosynthetic Reinforced Embankment: Meet the acceptance criteria for backfill and compaction requirements for embankment material in accordance with Section 120, Stabilization requirements in accordance with 160, Rock Base requirements in accordance with Section 200, Graded Aggregate Base requirements in accordance with Section 204, all Contract Documents, and any other applicable specification requirements. In addition to the requirements of the applicable earthwork material, test for pH in accordance with FM 5-550 and meet the pH test criteria set forth in 145-3.2.1.

145-6.3 Department Verification: Meet the requirements of 120-10.1.5 except that the Engineer will conduct Verification tests to accept all materials and work associated with 145-6.2.

145-6.4 Payment for Resolution Tests: Meet the requirements of 120-10.1.7.

145-7 Verification Comparison Criteria and Resolution Procedures.

145-7.1 Geosynthetic Reinforced Soil Slopes:

145-7.1.1 Maximum Density Determination: The Engineer will verify the QC test results in accordance with the procedures specified in 120-10.4.1 except replace FM 1-T099 with FM 1-T180. If the Contractor selects the optional acceptance criteria, the Engineer will verify the QC test results of FM 1-T099 in accordance with 120-10.4.1.

145-7.1.2 Density Testing: Meet the requirements of 120-10.4.2.

145-7.1.3 Soil Classification, Organic Content, and pH Testing: The Engineer will verify the QC test results if the verification test results meet the limits set forth in 145-3.2.1 for gradation (AASHTO T27 and FM 1-T011), liquid limit (AASHTO T89), plasticity index (AASHTO T90), organic content (FM 1-T267), and pH (FM 5-550) testing. Otherwise, the Engineer will test the sample retained in 145-6.2.1.1. The State Materials Office (SMO) or an AASHTO accredited laboratory designated by the SMO will perform resolution testing.

If the resolution test result satisfies the required gradation limits, liquid limit, plasticity index, organic content, and pH, then the LOTs will be verified. If the resolution test

results do not verify QC test results, then reconstruct the LOTs with acceptable material. The Engineer will perform new verification testing post reconstructing the LOTs.

145-7.2 Geosynthetic Reinforced Foundations Over Soft Soils: Meet the verification comparison criteria and resolution procedure for embankment material in accordance with Section 120. In addition, the Engineer will verify the QC tests results if the verification test results meet the limits set forth in 145-3.2.1 for pH in accordance with FM 5-550. Otherwise, the Engineer will follow the resolution procedures specified in 145-7.1.3.

145-7.3 Geosynthetic Reinforced Embankment: Meet the verification comparison criteria and resolution procedure for embankment material in accordance with Section 120, Stabilization requirements in accordance with 160, Rock Base requirements in accordance with Section 200, and Graded Aggregate Base with Section 204. In addition, the Engineer will verify the QC tests results if the verification test results meet the limits set forth in 145-3.2.1 for pH in accordance with FM 5-550. Otherwise, the Engineer will follow the resolution procedures specified in 145-7.1.3.

145-8 Method of Measurement.

145-8.1 Geosynthetic Reinforced Soil Slopes: The quantity to be paid for will be the plan quantity area, in square feet, of the projected vertical height of the slope face, measured from the top of slope to the finished graded surface at the toe of slope and from the beginning to end limits as shown in the Plans, regardless of the length or number of layers of geosynthetic within the reinforced volume and including any reinforcement required below the toe of slope elevation.

145-8.2 Geosynthetic Reinforced Foundations Over Soft Soils: The quantity to be paid for will be the plan quantity area, in square yards, of the embankment to be reinforced as shown in the Plans, regardless of the length or number of layers of geosynthetic within the reinforced soil volume, and including any reinforcement required below the original ground elevation.

145-8.3 Geosynthetic Reinforced Embankment: Meet the requirements of 145-8.2.

145-9 Basis of Payment.

145-9.1 Geosynthetic Reinforced Soil Slopes: Price and payment will be full compensation for all work, materials, and services specified in this Section, including geosynthetic materials, drainage materials, installation, testing, and required submittals. The cost and placement of all backfill material will be included in the pay quantity for embankment or borrow excavation, as applicable.

145-9.2 Geosynthetic Reinforced Foundations Over Soft Soils: Price and payment will be full compensation for all work, materials, and services specified in this Section, including geosynthetic materials, geotextile filter materials, facing materials, drainage materials, installation, testing, and required submittals. The cost and placement of all backfill will be included in the pay quantity for embankment or borrow excavation, as applicable.

145-9.3 Geosynthetic Reinforced Embankment: Meet the requirements of 145-9.2

145-9.4 Payment Items: Payment will be made under:

Item No. 145- 1-	Geosynthetic Reinforced Soil Slopes - per square foot.
Item No. 145- 2-	Geosynthetic Reinforced Foundations over Soft Soils - per square yard.
Item No. 145- 3-	Geosynthetic Reinforced Embankment - per square yard.

SECTION 160
STABILIZING

160-1 Description.

Stabilize designated portions of the roadbed to provide a firm and unyielding subgrade, having the required bearing value specified in the Plans.

160-2 Materials.

160-2.1 Commercial Material: Meet the requirements of Section 914-2.1.

160-2.2 Local Material: Submit test results to the Engineer at least 14 days prior to the stabilization operation.

160-2.2.1 Local Stabilizing Material: Sample and test material from each source and meet the requirements of Section 914. The Engineer will verify the Quality Control (QC) test results meet the requirements of Section 914. If the QC and Verification results do not compare, the Engineer will take one additional sample of material from the source in question and the State Materials Office (SMO) or an AASHTO accredited laboratory designated by the SMO will perform Resolution testing. If the Resolution test results satisfy the required criteria, material from that source will be verified and accepted. If the Resolution test results do not meet the required criteria, reject the material.

160-2.2.2 Reclaimed Asphalt Pavement (RAP): Obtain the Engineer's approval in writing for the option to use 100% RAP material. Material must be milled and stockpiled without blending or contaminating with any other material.

160-2.2.3 Reclaimed Asphalt Pavement (RAP) Blended Material: RAP blended material is defined as material meeting the requirements of 914-1 and 914-2.2 except for the limits for organic content. If the RAP blended material meets the requirements of 914-1 and 914-2, then the blended material will be classified as local stabilizing material. Provide test results to the Engineer and obtain their approval in writing before using RAP blended material. The Engineer will verify that the QC test results meet the acceptance criteria, otherwise the Engineer will perform Resolution testing procedures specified in 160-2.2.1.

160-2.3 Existing Base: Obtain the Engineer's approval in writing before using existing base. When the material from an existing base is used as all, or a portion, of the stabilizing additives, no further testing is required unless directed by the Engineer.

160-2.4 Granular Subbase: The Engineer may allow, at no additional cost to the Department, the substitution of 6 inches of granular subbase meeting the requirements of 290-2 and 290-3, only when 12 inches of Type B stabilization requiring a Limerock Bearing Ratio (LBR) value of 40 is specified in accordance with Standard Plans, Index 120-001.

160-3 Construction Methods.

160-3.1 General: Prior to the beginning of stabilizing operations, construct the area to be stabilized to an elevation such that, upon completion of stabilizing operations, the completed stabilized subgrade will conform to the lines and grades shown in the Plans. Prior to spreading any additive stabilizing material, bring the surface of the roadbed to a plane approximately parallel to the plane of the finished graded surface shown in the Plans.

Construct mainline pavement lanes, turn lanes, ramps, parking lots, concrete box culverts, retaining wall systems, shoulder-only areas, sidewalk, and shared use path areas meeting the requirements of 120-8.1, except replace "embankment" with "subgrade".

Isolated mixing operations will be considered as separate LOTs. Curb pads and shoulders compacted separately shall be considered separate LOTs. Isolated compaction operations will be considered as separate LOTs. For multiple phase construction, a LOT shall not extend beyond the limits of the phase.

160-3.2 Application and Acceptance of Stabilizing Material: After completing the roadbed grading operations, determine the type and quantity (if any) of stabilizing material necessary for compliance with the bearing value requirements. Before using any Fossil Fuel Combustion Products (FFCPs), submit documentation, at the preconstruction meeting or no later than 30 days prior to delivery of FFCP's to the project, signed and sealed by the Specialty Engineer that these materials meet the requirements of 403.7047 F.S. Notify the Engineer of the approximate quantity to be added before spreading. When additive stabilizing materials are required, spread the material uniformly over the area to be stabilized.

The Engineer may perform Independent Verification (IV) sampling and testing if variability in the stabilizing material is observed during inspection after spreading on the roadway. If the IV test results do not meet the requirements of Section 914, then remove and replace the failing LOTs with acceptable material. The Engineer reserves the right to reject stabilizing material that contains excessive deleterious substances.

160-3.3 Mixing: Perform mixing using rotary tillers, a plant or other equipment meeting the approval of the Engineer. The subgrade may be mixed in one course if the equipment and method of construction provides the uniformity, particle size limitation, compaction and other desired results of 160-4. Thoroughly mix the area to be stabilized throughout the entire depth and width of the stabilizing limits.

Perform the mixing operations, as specified, (either in place or in a plant) regardless of whether the existing soil, or any select soils placed within the limits of the stabilized sections, have the required bearing value without the addition of stabilizing materials.

160-3.4 Mixed Material Requirements: At the completion of the mixing, ensure the gradation of the material within the limits of the area being stabilized is such that 97% will pass a 3-1/2 inch sieve. Break down or remove from the stabilized area materials, including clay lumps or lumps made of clay-size particles (any particle size 2 microns or less), not meeting the gradation requirements. After mixing, remove any existing lumps of clay or clay-sized particles greater than one inch that do not meet the requirements of 160-3.2 or this Section from the stabilized area. The final product must meet the acceptance requirements of 160-4.

160-3.4.1 Classification and Bearing Value: Meet the soil utilization and bearing value requirements for the subgrade in accordance with 160-4.

160-3.4.2 Compaction: After completing the mixing operations and satisfying the requirements for bearing value, uniformity, and particle size, compact the materials at a moisture content permitting the specified compaction in 160-4.2.3. If the moisture content of the material is improper for attaining the specified density, either add water or allow the material to dry until reaching the proper moisture content for the specified compaction.

160-3.4.3 Finish Grading: Shape the completed stabilized subgrade to conform with the finished graded surface shown in the Plans. Check the subgrade using elevation stakes or other means approved by the Engineer.

160-3.4.4 Condition of Completed Subgrade: After completing the stabilizing and compacting operations, ensure that the subgrade is firm and substantially unyielding to the extent that it will support construction equipment and will have the bearing value required by the Plans.

Remove all soft and yielding material, and any other portions of the subgrade which will not compact readily, and replace it with suitable material so that the whole subgrade is brought to line and grade, with proper allowance for subsequent compaction.

160-3.4.5 Maintenance of Completed Subgrade: After completing the subgrade as specified above, maintain it free from ruts, depressions, and any damage resulting from the hauling or handling of materials, equipment, tools, etc. The Contractor is responsible for maintaining the required density until the subsequent base or pavement is in place including any repairs, replacement, etc., of curb and gutter, sidewalk, etc., which might become necessary in order to recompact the subgrade in the event of underwash or other damage occurring to the previously compacted subgrade. Perform any such recompaction at no expense to the Department. Construct and maintain ditches and drains along the completed subgrade section.

160-4 Acceptance Program for Mixed Materials.

160-4.1 General Requirements:

160-4.1.1 Initial Equipment Comparison: Meet the requirements of 120-10.1.1.

160-4.1.2 Initial Production LOT: Meet the requirements of 120-10.1.2.

160-4.1.3 Density over 105%: Meet the requirements of 120-10.1.3.

160-4.1.4 Quality Control Tests:

160-4.1.4.1 Modified Proctor Maximum Density Determination: Collect enough material to split and create three separate samples. Determine test locations, including stations and offsets, using the Random Number generator approved by the Department. Retain the Verification and Resolution samples for the Department until the Engineer accepts the LOTs represented by the samples. Determine modified Proctor maximum density and optimum moisture content by sampling and testing the material in accordance FM 1-T 180.

160-4.1.4.2 Density Testing Requirements: Meet the requirements of 120-10.1.4.2.

160-4.1.4.3 Bearing Value Requirements: Test the stabilized subgrade sample collected in 160-4.1.4.1 to determine the LBR in accordance with FM 5-515. Within the entire limits of the width and depth of the areas to be stabilized, obtain the required minimum bearing value at the frequency in 160-4.4.1. For any area where the bearing value obtained is deficient from the value indicated in the Plans, in excess of the tolerances established herein, spread and mix additional stabilizing material in accordance with 160-3.3. Perform this reprocessing for the full width of the roadway being stabilized and longitudinally for a distance of 50 feet beyond the limits of the area in which the bearing value is deficient.

Determine the quantity of additional stabilizing material to be used in reprocessing.

160-4.1.4.3.1 Under-tolerances in Bearing Value Requirements: The under-tolerances are allowed for the following specified Bearing Values:

Table 160-1

Specified Bearing Value	Under-tolerance
LBR 40	5.0
LBR 35	4.0
LBR 30 (and under)	2.5

160-4.1.4.3.2 Unsoaked LBR Requirements: If unsoaked LBR is desired, submit request for approval to the Engineer. Upon approval by the Engineer to consider the use of unsoaked LBR, randomly sample and test from three locations in the initial LOT for both soaked and unsoaked LBR in accordance with FM 5-515. Ensure all of the tests achieves the LBR value shown in the table below. Continue testing unsoaked LBR at the frequency shown in 160-4.4.1. Discontinue unsoaked LBR testing if any unsatisfactory QC LBR test result is obtained or resolution determines an unsatisfactory LBR.

The following unsoaked bearing value requirement is based on tests performed on samples obtained after completing mixing operations:

Table 160-2		
Specified Bearing Value	Unsoaked Bearing Value Required	Under-tolerance
LBR 40	LBR 43	0.0

160-4.1.4.4 Soil Classification and Organic Content Testing: Perform soil classification tests on the sample collected in 160-4.1.4.1, in accordance with AASHTO T88, AASHTO T89, AASHTO T90, and FM 1-T 267. The Engineer may waive the soil classification and organic content testing requirements for existing base or granular subbase materials. Classify soils in accordance with AASHTO M145 to determine compliance with soil utilization requirements as specified in Standard Plans, Index 120-001. If the stabilizing material used is 100% RAP or RAP blended material, then replace FM 1-T 267 with FM 5-563 (excluding gradation analysis). The following testing requirements must be met.

Table 160-3	
Test Method	Criteria
AASHTO M145	Soil Symbol = S
FM 1-T 267	Average of 3 Organic Content ≤ 2.5%
	Individual Organic Content Result ≤ 4.0%
AASHTO T89	Liquid Limit ≤ 30
AASHTO T90	Plastic Index ≤ 8
FM 5-563*	Asphalt Content ≤ 4.0%
* Replace FM 1-T 267 with FM 5-563 (excluding gradation analysis) for 100% RAP or RAP blended material	

160-4.1.5 Department Verification: Meet the requirements of 120-10.1.5 except the Engineer will conduct the Verification tests in order to accept all materials and work associated with 160-4.1.4.

160-4.1.6 Reduced Testing Frequency: Meet the requirements of 120-10.1.6.

160-4.1.7 Payment for Resolution Tests: Meet the requirements of 120-10.1.7.

160-4.2 Mixing Depth Requirements: Report depth requirements in the Earthwork Records System (ERS) section of the Department's database measured to the nearest 0.25 inch. The difference between the individual measured depth thickness on the roadway and the plan target thickness must not exceed 2 inches. The difference between the LOT average (average of

the three individual measured depth thickness) and the plan target thickness must not exceed 1 inch. No undertolerance of mixing depth is allowed.

As an exception to the above mixing requirements, where the subgrade is of rock, the Engineer may waive the mixing operations (and the work of stabilizing), and the Department will not pay for stabilization for such sections of the roadway.

Meet the required Plan mixing-depths by measuring from the proposed final grade line. Determine test locations, including stations and offsets, using the Random Number generator approved by the Department. Notify the Engineer a minimum of 24 hours before checking mixing depths. Record results on Department approved forms.

160-4.3 Density Acceptance Criteria:

160-4.3.1 General: Within the entire limits of the width and depth of the areas to be stabilized, other than as provided in 160-4.3.2, obtain a minimum density at any location of 98% of the Modified Proctor maximum density as determined by FM 1-T 180.

160-4.3.2 Exceptions to Density Requirements: The Contractor need not obtain the minimum density specified in 160-4.3.1 in the upper 6 inches of areas to be grassed under the same Contract. Compact these areas to a reasonably firm condition as directed by the Engineer.

160-4.4 Additional Requirements:

160-4.4.1 Frequency: Conduct QC sampling and testing at a minimum frequency listed in the table below. The Engineer will perform Verification sampling and tests at a minimum frequency listed in the table below.

Table 160-4

Test Name	Quality Control	Verification	Verification for Shoulder-Only, Shared Use Path and Sidewalk Construction
Modified Proctor Maximum Density	One per two consecutive LOTs	One per eight consecutive LOTs	One per four LOTs
LBR			
Gradation, LL/PI, and Soil Classification			
Organic Content			
Asphalt Content*			
Density	One per LOT	One per four LOTs	One per two LOTs
Stabilizing Mixing Depth	Three per 500 feet	Witness QC	Witness QC

*Replace organic content with asphalt content for 100% RAP or RAP blended material only.

160-4.5 Verification Comparison Criteria and Resolution Procedures:

160-4.5.1 Bearing Value: The Engineer will collect a sample at a location other than the location where the sample was collected in 160-4.1.4.1, and test the stabilized subgrade for determination of the LBR in accordance with FM 5-515. The Engineer will select test locations, including stations and offsets, using a Random Number generator, based on the LOTs under consideration.

160-4.5.1.1 Unsoaked LBR: The Engineer will sample and test the initial LOT for one soaked and one unsoaked LBR if consideration of the unsoaked LBR has been approved.

160-4.5.1.2 Resolution Procedure: If the Department's Verification test meets the requirements of 160-4.1.4.3, the Engineer will accept the corresponding LOTs. Otherwise, the Engineer will collect an additional sample in the same LOT the Verification sample was obtained. SMO or an AASHTO accredited laboratory designated by SMO will perform Resolution testing on the additional sample. The material will be sampled and tested in accordance with FM 5-515.

If the resolution testing results meet the requirements of 160-4.1.4.3, then the Engineer will accept the LOTs in question. Otherwise reprocess the corresponding LOTs in accordance with 160-3 and retest in accordance with 160-4.1.4.3.

160-4.5.2 Modified Proctor Maximum Density Determination: The Engineer will randomly select one of the retained split samples referenced in 160-4.1.4.1. The Engineer will compare the Verification test results to the corresponding Quality Control (QC) test results. If the test result is within 4.5 lb/ft^3 of the QC test result, the LOTs will be verified. Otherwise, the Engineer will collect the Resolution split sample corresponding to the Verification sample tested. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office will perform Resolution testing. The material will be sampled and tested in accordance with FM 1-T 180.

The Engineer will compare the Resolution Test (RT) results with the QC test results. If the RT result is within 4.5 lb/ft^3 of the corresponding QC test result, the Engineer will use the QC test results for material acceptance purposes for each corresponding pair of LOTs. If the RT result is not within 4.5 lb/ft^3 of the corresponding QC test, the Engineer will collect and test the remaining Verification split samples for the LOTs in question. Verification test results will be used for material acceptance purposes for the remaining LOTs in question.

160-4.5.3 Density Testing: Meet the requirement of 120-10.4.2

160-4.5.4 Soil Classification: Meet the requirements of 120-10.4.3 with the exception that the limits will be in accordance with 160-4.1.4.4.

160-4.5.5 Organic Content: Meet the requirements of 120-10.4.4 with the exception that the limits will be in accordance with 160-4.1.4.4.

160-4.5.6 Asphalt Content: If the material used to stabilize is 100% RAP or RAP blended material, meet the requirement of 120-10.4.4, except replace FM 1-T 267 with FM 5-563 (exclude gradation analysis) and meet the limits of 160-4.1.4.4.

160-4.5.7 Mixing Depth: The Engineer will witness the Contractor's mixing depth checks to ensure compliance with 160-4.2. The Engineer will select test locations, including stations and offsets, using a Random Number generator. The Department will witness the mixing depth checks.

1. If the depth checks meet the requirements of 160-4.2, the Engineer will accept that 500-foot section.

2. If the depth checks confirm shallow depth, re-mix the 500-foot section to an appropriate depth and re-measure in accordance with 160-4.2. The Engineer will repeat the witness process.

3. If the depth checks confirm extra deep mixing, conduct an additional QC density test after compaction for the bottom 12 inches of the subgrade for that 500-foot

section in addition to a QC density test for the top 12 inches. The additional density test must meet the requirements of 160-4.3.

160-4.6 Disposition of Defective Materials: Meet the requirements of 120-10.5.

160-5 Method of Measurement.

The quantity to be paid for will be the plan quantity, in square yards, completed and accepted.

160-6 Basis of Payment.

Price and payment will constitute full compensation for all work and materials specified in this Section, including furnishing, spreading and mixing of all stabilizing material required and any reprocessing of stabilization areas necessary to attain the specified bearing value. The Department will make full payment for any areas where the existing subgrade materials meet the design bearing value requirements without the addition of stabilizing additives, as well as areas where the Contractor may elect to place select high-bearing materials from other sources within the limits of the stabilizing.

If the item of borrow excavation is included in the Contract, any stabilizing materials obtained from designated borrow areas will be included in the pay quantity for borrow excavation.

Payment will be made under:

Item No. 160- 4- Stabilization - per square yard.

SECTION 175
CRACKING AND RESEATING EXISTING CONCRETE PAVEMENT

175-1 Description.

Perform controlled cracking of concrete pavement and reseating of the cracked slabs, by rolling, tamping, etc., on the underlying subgrade to provide a firm base for asphalt concrete surfacing.

175-2 Equipment.

175-2.1 For Cracking: Provide pneumatic or gravity-type breakers, or other specifically approved equipment that ensures controlled cracking to the size and extent of uniformity, etc., specified. Control the fall of gravity-type breakers by leads so that the fall will be straight and vertical. Use hammers for both pneumatic and gravity-type breakers of a type that will crack the concrete cleanly and not punch or unnecessarily shatter the concrete.

175-2.2 For Reseating Provide vibratory compacting equipment or traffic rollers. Use traffic rollers that weigh at least 15 tons.

175-3 Construction Requirements.

175-3.1 Protection of New Construction and Adjacent Structures: Perform cracking and reseating work prior to beginning all new construction which this work might endanger or disturb. Perform cracking and reseating in a manner that will not damage any existing structures which are to remain, and repair any damage to such structures that this work causes by this work at no expense to the Department.

175-3.2 Cracking and Seating: For the cracked slabs, make clean fractures, as near vertical as practicable. Do not punch the pieces into the subgrade, but firmly seat them thereon, to as uniform a contour as is practicable.

175-3.3 Special Requirements for Asphalt-Surfaced Pavement: Where the existing concrete pavement is covered with an asphalt surface, remove the asphalt surfacing (after the cracking operation) on test areas approximately 10 by 10 feet, at locations selected by the Engineer, in order to determine if the required results are being obtained in the cracking operations. Prepare at least one such test area for each day's operation, and prepare additional areas if deemed necessary by the Engineer.

175-3.4 Dimensions of Slabs: Ensure that the cracked slabs have no dimension greater than 3 feet. In the event that the required results in the cracking are not being obtained, adjust the spacing of blows or the height of drop of the blows as necessary to obtain the required results with the equipment being used.

175-4 Method of Measurement.

The quantity to be paid for will be the plan quantity, in square yards, of existing concrete pavement acceptably cracked and reseated on the subgrade.

175-5 Basis of Payment.

Price and payment will be full compensation for performing and completing all work specified in this Section.

Payment will be made under:

Item No. 175- 1- Reseating Concrete Pavement - per square yard.

SECTION 200
ROCK BASE

200-1 Description.

Construct a base composed of base rock. Do not use recycled concrete aggregate (RCA) base on interstate roadways.

200-2 Materials.

200-2.1 General: Meet the requirements of Section 911for the particular type of base to be constructed. The Contractor may use more than one source of base rock on a single Contract provided that a single source is used throughout the entire width and depth of a section of base. Obtain approval from the Engineer before placing material from more than one source. Place material to ensure total thickness single source integrity at any station location of the base. Intermittent placement or "blending" of sources is not permitted. Base rock may be referred to hereinafter as "rock".

The reuse of existing base may be considered provided it meets the requirements of this Section. Submit as a Cost Savings Initiative Proposal in accordance with Section 4.

200-2.2 Existing Rock: Meet the following requirements for use of existing rock on the same project:

1. Notify the Engineer in writing prior to excavating existing rock. Do not mill any existing rock from the roadway.
2. Submit a process control plan, herein referred to as "Plan" consisting of the following:
    a. Locations where existing rock will be removed from the roadway.
    b. Locations where existing rock will be used for new construction.
    c. Method of excavation, transport, and placement to ensure excavated rock will be kept separate from other approved stockpiles. Excavation methods that may result in damage to the rock rendering it unfit to be used as base will not be approved.
    d. Proposed measures to prevent contamination and segregation.
    e. Proposed locations and methods for constructing stockpiles for sampling and testing.
    f. Method for sampling and reporting test results.
3. The Engineer will coordinate the review of the "Plan" with the District Materials Office.
4. Upon the Engineer's review of the "Plan", build a preliminary stockpile, not to exceed 1,000 cubic yards.
5. Collect and test a minimum of three samples from the preliminary stockpile. Once the stockpile has been sampled, do not add any additional material to the stockpile. Determine compliance with 200-2.1, with the exception of carbonate contents. Reject any stockpile if the Limerock Bearing Ratio (LBR) is less than 100. Engineer will sample and test the preliminary stockpile to verify compliance with this Section.
6. If all test results meet the requirements of this Section, the Engineer will notify the Contractor in writing of the approved status of the preliminary stockpile based on the analysis of test data performed by the District Materials Office.

7. If the use of existing rock is approved, continue to produce additional stockpiles not exceeding 1,000 cubic yards. Ensure the rock meets the requirements of this Section by sampling and testing each new stockpile at a minimum frequency of one sample per 400 cubic yards. Once a stockpile has been sampled, do not add additional material to that stockpile. The District Materials Office may also perform sampling and testing. Materials will be accepted if test results meet the requirements of this Section.

8. After 10 consecutive quality control (QC) LBR test results meet the requirements of the Section and no individual LBR test is less than 120, the sampling and testing frequency may be reduced to a minimum frequency of one sample per 800 cubic yards for each stockpile. Notify the Engineer in writing prior to reducing testing frequency. If any QC LBR test result falls below 120 or a stockpile is rejected, revert to original sampling frequency of one sample per 400 cubic yards.

9. Construct a new preliminary stockpile if there is a change in material, conditions not addressed in the "Plan" are encountered, or if production varies from the approved "Plan".

200-3 Equipment.

Use mechanical rock spreaders, equipped with a device that strikes off the rock uniformly to laying thickness, capable of producing even distribution. For crossovers, intersections and ramp areas; roadway widths of 20 feet or less; the main roadway area when forms are used and any other areas where the use of a mechanical spreader is not practicable; the Contractor may spread the rock using bulldozers or blade graders.

200-4 Transporting Rock.

Transport the rock to its point of use, over rock previously placed, if practicable, and dump it on the end of the preceding spread. Hauling and dumping on the subgrade will be permitted only when, in the Engineer's opinion, these operations will not be detrimental to the subgrade.

200-5 Spreading Rock.

200-5.1 Method of Spreading: Spread the rock uniformly. Remove all segregated areas of fine or coarse rock and replace them with properly graded rock.

200-5.2 Number of Courses: When the specified compacted thickness of the base is greater than 6 inches, construct the base in multiple courses of equal thickness. Individual courses shall not be less than 3 inches. The thickness of the first course may be increased to bear the weight of the construction equipment without disturbing the subgrade.

If, through field tests, the Contractor can demonstrate that the compaction equipment can achieve density for the full depth of a thicker lift, and if approved by the Engineer, the base may be constructed in successive courses of not more than 8 inches compacted thickness. The Engineer's approval of thick lift compaction will be based on results of a successful test section constructed using the Contractor's specified compaction effort. Notify the Engineer prior to beginning construction of a test section. Construct a test section of the length of one full LOT. Perform two sets of QC density tests per source at random locations within the test section. Each set will include five density tests. One set will include the entire lift thickness and the second set a dig down test of the bottom 6 inches at the same location where the thick lift test was taken.

All QC tests and a Department Verification test must meet the density required by 200-7.2.1. Identify the test section with the compaction effort and thickness in the Earthwork Records System (ERS) portion of the Department's database. Remove the materials above the bottom 6 inches, at no expense to the Department. After completion of a successful test section, the minimum density required on the thicker lift from thereon will be the average of the five density test results obtained on the thick lift.

Maintain the exposed surface as close to "undisturbed" as possible; no further compaction will be permitted during the test preparation. If unable to achieve the required density, remove and replace or repair the test section to comply with the specifications at no additional expense to the Department. The Contractor may elect to place material in 6 inches compacted thickness at any time.

Once approved, a change in the source of base material will require the construction of a new test section. Do not change the compaction effort once the test section is approved. The Engineer will periodically verify the density of the bottom 6 inches during thick lift operations.

The Engineer may terminate the use of thick lift construction and instruct the Contractor to revert to the 6 inches maximum lift thickness if the Contractor fails to achieve satisfactory results or meet applicable specifications.

200-5.3 Rock Base for Shoulder Pavement: Unless otherwise permitted, complete all rock base shoulder construction at any particular location before placing the final course of pavement on the traveled roadway. When dumping material for the construction of a rock base on the shoulders, do not allow material capable of scarring or contaminating the pavement surface on the adjacent pavement. Immediately sweep off any rock material that is deposited on the surface course.

200-6 Compacting and Finishing Base.

200-6.1 General: Construct mainline pavement lanes, turn lanes, ramps, parking lots, concrete box culverts and retaining wall systems meeting the requirements of 120-8.1, except replace "embankment" with "base".

Construct shoulder-only areas, shared use paths, and sidewalks. Meet the requirements of 120-8.1 except replace "embankment" with "base" meeting the acceptance criteria of 200-7.2. Shoulders compacted separately shall be considered separate LOTs.

200-6.1.1 Single Course Base: After spreading, scarify the entire surface, then shape the base to produce the required grade and cross slope, free of scabs and laminations, after compaction.

200-6.1.2 Multiple Course Base: Clean the first course of foreign material, then blade and bring it to a surface cross slope approximately parallel to the finished base. Before spreading any material for the upper courses, allow the Engineer to make density tests for the lower courses to determine that the required compaction has been obtained. After spreading the material for the top course, scarify finish and shape its surface to produce the required grade and cross slope, free of scabs and laminations, after compaction.

200-6.2 Moisture Content: When the material does not have the proper moisture content to ensure the required density, wet or dry it as required. When adding water, uniformly mix it in to the full depth of the course that is being compacted. During wetting or drying operations, manipulate, as a unit, the entire width and depth of the course that is being compacted.

200-6.3 Thickness Requirements: Within the entire limits of the length and width of the finished base, meet the specified plan thickness in accordance with the requirements of 200-7.3.1.2.

200-6.4 Correction of Defects:

200-6.4.1 Contamination of Base Material: If, at any time, the subgrade material becomes mixed with the base course material, dig out and remove the mixture, and reshape and compact the subgrade. Then replace the materials removed with clean base material, and shape and compact as specified above. Perform this work at no expense to the Department.

200-6.4.2 Cracks and Checks: If cracks or checks appear in the base, either before or after priming, which, in the opinion of the Engineer, would impair the structural efficiency of the base, remove the cracks or checks by rescarifying, reshaping, adding base material where necessary, and recompacting.

200-6.5 Compaction of Widening Strips: Where base construction consists of widening strips and the trench width is not sufficient to permit use of standard base compaction equipment, compact the base using vibratory compactors, trench rollers or other special equipment which will achieve the density requirements specified herein.

When multiple course base construction is required, compact each course prior to spreading material for the overlaying course.

200-7 Acceptance Program.

200-7.1 General Requirements: Meet the requirements of 120-10, except exclude the requirements of 120-10.1.4.3, 120-10.3.1, 120-10.4.3, and 120-10.4.4. Use 200-7.3.1.1 instead of 120-10.1.4.1, 200-7.2 instead of 120-10.2, and 200-7.4.1 instead of 120-10.4.1.

200-7.2 Acceptance Criteria:

200-7.2.1 Density: Within the entire limits of the width and depth of the base, obtain a minimum density in any LOT of 98% of modified Proctor maximum density as determined by FM 1-T180 or the Pit Proctor when using the Pit Proctor option. For shoulder only areas and shared use paths, obtain a minimum density of 95% of the modified Proctor maximum density as determined by FM 1-T180 or the Pit Proctor when using the Pit Proctor option.

200-7.2.2 Frequency: Conduct QC sampling and testing at a minimum frequency listed in the table below. The Engineer will perform Verification sampling and tests at a minimum frequency listed in the table below.

Table 200-1
Mainline Pavement Lanes, Turn Lanes, Ramps, Parking Lots, Concrete Box Culverts and Retaining Wall Systems

Test Name	Quality Control	Verification
Modified Proctor Maximum Density	One per eight consecutive LOTs	One per 16 consecutive LOTs
Density	One per LOT	One per four LOTs
Roadway Surface and Cross Slope	One per LOT	One per two LOTs
Roadway Thickness	Three per LOT	Witness

Table 200-2 Shoulder-Only, Shared Use Path and Sidewalk Construction		
Test Name	Quality Control	Verification
Modified Proctor Maximum Density	One per two LOTs	One per four LOTs
Density	One per LOT	One per two LOTs
Surface and Cross Slope	One per LOT	One per two LOTs
Thickness	Three per 1000 consecutive feet	Witness

200-7.2.3 Pit Proctor: In lieu of Modified Proctor Maximum Density testing at the roadway, notify the Engineer in writing that the Contractor option to use the Pit Proctor supplied by the Department will be used. The Modified Proctor maximum density frequency requirements of 200-7.2.2 shall not apply. The Department will determine the Pit Proctor from statistical analysis of the base rock Modified Proctor maximum density at Department approved mines. For posting of Mines and Pit Proctors for each calendar quarter refer to the Pit Proctor Quarterly report located at the following URL: https://www.fdot.gov/materials/laboratory/geotechnical/aggregates/pitproctor/index.shtm. Use the current posted Pit Proctor value in lieu of the Modified Proctor maximum density required by 200-7.2.1. Use the current posted Pit Proctor value for density acceptance during the quarter corresponding to the posting. Notify the Engineer in writing if returning to the provisions of 200-7.2 and 200-7.2.2 but do not re-elect to use the Pit Proctor until the start of the next calendar quarter.

200-7.3 Additional Requirements:

200-7.3.1 Quality Control Testing:

200-7.3.1.1 Modified Proctor Maximum Density Requirement: Collect enough material to split and create three separate samples and retain two for the Engineer's Verification and Resolution testing until the Engineer accepts the 16 LOTs represented by the samples.

200-7.3.1.2 Thickness and Surface Testing Requirements: Notify the Engineer a minimum of 24 hours before checking base depths and surface checking. Determine test locations including Stations and Offsets, using the Random Number generator approved by the Department. Do not perform depth and surface checks until the Engineer is present to witness. Enter test results into the Department's database. Perform thickness check on the finished base or granular subbase component of a composite base. Provide traffic control, coring/boring equipment, and an operator for the coring/boring equipment. Traffic control is to be provided in accordance with the standard maintenance of traffic requirements of the Contract.

The thickness is considered deficient, if the measured depth is over 1/2 inch less than the specified thickness. Correct all deficient areas of the completed base by scarifying and adding additional base material. As an exception, if authorized by the Department, such areas may be left in place without correction and with no payment.

Check the finished surface of the base course using a Global Navigation Satellite System enabled Automated Machine Guidance technology in accordance with Section 5. Alternately, the finished surface of the base course can be verified using stringline method with stakes or with a template cut to the required crown and with a 15-foot straightedge laid parallel to the centerline of the road. Correct all irregularities greater than ¼-

inch to the satisfaction of the Engineer by scarifying and removing or adding rock as required, and recompact the entire area as specified hereinbefore.

200-7.3.1.2.1 Thickness and Surface Reduced Testing Frequency: When no Resolution testing is required for 12 consecutive verified LOTs, or if required, the QC test data was upheld, reduce the QC surface and/or thickness checks to one half the minimum requirements as stated in 200-7.2.2 (e.g., reduce frequency from ten per LOT to ten per two LOTs) by identifying the substantiating tests and notifying the Engineer in writing prior to starting reduced frequency of testing. If the Verification test fails, and QC test data is not upheld by Resolution testing the QC testing will revert to the original frequency of 200-7.2.2. The results of the Independent Verification testing will not affect the frequency of the QC testing. Do not apply reduced testing frequency in construction of shoulder-only areas, shared use paths, and sidewalks.

200-7.3.1.3 Cross Slope: Construct base surface course to conform to the lines and grades shown in the Plans. Furnish a level with a minimum length of 4 feet with a digital slope measuring device approved by the Engineer for control of the cross slope. Make this level available at the jobsite at all times during base construction operations.

Measure the cross slope of the base surface by placing the measuring device perpendicular to the roadway centerline. Report the cross slope to the nearest 0.1%. Record all the measurements and submit to the Engineer for documentation. Measure the cross slope at a minimum frequency of one measurement per LOT to ensure the cross slope is uniform and in compliance with the design cross slope. When the difference between the measured cross slope and the design cross slope exceeds ±0.2% for travel lanes including turn lanes or ±0.5% for shoulders, make all corrections to bring the cross slope to acceptable range by scarifying and removing or adding rock as required, and recompact the entire area as specified hereinbefore.

200-7.3.1.4 Elevation Data Collection: Within curb-and-gutter and widening areas, record the elevation of finished surface of base course every 500 feet by measuring the elevation of base adjacent to curb and gutter, as well as at each lane edge location. Provide the elevation measurements to the Engineer.

200-7.3.2 Department Verification Tests:

200-7.3.2.1 Maximum Density: The Engineer will randomly select one of the remaining two split samples and test in accordance with FM 1-T180.

200-7.3.2.2 Thickness and Surface Testing Requirements: The Department will witness the base depth and surface checks to ensure compliance with 200-7.3.1.2. If the QC test results are not deficient as defined in 200-7.3.1.2, the LOT or 500-foot section will be accepted. If the QC test results are deficient, resolve deficiencies in accordance with 200-7.3.1.2. Repeat acceptance testing. Provide traffic control, coring/boring equipment, and an operator for the coring/boring equipment.

200-7.3.2.3 Cross Slope: The Engineer will take cross slope measurements at random locations at a frequency of one per two LOTs.

200-7.4 Verification Comparison Criteria and Resolution Procedures:

200-7.4.1 Modified Proctor Maximum Density: The Engineer will compare the Verification test results of 200-7.3.2.1 to the corresponding QC test results. If the test result is within 4.5 lb/ft^3 of the QC test result, the LOTs will be verified. Otherwise, the Engineer will collect the Resolution split sample corresponding to the Verification sample tested. The State Materials Office or an AASHTO accredited laboratory designated by the State Materials Office

will perform Resolution testing. The material will be sampled and tested in accordance with FM 1-T180.

The Engineer will compare the Resolution Test results with the QC test results. If the Resolution Test result is within 4.5 lb/ft^3 of the corresponding QC test result, the Engineer will use the QC test results for material acceptance purposes for each corresponding set of LOTs. If the Resolution test result is not within 4.5 lb/ft^3 of the corresponding QC test, the Engineer will collect the remaining Verification split sample for testing. Verification Test results will be used for material acceptance purposes for the LOTs in question**.**

200-7.4.2 Pit Proctor: When using the Pit Proctor option, the Engineer will select a random location to sample and test at the minimum frequency in the table below, to obtain an Independent Verification (IV) maximum density as determined by FM 1-T180. The Engineer will collect enough material to split and hold a sample for Resolution testing.

Table 200-3		
Test Name	Mainline Pavement Lanes, Turn Lanes, Ramps, Parking Lots, Concrete Box Culverts and Retaining Wall Systems	Shoulder-Only, Shared Use Path and Sidewalk Construction
IV Modified Proctor Maximum Density	One per 16 consecutive LOTs	One per 4 consecutive LOTs

The Engineer will compare the IV results with the Pit Proctor. If the IV result is lower than or equal to the Pit Proctor plus 4.5 pcf, keep the option to use the Pit Proctor. If the IV result is more than 4.5 pcf higher than the Pit Proctor the Engineer will test the Resolution sample and compare the Resolution result with the Pit Proctor. If the Resolution result is lower than or equal to the Pit Proctor plus 4.5 pcf, keep the option to use the Pit Proctor. Otherwise return to the provisions of 200-7.2.2, 200-7.3.1.1, 200-7.3.2.1, and 200-7.4.1.

200-7.4.3 Density: When a Verification or Independent Verification density test does not meet the requirements of 200-7.2.1 (Acceptance Criteria), meet the resolution requirements of 120-10.4.2.

200-7.4.4 Surface Testing Requirements: Resolve deficiencies in accordance with 200-7.3.1.2.

200-7.4.5 Cross Slope: The Engineer will verify the Contractor's cross slope measurements if the average cross slope of ten random measurements does not exceed the allowable tolerance from the design cross slope (±0.2% for travel lanes including turn lanes and ±0.5% for shoulders). Otherwise reprocess the LOTs in question by making corrections in accordance with 200-7.3.1.3 to bring the cross slope to acceptable range. A recheck of the cross slope will be made following any corrections or additional work performed on the base surface. This process will be repeated until the base cross slope meets the requirements of this specification.

The Engineer may waive the corrections specified above at no reduction in payment if the following conditions are met:

1. the deficiencies are sufficiently separated so as not to affect the overall ride quality, traffic safety, and surface drainage characteristics of the pavement.

2. the Contractor agrees to use asphalt to fill in areas where the earthwork is low at no additional cost to the Department when the overall project amount is greater than the 10% allowed in Sections 234, 334, 337, and 339.

For intersections, tapers, crossovers, transitions at beginning and end of project and similar areas, adjust the cross slope to match the actual site conditions or as directed by the Engineer.

200-8 Priming and Maintaining.

200-8.1 Priming: Apply the prime coat only when the base meets the specified density requirements and when the moisture content in the top half of the base does not exceed the optimum moisture of the base material. At the time of priming, ensure that the base is firm, unyielding and in such condition that no undue distortion will occur. Ensure the prime coat adheres to the base course.

200-8.2 Maintaining: Maintain the true crown and template, with no rutting or other distortion, while applying the surface course.

200-9 Calculations for Average Thickness of Base.

For bases that are not mixed in place, the Engineer will determine the average thickness from the measurements specified in 200-10.1, calculated as follows:

1. When the measured thickness is more than 1/2 inch greater than the design thickness shown on the typical section in the Plans, it will be considered as the design thickness plus 1/2 inch.

2. Average thickness will be calculated per typical section for the entire job as a unit.

3. Any areas of base left in place with no payment will not be included in the calculations.

4. Where it is not possible through borings to distinguish the base materials from the underlying materials, the thickness of the base used in the measurement will be the design thickness.

200-10 Method of Measurement.

200-10.1 General: The quantity to be paid for will be the plan quantity, adjusted as specified below.

200-10.2 Authorized Normal Thickness Base: The surface area of authorized normal thickness base to be adjusted will be the plan quantity as specified above, omitting any areas not allowed for payment under the provisions of 200-6.3 and omitting areas which are to be included for payment under 200-10.3. The adjustment shall be made by adding or deducting, as appropriate, the area of base represented by the difference between the calculated average thickness, determined as provided in 200-9, and the specified normal thickness, converted to equivalent square yards of normal thickness base.

200-10.3 Authorized Variable Thickness Base: Where the base is constructed to a compacted thickness other than the normal thickness as shown on the typical section in the Plans, as specified in the Plans or ordered by the Engineer for providing additional depths at culverts or bridges, or for providing transitions to connecting pavements, the volume of such authorized variable thickness compacted base will be calculated from authorized lines and grades, or by other methods selected by the Engineer, converted to equivalent square yards of normal thickness base for payment.

200-11 Basis of Payment.

Price and payment will be full compensation for all the work specified in this Section, including dust abatement, correcting all defective surface and deficient thickness, removing cracks and checks as provided in 200-6.4.2, the prime coat application as directed in 300-8, and the additional rock required for crack elimination.

Payment shall be made under:

Item No. 285- 7- Optional Base - per square yard.

SECTION 204
GRADED AGGREGATE BASE

204-1 Description.

Construct a base course composed of graded aggregate.

204-2 Materials.

Use graded aggregate material, produced from Department approved sources, which yields a satisfactory mixture meeting all the requirements of these Specifications after it has been crushed and processed as a part of the mining operations.

The Contractor may furnish the material in two sizes of such gradation that, when combined in a central mix plant pugmill, the resultant mixture meets the required specifications.

Use graded aggregate base material of uniform quality throughout, substantially free from vegetable matter, shale, lumps and clay balls, and having a Limerock Bearing Ratio value of not less than 100. Use material retained on the No. 10 sieve composed of aggregate meeting the following requirements:

Soundness Loss, Sodium, Sulfate: AASHTO T104 ..... 15%

Percent Wear: AASHTO T 96 (Grading A)

Group 1 Aggregates 45%

Group 2 Aggregates 65%

Group 1: This group of aggregates is composed of limestone, marble, or dolomite.

Group 2: This group of aggregates is composed of granite, gneiss, or quartzite.

Use graded aggregate base material meeting the following gradation:

Table 204-1

Sieve Size	Percent by Weight Passing
2 inch	100
1-1/2 inch	95 to 100
3/4 inch	65 to 90
3/8 inch	45 to 75
No. 4	35 to 60
No. 10	25 to 45
No. 50	5 to 25
No. 200	0 to 10

For Group 1 aggregates, ensure that the fraction passing the No. 40 sieve has a Plasticity Index (AASHTO T 90) of not more than 4.0 and a Liquid Limit (AASHTO T 89) of not more than 25, and contains not more than 67% of the weight passing the No. 200 sieve.

For Group 2 aggregates, ensure that the material passing the No. 10 sieve has a sand equivalent (AASHTO T 176) value of not less than 28.

The Contractor may use graded aggregate of either Group 1 or Group 2, but only use one group on any Contract. (Graded aggregate may be referred to hereinafter as “aggregate”.)

204-3 Equipment.

Provide equipment meeting the requirements of 200-3.

204-4 Transporting Aggregate.

Transport aggregate as specified in 200-4.

204-5 Spreading Aggregate.

Spread aggregate as specified in 200-5.

204-6 Compacting and Finishing Base.

204-6.1 General: Meet the requirements of 200-7.1 with density requirements of 204-6.3.

204-6.1.1 Single-Course Base: Construct as specified in 200-6.1.1.

204-6.1.2 Multiple-Course Base: Construct as specified in 200-6.1.2.

204-6.2 Moisture Content: Meet the requirements of 200-6.2.

204-6.3 Density Requirements: After attaining the proper moisture conditions, uniformly compact the material to a density of not less than 100% of the maximum density as determined by FM 1-T 180, Method D. For shoulder only areas and shared use paths, obtain a minimum density of 98% of the maximum density as determined by FM 1-T 180, Method D.

204-6.4 Density Tests: Meet the requirements of 200-7.2.2.

204-6.5 Correction of Defects: Meet the requirements of 200-6.4.

204-6.6 Dust Abatement: Minimize the dispersion of dust from the base material during construction and maintenance operations by applying water or other dust control materials.

204-7 Testing Surface.

Test the surface in accordance with the requirements of 200-7.

204-8 Priming and Maintaining.

Meet the requirements of 200-8.

204-9 Thickness Requirements.

Meet the requirements of 285-6.

204-10 Calculations for Average Thickness of Base.

Calculations for determining the average thickness of base will be made in accordance with 285-7.

204-11 Method of Measurement.

204-11.1 General: The quantity to be paid for will be the plan quantity area, in square yards, completed and accepted.

204-11.2 Authorized Normal Thickness Base: The surface area of authorized normal thickness base will be the plan quantity area, omitting any areas not allowed for payment under the provisions of 204-9 and omitting areas which are to be included for payment under 204-11.3. The area for payment, of authorized normal thickness base, will be the surface area determined as provided above, adjusted by adding or deducting, as appropriate, the area of base represented by the difference between the calculated average thickness, determined as provided in 204-10, and the specified normal thickness, converted to equivalent square yards of normal thickness base.

204-11.3 Authorized Variable Thickness Base: As specified in 200-10.3.

204-12 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including dust abatement, correcting all defective surface and deficient thickness, removing cracks and checks and the additional aggregate required for such crack elimination.

Payment will be made under:

Item No. 285- 7- Optional Base - per square yard.

SECTION 210
REWORKING LIMEROCK BASE

210-1 Description.

Rework (or rework and widen) the existing rock base, by adding new limerock material as required by the Plans. Construct adjacent turnouts, entirely with new limerock.

210-2 Materials.

Meet the following requirements:

Limerock ..... Section 911
Prime Coat ..... Section 300

210-2.1 Limerock: Meet the limerock material requirements as specified in Section 911 if new limerock is needed. The Contractor may use limerock of either Miami Oolite or Ocala Formation but only use limerock of one formation on any Contract.

210-3 Equipment.

Provide equipment meeting the requirements of 200-3.

210-4 Existing Bituminous Surfaces.

210-4.1 Asphalt Concrete: Remove asphalt concrete surfaces from the base prior to excavating trenches or scarifying the rock. Dispose of removed materials as specified in 120-5.

210-4.2 Bituminous Surface Treatment: Remove and dispose of existing bituminous surface treatment only when specifically specified in the Plans. Otherwise, the Contractor may mix the existing bituminous surfacing in with the existing limerock material.

210-5 Trenches and Subgrade.

Where widening the existing base, excavate trenches along the edges of the existing pavement to the width and depth indicated in the Plans. Excavate the trenches before scarifying the existing base. Shape, compact, and maintain the subgrade of the trenches and turnouts as specified in 120-9, except that when stabilization of the subgrade is not included in the Plans, do not compact the trenches unless the native underlying material has been disturbed. Dispose of all excavated materials as specified in 120-5.

210-6 Spreading, Shaping, and Compacting Rock.

210-6.1 General: Scarify and disk, or otherwise loosen the existing base to such extent that no pieces larger than 3 1/2 inches in greatest dimension remain bonded together. Then, spread the material to the full width of the proposed new base course and to a grade and cross-section roughly parallel to the finished grade. Meet the requirements of 200-7.1.

210-6.2 Widening Strips: Where the widening strips are not of sufficient width to permit the use of standard compaction equipment, compact the rock in accordance with 200-6.5.

210-6.3 Construction Sequence: Do not spread any material for the upper course until the Engineer has made the density tests on the lower course and has determined that the specified compaction requirements have been met. Then, construct the second course of new limerock in accordance with the requirements of 200-5 through 200-7.

210-7 Priming and Maintaining.

Meet the requirements of 200-8.

210-8 Method of Measurement.

210-8.1 Base: The quantity to be paid for will be the plan quantity, in square yards, completed and accepted, including the areas of widened base and of turnouts constructed of new limerock material.

210-8.2 Limerock Material: The quantity to be paid for will be the number of cubic yards of only the new limerock material actually placed in the road and accepted. The quantity will be determined by measurement in loose volume, in truck bodies, at the point of dumping on the road, with proper deduction for all materials wasted, left in trucks or otherwise not actually used in the road. For this purpose, level the material in the truck bodies to facilitate accurate measurement.

210-9 Basis of Payment.

Prices and payments will be full compensation for performing all work specified in this Section including prime coat application as specified in 300-7, except all earthwork required for this work, and the work of removal and disposal of the existing bituminous surfaces, if required, as indicated in the Plans.

When the plans do not provide for direct payment for such work, the cost will be included in the Contract unit price for reworking limerock base.

Payment will be made under:

Item No. 210-	1-	Reworking Limerock Base - per square yard.
Item No. 210-	2-	Limerock, New Material - per cubic yard.

SECTION 230
LIMEROCK STABILIZED BASE

230-1 Description.

Construct a base course composed of roadbed soil stabilized with limerock.

230-2 Materials.

Meet the following requirements:

Limerock	Section 911
Prime Coat	Section 300

230-3 Equipment.

230-3.1 For Mixing: For mixing in the roadway, provide a heavy-duty rotary tiller or other equipment approved by the Engineer as equally effective for this work.

230-3.2 For Compaction: Select the equipment for compacting the stabilized material, except that for the final finish use a steel-wheeled roller.

230-4 Preparation of Roadbed.

Complete the area to be stabilized to the lines shown in the Plans and to a grade parallel to the finished elevation of the stabilized base, before adding the stabilizing material. Ensure that the elevation of the roadbed is such that the base will conform to the typical section upon completing the work. Dispose of any surplus excavated materials resulting from this work, as specified in 120-5.

230-5 Incorporation of Stabilizing Material and Mixing-In.

230-5.1 Spreading and Mixing: Place the limerock on the areas to be stabilized, and spread it uniformly to the loose depth shown in the Plans or ordered by the Engineer. Then, thoroughly mix the limerock with the soil. Perform mixing as soon as practicable but not later than one week after placing the limerock on the road. Do not spread more limerock in advance of the mixing operations than can be mixed-in with the soil within one week.

230-5.2 Further Mixing Operations: Repeat the mixing operations as often as may be necessary to distribute the limerock uniformly throughout the soil, as determined by the Engineer. Further manipulate the material to uniformly distribute the limerock throughout the width and depth of the base course.

230-5.3 Plant Mixing: The Contractor may mix the soil, limerock, and water using the central plant-mix method in lieu of mixing in place, provided he obtains a uniform mixture with the proper amount of water.

230-5.4 Shaping Surface: After mixing, shape the surface so it conforms to the grade and typical section shown in the Plans after compacting.

230-5.5 Depth of Mixing Stabilizing Material: Ensure that the depth of mixing of the stabilizing material is in accordance with Table 230-1 below:

Table 230-1		
Specified Base Thickness (inches)	Required Mixing Depth (inches)	
	Minimum	Maximum
6	5-1/2	7-1/2
8	7-1/4	9-3/4
10	9	12

In the event that the measured depth of mixing is less than the minimum specified above, remix the base course, as directed by the Engineer, until the stabilizing material is distributed to the required depth throughout the base course.

Where the measured depth of mixing exceeds the maximum limits specified in Table 230-1 above, add 1 inch, loose measure, of stabilizing material for each 1 inch of mixing depth in excess of the allowable depth (but in no case less than 1 inch of material, for any excess depth), and mix the added material in the top 6 inches of the base as specified in 230-5.1 and 230-5.2, at no expense to the Department. The Department will not include the volume of stabilizing material, which is added to compensate for excess mixing depth, in the pay quantity, and will not allow any additional compensation for the extra mixing required.

230-6 Compacting and Finishing Base.

Meet the requirements of 200-6.

230-7 Testing Surface.

Test the surface in accordance with the requirements of 200-7.

230-8 Priming and Maintaining.

Meet the requirements of 200-8.

230-9 Method of Measurement.

230-9.1 General: The quantities to be paid for will be the plan quantity, in square yards, completed and accepted.

230-9.2 Quantity of Limerock: The quantity to be paid for will be as specified in 210-8.2.

230-10 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including furnishing, hauling, placing, spreading, mixing, compacting, prime coat application as specified in 300-7 and finishing all limerock stabilizing material; any necessary excavating below the finished grade of the base to provide for placing the stabilizing material; and disposing of all surplus excavation resulting from this work.

Where extra limerock material is placed at locations of culverts, etc., as detailed in the Plans, the volume of such material, determined as provided above, will be included in the quantity of limerock material to be paid for, but no adjustment will be made in the area of base to be paid for.

Payment will be made under:

Item No. 230- 1- Limerock Stabilized Base - per square yard.
Item No. 230- 2- Limerock Material - per cubic yard.

SECTION 234
SUPERPAVE ASPHALT BASE

234-1 Description.

Construct a Superpave asphalt concrete base course as defined in these Specifications. Base course mixes are designated as Type B-12.5. The Contractor may use a Type SP-12.5 mixture (Traffic Level B, C, or E) or a Type SP-19.0 mixture (Traffic Level B, C, or E), in lieu of a Type B-12.5 at no additional cost to the Department.

Obtain Superpave asphalt base from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.

234-2 Materials.

234-2.1 General: Use materials that conform to the requirements of Division III. Specific references are as follows:

Superpave PG Asphalt Binder .....Section 916
Coarse Aggregate, Stone, Slag or
Crushed Gravel .....Section 901
Fine Aggregate.....Section 902

234-2.2 Reclaimed Asphalt Pavement (RAP): RAP may be used as a component material of the asphalt mixture provided the requirements of 334-2.3 are met.

234-3 General Composition of Mixture.

234-3.1 General: Compose the asphalt mixture using a combination of aggregate (coarse, fine or mixtures thereof), mineral filler if required, and asphalt binder material. Size, grade and combine the aggregate fractions to meet the grading and physical properties of the mix design. Aggregates from various sources may be combined.

234-3.2 Mix Design: Unless otherwise specified, design the mix such that all requirements for a Type SP-12.5, Traffic Level B or C mixture as specified in Section 334 are met.

234-3.2.1 Gradation Classification: Use a fine mix as defined in 334-3.2.2.1.

234-3.2.2 Aggregate Consensus Properties: Meet the aggregate consensus properties at design as specified in 334-3.2.3. Meet the criteria specified for a depth of top of pavement layer from surface of greater than 4 inches.

234-3.2.3 Mix Design Revisions: Meet the requirements of 334-3.3.

234-4 Contractor's Process Control.

Meet the requirements of 320-2, 330-2 and 334-4.

234-5 Acceptance of the Mixture.

The mixture will be accepted in accordance with the requirements of 334-5. Use the permissible variations from longitudinal and transverse grades as specified in 200-7.

234-6 Plant, Methods and Equipment.

Meet requirements of Section 320, with the following modifications:

234-6.1 Paving Equipment: A motor grader may be used to spread the first course of multiple course bases when the subgrade will not support the use of a mechanical spreader. The

Engineer will not require mechanical spreading and finishing equipment for the construction of base widening strips less than 6 feet in width or where the shape or size of the area will not accommodate mechanical spreading and finishing equipment.

234-6.2 Compaction Equipment: In areas where standard rollers cannot be accommodated, vibratory rollers supplemented with trucks, motor graders, or other compaction equipment approved by the Engineer may be used.

234-7 Construction Requirements.

234-7.1 General: Meet the general construction requirements of Section 330, with the following modifications:

234-7.1.1 Temperature Limitations: Spread the mixture only when the air temperature is at least 40ºF. Do not place the material on frozen subgrade.

234-7.1.2 Tack Coat: Unless otherwise authorized by the Engineer, apply a tack coat between successive layers of base material.

234-7.1.3 Thickness of Layers: Construct each course in layers, such that the compacted thickness is in compliance with the layer thicknesses in 234-8.1.1 and spread rate tolerance in 234-8.2.

234-8 Thickness Requirements.

234-8.1 General: The total thickness of the Type B asphalt layers will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined with other layers (as applicable) will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

Spread rate (lbs. per square yard) = t x G_{mm} x 43.3

Where: t = Thickness (in.) (Plan thickness or individual layer thickness)

G_{mm} = Maximum specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-3.2. For target purposes only, spread rate calculations should be rounded to the nearest whole number.

234-8.1.1 Layer Thicknesses: The allowable layer thicknesses for asphalt base mixtures are as follows:

Type B-12.5, SP-12.5.....1-1/2 to 3-1/2 inches

Type SP-19.0.....2 to 4 inches

234-8.2 Spread Rate Tolerance: Control the average spread rate on a daily basis to within plus or minus 5% of the target spread rate for the individual layers established by the Engineer. When the average daily spread rate is outside this tolerance from the target, adjust the spread rate to the required value established by the Engineer. The Engineer will periodically verify the spread rate at the job site during the paving operation.

234-8.3 Allowable Deficiencies: The Engineer will allow a maximum deficiency from the specified spread rate for the total thickness as follows:

1. For pavement of a specified thickness of 2-1/2 inches or more: 50 pounds per square yard.

2. For pavement of a specified thickness of less than 2-1/2 inches: 25 pounds per square yard.

234-8.4 Pavement Exceeding Allowable Deficiency in Spread Rate: Where the deficiency in spread rate for the total thickness is in excess of 50 pounds per square yard for pavements with a specified thickness of 2-1/2 inches or more, or in excess of 25 pounds per square yard for pavements with a specified thickness of less than 2-1/2 inches, the Engineer may require removal and replacement at no cost or may require a correction as specified in 234-8.5. The Engineer may require the Contractor to core the pavement for thickness in order to determine the area of pavement with deficient thickness.

As an exception to the above, the Contractor may leave pavement outside the main roadway in place without compensation when the Engineer allows, even though the deficiency exceeds the tolerance as specified above.

The Department will not compensate the Contractor for any pavement removed or for the work of removing such pavement.

234-8.5 Correcting Deficiency by Adding New Surface Material: In the event the total thickness as determined by the spread rate is excessively deficient as defined above and if approved by the Engineer for each particular location, correct the deficient thickness by adding new surface material and compacting it using a rolling pattern as approved by the Engineer. The Engineer will determine the area to be corrected and the thickness of new material added. Perform all overlaying and compacting at no expense to the Department.

234-9 Method of Measurement.

The quantity to be paid for will be the plan quantity. For each pay item, the pay area will be adjusted based upon the following formula:

Pay Area = Surface Area (actual tonnage placed/adjusted plan quantity tonnage).

Where: The adjusted plan quantity tonnage is calculated by multiplying the plan quantity square yards (including any Engineer approved quantity revisions) times the spread rate as defined in 234-8.1 and dividing by 2,000 pounds per ton, except the pay item's tonnage-weighted average G_{mm} is used instead of the design G_{mm} as defined in 234-8.1.

The pay area shall not exceed 110% of the designed surface area.

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9 2.1.2.

234-10 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including the applicable requirements of Sections 320, 330 and 334. The bid price for the asphalt mix will include the cost of the liquid asphalt binder and the tack coat application as directed in 300-8.

Payment will be made under:

Item No. 285- 7- Optional Base - per square yard.

SECTION 283
RECLAIMED ASPHALT PAVEMENT BASE

283-1 Description.

Construct a base course composed of reclaimed asphalt pavement (RAP) material. Use RAP material as a base course only on non-limited access paved shoulders, shared use paths, or other non-traffic bearing applications.

283-2 Materials.

Meet the following requirements:

Recycled Asphalt Pavement (RAP) 334-2.3
Prime Coat* ..... Section 300
*Use products listed on the Department's Approved Products List (APL).

Obtain the RAP material by either milling or crushing an existing asphalt pavement. Use material so that at least 97% (by weight) pass a 3-1/2 inch sieve and is graded uniformly down to dust.

When the RAP material is from a Department project and the composition of existing pavement is known, the Engineer may approve material on the basis of the composition. When the composition of obtained RAP is not known, the following procedure will be used for approval:

1. Conduct a minimum of six extraction gradation analyses of the RAP material. Take samples at random locations in the stockpile. The average asphalt cement content of the six stockpile samples must be 4% or greater with no individual result below 3-1/2%.

2. Request the Engineer to make a visual inspection of the stockpile of RAP material. Based on this visual inspection of the stockpiled material and the results of the Contractor's extraction gradation analyses, the Engineer will determine the suitability of the materials.

3. The Engineer may require crushing of stockpiled material to meet the gradation criterion. Perform all crushing before the material is placed.

283-3 Spreading RAP Material.

283-3.1 Method of Spreading: Spread the RAP with a blade or device which strikes off the material uniformly to laying thickness and produces an even distribution of the RAP. The Contractor may also place the RAP material directly from the milling machine into the trench by a conveyor. When placing the RAP material by conveyor directly from the milling machine, obtain the Engineer's approval of the milling process.

283-3.2 Number of Courses: When the specified compacted thickness of the base is greater than 6 inches, construct the base in two courses. Place the first course to a thickness of approximately one half the total thickness of the finished base, or sufficient additional thickness to bear the weight of construction equipment without disturbing the subgrade.

Except as might be permitted by the Engineer for special cases, conduct all RAP base construction operations for shoulders before placing the final pavement on the adjacent traveled roadway.

283-4 Compacting and Finishing Base.

283-4.1 General: Meet the requirements of 200-6.1:

283-4.1.1 Single-Course Base: Construct as specified in 200-6.1.1.

283-4.1.2 Multiple-Course Base: Construct as specified in 200-6.1.2.

283-4.2 Moisture Content: Meet the requirements of 200-6.2.

283-4.3 Density Requirements: Compact the material to a density of not less than 95% of maximum density as determined by FM 1-T180. Where the width of the base construction is not sufficient to permit use of standard base compaction equipment, perform compaction using vibratory compactors, trench rollers, or other special equipment which will provide the density requirements specified herein.

283-4.4 Density Tests: Meet the requirements of 200-7 with the exception of 200-7.2.1. Within the entire limits of the width and depth of the base, obtain a minimum density in any LOT of 95% of the maximum density as determined by FM 1-T180.

283-4.5 Thickness Requirements: Meets the thickness requirements of 285-6.

283-5 Testing Surface.

Test the surface in accordance with the requirements of 200-7-3.

283-6 Priming and Maintaining.

283-6.1 Priming: Apply the prime coat only when the base meets the specified density requirements and the moisture content in the top half of the base is within 2% of optimum. At the time of priming, ensure that the base is firm, unyielding, and in such condition that no undue distortion will occur. The Engineer will not allow priming if the surface is dry, dusty, or sloughing.

283-6.2 Maintaining: Meet the requirements of 200-8.2.

SECTION 285
OPTIONAL BASE COURSE

285-1 Description.

Construct a base course composed of one of the optional materials shown on the typical sections.

285-2 Materials.

Meet the material requirements as specified in the Section covering the particular type of base to be constructed.

Graded Aggregate .....Section 204
Asphalt .....Section 234
Reclaimed Asphalt Pavement (RAP)* .....Section 283
Limerock .....Section 911
Shell Base.....Section 911
Shell-Rock.....Section 911
Cemented Coquina.....Section 911
Recycled Concrete Aggregate (RCA)** .....Section 911

*Only for use on non-limited access paved shoulders, shared use paths, or other non-traffic bearing applications.

**Do not use on interstate roadways.

285-3 Selection of Base Option.

The Plans will include typical sections indicating the various types of base construction (material and thickness) allowable.

When base options are specified in the Plans, use only those options. When base options are not specified, select one base option as allowed for each typical section shown in the Plans. Only one base option is permitted for each typical section. See Tables 285-1 and 285-2 for optional base materials, thickness and additional restrictions.

Notify the Engineer in writing of the base option selected for each typical section at least 45 calendar days prior to beginning placement of base material.

Table 285-1 Optional Base Groups 1 through 7							
Base Materials	Base Group (Base Group Pay Item)						
	1 (701)	2 (702)	3 (703)	4 (704)	5 (705)	6 (706)	7 (707)
Limerock, LBR 100	4”	5”	5-1/2”	6”	7”	8”	8-1/2”
Cemented Coquina, LBR 100	4”	5”	5-1/2”	6”	7”	8”	8-1/2”
Shell Rock, LBR 100	4”	5”	5-1/2”	6”	7”	8”	8-1/2”
Bank Run Shell, LBR 100	4”	5”	5-1/2”	6”	7”	8”	8-1/2”
Recycled Concrete Aggregate, LBR 150 (1)	4”	5”	5-1/2”	6”	7”	8”	8-1/2”
Graded Aggregate Base, LBR 100	4-1/2”	5-1/2”	6-1/2”	7-1/2”	8-1/2”	9”	10”
Type B-12.5	4” (3)	4” (3)	4” (3)	4” (3)	4-1/2”	5”	5-1/2”
B-12.5 and 4” Granular Subbase, LBR 100 (2)	-	-	-	-	-	-	-
RAP Base (4)	5” (4)	-	-	-	-	-	-

(1) Do not use on interstate roadways.
(2) The construction of both the subbase and Type B-12.5 will be bid and used as Optional Base. Granular subbases include limerock, cemented coquina, shell rock, bank run shell, recycled concrete aggregate and graded aggregate base. All subbase thicknesses are 4” minimum prior to adding the required prime coat.
(3) Based on minimum practical thickness.
(4) Only for use on non-limited access paved shoulders, shared use paths, or other non-traffic bearing applications.
(5) To be used for widening, three feet or less.

Table 285-1(continued) Optional Base Groups 8 through 15								
Base Materials	Base Group (Base Group Pay Item)							
	8 (708)	9 (709)	10 (710)	11 (711)	12 (712)	13 (713)	14 (714)	15 (715)
Limerock, LBR 100	9-1/2”	10”	11”	12”	12-1/2”	13-1/2” (5)	14” (5)	-
Cemented Coquina, LBR 100	9-1/2”	10”	11”	12”	12-1/2”	13-1/2” (5)	14” (5)	-
Shell Rock, LBR 100	9-1/2”	10”	11”	12”	12-1/2”	13-1/2” (5)	14” (5)	-
Bank Run Shell, LBR 100	9-1/2”	10”	11”	12”	12-1/2”	13-1/2” (5)	14 (5)	-
Recycled Concrete Aggregate, LBR 150 (1)	9-1/2”	10”	11”	12”	12-1/2”	13-1/2” (5)	14” (5)	-
Graded Aggregate Base, LBR 100	11”	12”	13”	14”	-	-	-	-
Type B-12.5	5-1/2”	6”	6-1/2”	7”	7-1/2”	8”	8-1/2”	9”
B-12.5 and 4” Granular Subbase, LBR 100 (2)	-	4”	4-1/2”	5”	5-1/2”	6”	6-1/2”	7”

Table 285-1(continued) Optional Base Groups 8 through 15								
Base Materials	Base Group (Base Group Pay Item)							
	8 (708)	9 (709)	10 (710)	11 (711)	12 (712)	13 (713)	14 (714)	15 (715)
RAP Base [4]	-	-	-	-	-	-	-	-

(1) Do not use on interstate roadways.
(2) The construction of both the subbase and Type B-12.5 will be bid and used as Optional Base. Granular subbases include limerock, cemented coquina, shell rock, bank run shell, recycled concrete aggregate and graded aggregate base. All subbase thicknesses are 4" minimum prior to adding the required prime coat.
(3) Based on minimum practical thickness.
(4) Only for use on non-limited access paved shoulders, shared use paths, or other non-traffic bearing applications.
(5) To be used for widening, three feet or less.

Table 285-2: Limited Use Optional Base Groups[1]								
Base Materials	Base Group (Base Group Pay Item)							
	101 (701)	102 (702)	103 (703)	104 (704)	105 (705)	106 (706)	107 (707)	108 (708)
Limerock Stabilized, LBR 70	5"	6-1/2"	8"	9"	10"	11"	12-1/2"	-
Shell, LBR 70	5"	6-1/2"	8"	9"	10"	11"	12-1/2"	-
Shell Stabilized, LBR 70	7"	8-1/2"	9-1/2"	10-1/2"	12"	-	-	-
Sand-Clay, LBR 75	5"	6-1/2"	8"	9"	10"	11"	12-1/2"	-
Soil Cement (300 psi) (Plant Mixed)	5"	5-1/2"	6-1/2"	7-1/2"	8-1/2"	9"	10"	11"
Soil Cement (300 psi) (Road Mixed)	5"	5-1/2"	6-1/2"	7-1/2"	8-1/2"	-	-	-
Soil Cement (500 psi) (Plant Mixed)	4" [2]	4"	5"	5-1/2"	6"	7"	7-1/2"	8-1/2"

(1) Use only when specified in the Plans.
(2) Based on minimum practical thicknesses.

285-4 Construction Requirements.

Construct the base in accordance with the Section covering the particular type of base to be constructed.

Graded Aggregate .....Section 204
Asphalt .....Section 234
Reclaimed Asphalt Pavement (RAP)* .....Section 283
Limerock .....Section 200
Shell Base .....Section 200
Shell Rock .....Section 200
Cemented Coquina .....Section 200
Recycled Concrete Aggregate (RCA)** .....Section 200

*Only for use on non-limited access paved shoulders, shared use paths, or other non-traffic

**Do not use on interstate roadways.

285-5 Variation in Earthwork Quantities.

The Plans will identify the optional materials used by the Department for determining the earthwork quantities (Roadway Excavation, Borrow Excavation, Subsoil Excavation, Subsoil Earthwork, or Embankment). The Department will not revise the quantities, for those items having final pay based on plan quantity, to reflect any volumetric change caused by the Contractor's selection of a different optional material.

285-6 Thickness Requirements.

285-6.1 Measurements: For non-asphalt bases, meet the requirements of 200-7.3.1.2.

For subbases, meet the thickness requirements of 290-4.

The Engineer will determine the thickness of asphalt base courses in accordance with 234-8.1.

285-6.2 Correction of Deficient Areas: For non-asphalt bases, correct all areas of the completed base having a deficiency in thickness in excess of 1/2 inch by scarifying and adding additional base material. As an exception, if authorized by the Engineer, such areas may be left in place without correction and with no payment.

For asphalt bases, correct all areas of deficient thickness in accordance with 234-8.

285-7 Calculation of Average Thickness of Base.

For bases that are not mixed in place, the Engineer will determine the average thickness from the measurements specified in 285-6.1, calculated as follows:

1. When the measured thickness is more than 1/2 inch greater than the design thickness shown on the typical section in the Plans, it will be considered as the design thickness plus 1/2 inch.

2. Average thickness will be calculated per typical section for the entire job as a unit.

3. Any areas of base left in place with no payment will not be included in the calculations.

4. Where it is not possible through borings to distinguish the base materials from the underlying materials, the thickness of the base used in the measurement will be the design thickness.

5. For Superpave asphalt base course, the average spread rate of each course shall be constructed in compliance with 234-8.

285-8 Method of Measurement.

The quantity to be paid for will be the plan quantity area in square yards, omitting any areas where under-thickness is in excess of the allowable tolerance as specified in 285-6. The pay area will be the surface area, determined as provided above, adjusted in accordance with the following formula:

$$Pay\ Area = Surface\ Area\ (\frac{Calculated\ \ Average\ Thickness\ per\ 285\text{-}7}{Plan\ Thickness})$$

The pay area shall not exceed 105% of the surface area.

There will be no adjustment of the pay area on the basis of thickness for base courses constructed utilizing mixed-in-place operations.

For Superpave asphalt base course, the quantity to be paid for will be the plan quantity area in square yards. The pay area will be adjusted in accordance with 234-9.

285-9 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including tack coat between base layers, prime coat, cover material for prime coat, bituminous material used in bituminous plant mix, and cement used in soil-cement.

For superpave asphalt base course, a pay adjustment based upon the quality of the material will be applied in accordance with 334-8.

Where the Plans include a typical section which requires the construction of an asphalt base only, price adjustments for bituminous material provided for in 9-2.1.2 will apply to that typical section. For typical sections which permit the use of asphalt or other materials for construction of an optional base, price adjustments for bituminous material provided for in 9-2.1.2 will not apply.

Payment will be made under:

Item No. 285- 7- Optional Base - per square yard.

SECTION 286
DRIVEWAY BASE

286-1 Description.

Construct a base course for paved or graded driveways in accordance with the Plans and Standard Plans, Index 330-001.

The Department does not include placing of pavement over driveway base in this Section. The requirements for concrete driveways are included in Section 522.

286-2 Materials.

For driveway base material, use any material meeting the minimum requirements provided in Standard Plans, Index 330-001 and currently specified by the Department for base or surface construction, except do not use hot bituminous mixtures intended for use as open-graded friction course. Proportion bituminous mixtures in accordance with a job-mix formula approved by the Department.

In general, the Engineer will accept the material based on visual inspection, with no testing required.

286-3 Excavation.

Excavate the area over which driveway construction is to be accomplished to the dimensions shown in the Plans. If the surface of the underlying soil is disturbed during the excavation operation, compact it to the approximate density of the surrounding undisturbed soil.

If an existing paved driveway lies within the specified limits for construction, leave the existing base and surface in place, as directed by the Engineer.

286-4 Spreading, Compacting, and Finishing Base.

Uniformly spread base material over the prepared area to a depth which will, upon completion of compaction and finishing, result in driveway base conforming with the specified lines and elevations. Then, strike off the base material to a plane paralleling the finished surface, and compact it in a manner similar to that used in the construction of roadway base. The Engineer will not require any specific density.

Finish the surface to the specified grade and cross slope.

286-5 Method of Measurement.

286-5.1 Driveway Base (Optional): The quantity to be paid for will be the plan quantity area, in square yards.

286-5.2 Driveway Asphalt Base: When specified in the Plans, asphalt base will be paid for by weight of mixture, the weight will be measured as specified in 320-3.

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

286-6 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including excavating; compacting excavated areas; furnishing material; placing, compacting, and finishing of base; and incidental work.

No separate payment will be made for any tack coat between base layers, prime coat, cover material for prime coat, bituminous material used in bituminous plant mix, and cement used in soil-cement.

Payment will be made under:

Item No. 286-	1-	Driveway Base (Optional) - per square yard.
Item No. 286-	2-	Driveway Asphalt Base - per ton.

SECTION 287
ASPHALT TREATED PERMEABLE BASE

287-1 Description.

Construct asphalt treated permeable base (ATPB) and outlet pipe for use under concrete pavement, in accordance with the details shown in the Plans and Standard Plans, Index 446-001. Meet the plant and equipment requirements of Section 320 and the general construction requirements of Section 330, except as noted below.

287-2 Materials.

Meet the following requirements:

Coarse Aggregate, Stone, Slag, or Crushed Gravel	
Grade No. 57 or 67	Section 901
Superpave PG Asphalt Binder (PG 67-22) [(1)]	916-1
Hydrated Lime [(2)]	AASHTO M-303-89 Type 1
Polyvinyl-Chloride Pipe [(3)]	Section 948
Polyethylene Pipe [(3)]	Section 948
Geosynthetic Material	Section 985

1. Use PG 67-22 in the ATPB containing 0.50% heat-stable anti-strip additive (by weight of asphalt) from an approved source. Introduce and mix the anti-strip additive at the terminal.

2. For mixtures containing granite, add hydrated lime at a dosage rate of 1.0% by weight of the total dry aggregate in lieu of adding 0.50% anti-strip additive. Submit certified test results for each shipment of hydrated lime indicating compliance with the specifications. In addition, meet the requirements of 337-9.2 and 337-9.3.

3. Use either polyvinyl chloride pipe or polyethylene pipe, unless otherwise specified in the Contract Documents.

287-3 Composition of Mixture.

287-3.1 General: Use ATPB composed of a combination of coarse aggregate and asphalt cement. Use a mix design verified by the Engineer.

287-3.2 Mix Design: Submit a proposed mix design along with representative samples of all component materials to the Engineer, at least two weeks before the scheduled start of production. Establish the design asphalt content within the range of 2.0 - 4.0%, by weight of total mixture. During the mix design process, the Engineer may adjust the asphalt content within the 2.0 - 4.0% range. The Engineer may increase or decrease the specified asphalt content during production of the mix after testing and visual inspection. Ensure that a minimum of 95% of the aggregate is coated. There will be no separate payment for the bituminous material in the mix. Establish the mix temperature within the range of 230ºF to 250ºF, or as approved by the Engineer.

287-4 Control of Quality.

Provide the necessary control of the ATPB and construction in accordance with the applicable provisions of 320-2 and 330-2.

287-5 Acceptance of the Mixture at the Plant.

The ATPB mixture will be accepted at the plant with respect to 334-5.1 with the following exceptions:

1. The mixture will be accepted with respect to gradation ($P_{-1/2}$ if No. 57 stone is used and $P_{-3/8}$ if No. 67 stone is used) and asphalt binder content (P_b) only.
2. Testing in accordance with AASHTO T312-12 and FM 1-T209 (and conditioning of the mix prior to testing) will not be required as part of 334-5.1.1.1.
3. The standard LOT size will be, 2,000 tons, with each LOT subdivided into four equal sublots of 500 tons each.
4. Initial production requirements of 334-5.1.3 do not apply.
5. The Between-Laboratory Precision Values described in Table 334-7 are modified to include ($P_{-1/2}$ and $P_{-3/8}$) with a maximum difference per FM 1-T030 (Figure 2).
6. Table 334-6 (Master Production Range) is replaced by Table 287-1.

Table 287-1
ATPB Master Production Range

Characteristic	Tolerance (1)
Asphalt Binder Content (%)	Target ± 0.60
Passing 1/2 inch Sieve (%) if using No. 57 stone	Target ± 12.00
Passing 3/8 inch Sieve (%) if using No. 67 stone	Target ± 12.00

(1) Tolerances for sample size of n = 1 from the verified mix design

287-5.1 Individual Test Tolerances for ATPB Production: In the event that an individual Quality Control test result of a sublot for gradation ($P_{-1/2}$ if No. 57 stone is used and $P_{-3/8}$ if No. 67 stone is used), or asphalt binder content does not meet the requirements of Table 287-1, take steps to correct the situation and actions taken shall be reported to the Engineer.

In the event that two consecutive individual Quality Control test results for gradation ($P_{-1/2}$ if No. 57 stone is used and $P_{-3/8}$ if No. 67 stone is used) or asphalt binder content do not meet the requirements of Table 287-1, the LOT will be automatically terminated and production of the mixture stopped until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Evaluate any material represented by the failing test result in accordance with 334-5.1.9.

287-6 Acceptance of the Mixture at the Roadway.

Acceptance of the Contractor's methods of placement and compaction will be based upon the completion of a 500 foot test section, (initially and at other times as determined by the Engineer), acceptable to the Engineer, prior to further placement. In the event that the placement/compaction method deviates from the approved method, cease placement of the mix until the problem is adequately resolved to the satisfaction of the Engineer.

287-7 Temperature and Storage Limitations.

Place the ATPB material when the atmospheric temperature is above 50ºF and rising. Do not use ATPB material that was mixed more than two hours prior to placement.

287-8 Construction Requirements.

287-8.1 Placement: Ensure that the structural course on which ATPB is to be placed conforms to the compaction and elevation tolerances specified in the Contract Documents and is free of loose or extraneous material. Fill any area of the structural course which is lower than the grade established by the Plans with structural course material, at no additional cost to the Department.

Place and compact ATPB in one lift, with a compacted thickness of 4 inches plus or minus 1/2 inch (except the trench which includes the subdrainage pipe), in accordance with these Specifications, lines, grades, dimensions and notes as shown in the Plans.

Place and compact ATPB material around the subdrainage pipe for the full width of the trench, in layers not exceeding 8 inches (loose measure). Do not displace or damage the subdrainage pipe or filter fabric.

Remove and replace all ATPB material which is greater than 1/2 inch below the grade shown in the Plans or, in the opinion of the Engineer, is damaged or contaminated, at no additional cost to the Department.

287-8.2 Compaction: Compact the ATPB by one of the following methods:

1. A steel-wheeled, tandem roller which will produce an operating weight of not more than 140 PLI of drum width.

2. A steel-wheeled tandem roller weighing from 8 to 12 tons.

Compact the ATPB material (in the static mode only) as approved by the Engineer. Begin compaction as soon as the surface temperature has cooled to 190°F, or as approved by the Engineer and complete compaction before the surface temperature has cooled to 100°F. If necessary, cool the ATPB material with water.

287-8.3 Surface Requirements: Ensure that the finished surface of the ATPB does not vary more than plus or minus 1/2 inch from the grade shown in the Plans.

The Engineer may approve removal of high spots to within specified tolerance by a method which does not produce contaminating fines. Remove and replace ATPB material that is outside the established tolerance, at no additional cost to the Department. Grinding or milling will not be permitted.

287-9 Subdrainage Pipe and Geosynthetic Material.

Place the subdrainage pipe and geosynthetic material (filter fabric) in accordance with the Plans and Standard Plans, Index 446-001.

287-10 Outlet Pipe.

Install outlet fittings and pipes concurrent with subdrainage pipe to provide positive gravity drainage and eliminate soil intrusion. The Engineer will restrict installation of additional sections of ATPB, until appropriate outlets are installed.

Ensure that all fittings and materials are designed and installed to eliminate soil intrusion into the system.

Connect the open end of the outlet pipe into either an existing drainage structure, existing ditch pavement or terminate with a concrete apron.

Do not block the drainage system at any time. Ensure that at the time of inspection and project acceptance, all outlet pipes and concrete aprons are clear of earth material, vegetation, and other debris.

287-11 Compensation.

Meet the requirements of 334-8 with the following exceptions:

1. Pay factors will be calculated for asphalt binder content and the percentages passing the 1/2 inch and the 3/8 inch sieves only.
2. Table 287-2 replaces Table 334-8.
3. Table 287-3 replaces Table 334-9.
4. The Composite Pay Factor in 334-8.3 is replaced with the following:

CPF = [(0.25 x PF 1/2 inch or 3/8 inch) + (0.75 x PF AC)]

Note: Use the PF for the 1/2 inch sieve if No. 57 stone is used in the mixture or use the PF for the 3/8 inch sieve if No. 67 stone is used in the mixture.

Table 287-2 Small Quantity Pay Table for ATPB		
Pay Factor	1-Test Deviation	2-Test Average Deviation
Asphalt Binder Content (%)		
1.00	0.00-0.50	0.00-0.35
0.90	0.51-0.60	0.36-0.42
0.80	>0.60	>0.42
1/2 inch Sieve (%) if using No. 57 stone		
1.00	0.00-11.00	0.00-7.78
0.90	11.01-12.00	7.79-8.49
0.80	>12.00	>8.49
3/8 inch Sieve (%) if using No. 67 stone		
1.00	0.00- 11.00	0.00- 7.78
0.90	11.01-12.00	7.79-8.49
0.80	>12.00	>8.49

Table 287-3 Specification Limits for ATPB	
Quality Characteristic	Specification Limits
Asphalt Binder Content (%)	Target ± 0.45
Passing 1/2 inch sieve (%) if using No. 57 stone	Target ± 10.00
Passing 3/8 inch sieve (%) if using No. 67 stone	Target ± 10.00

287-12 Low Quality Material.

Meet the requirements of 334-5.1.9. For ATPB, use the Master Production Range defined in Table 287-1 in lieu of Table 334-6.

287-13 Method of Measurement.

287-13.1 Asphalt Treated Permeable Base: The quantity of ATPB to be paid for will be the plan quantity, in cubic yards, completed and accepted, subject to 9-3.2. No allowance will be made for ATPB placed outside plan dimensions, unless otherwise ordered by the Engineer.

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

287-13.2 Outlet Pipe: The quantity of outlet pipe to be paid for will be the length, in feet, measured in place along the centerline and gradient of the pipe, completed and accepted.

287-14 Basis of Payment.

287-14.1 Asphalt Permeable Base: Price and payment will be full compensation for work specified in this Section, including furnishing all labor, materials (including the ATPB material, geosynthetic material, and subdrainage pipe), tools, equipment, and incidentals, necessary to complete the work.

287-14.2 Outlet Pipe: Price and payment will be full compensation for work specified in this Section, including removal of existing shoulder pavement, trench excavation, pipe and fittings, standard aprons, galvanized hardware cloth (rodent screens), grouting around and stubbing into existing or proposed drainage structures or ditch pavement; restoration of ditch pavement, sod and other areas disturbed by the Contractor, backfill in place, disposal of excess materials and incidentals, necessary to complete the work.

287-14.3 Payment Items: Payment will be made under:

Item No. 287- 1-	Asphalt Treated Permeable Base - per cubic yard.
Item No. 446- 71- 1-	Edgedrain Outlet Pipe - per foot.

SECTION 288
CEMENT TREATED PERMEABLE BASE

288-1 Description.

288-1.1 General: Construct Cement Treated Permeable Base and Outlet Pipe as shown in the Plans and Standard Plans, Index 446-001. Use any one of the types of pipe listed in 288-2, unless a particular type is specifically required by the Contract Documents. Use only perforated pipe, and do not use open joints.

288-1.2 Concrete Plant and Cement Concrete pavement: Meet the requirements of Section 346 for plant and equipment, and Section 350 for general construction requirements.

Work will be accepted in accordance with the applicable provisions in Section 350.

288-2 Materials.

Meet the following requirements:

Coarse Aggregate	Section 901
Portland Cement	Section 921
Water	Section 923
Polyvinyl-Chloride Pipe	Section 948
Polyethylene Pipe	Section 948
Geotextile Fabric	Section 985

For Cement Treated Permeable Base, the concrete requirements of Section 346 are modified as follows:

Use Type I or II portland cement (no supplementary cementitious materials permitted).

Composition:

Grade of coarse aggregate (stone)	# 57 or # 67
Maximum Water/Cement ratio*	0.40
Minimum cement factor**	9 lb/ft^3
Maximum Slump Range	Not Applicable
Fine Aggregate	None
Admixtures	None

*The Engineer will approve the Water/Cement ratio.

**±2 lb/ft^3

Do not use materials which contain hardened lumps, crusts, or frozen matter, or are contaminated with dissimilar material.

288-3 Control of Quality.

288-3.1 General: Meet the provisions of this Section and Chapter 9.2 of the Materials Manual - Concrete Production Facilities Guidelines, which may be view at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section92V2.shtm.

288-3.2 Concrete Design Mix: Submit the proposed design mix prior to production, on the "Concrete Mix Design" form, for the Engineer's approval. Use only Cement Treated Permeable Base design mixes having prior approval of the Engineer.

Furnish sufficient material of each component when requested by the Engineer, for verification of the proposed mix design by the State Materials Office. Verify the unit weight

requirements as determined in accordance with FM 5-530. Also, submit one of the following with the design mix submittal:

1. Evidence from three sets of production data, either from Department acceptance tests or independently verifiable commercial mixes, that Cement Treated Permeable Base produced in accordance with the proposed design mix meets the requirements of this Section.

2. Test data from a single trial batch of a 1 yd^3 minimum is required, which demonstrates that the Cement Treated Permeable Base produced using the proposed mix, designated ingredients, and designated water-cement ratio meets the requirements of this Section.

288-3.3 Batch Adjustment - Materials: Meet the theoretical yield requirements of the approved mix design. Inform the Engineer of any adjustments to the approved mix design. Note any batch adjustments and record the actual quantities incorporated into the mix, on the concrete "Delivery Ticket/Certification" form.

288-3.4 Delivery Certification: Submit to the Engineer a complete "Delivery Ticket/Certification" form with each batch of Cement Treated Permeable Base prior to unloading at the site.

288-4 Acceptance of Placement.

Acceptance of the Contractor's method of placement and compaction will be based upon the completion of a 500 foot test section, acceptable to the Engineer, prior to further placement.

For the purpose of acceptance and partial payment, each day's production will be divided into LOTs as specified in Section 346 and in accordance with the applicable requirements of Sections 5, 6, and 9.

288-5 Temperature Requirements.

Place Cement Treated Permeable Base only when the atmospheric temperature is above 40°F and rising.

288-6 Construction Requirements.

288-6.1 Placement: Ensure that the structural course on which Cement Treated Permeable Base is to be placed conforms to the compaction and elevation tolerances specified in the Plans and is free of loose or extraneous material. Fill any area of the structural course which is lower than the grade established by the Plans with structural course material, at no additional cost to the Department.

Place and compact Cement Treated Permeable Base in one course (except the trench which includes the subdrainage pipe), in accordance with these Specifications, lines, grades, dimensions and notes as shown in the Plans. Placement may be accomplished by either the fixed-form or the slip-form method.

Place and compact Cement Treated Permeable Base material around the subdrainage pipe for the full width of the trench, in layers not exceeding 8 inches (loose measure). Do not displace or damage the subdrainage pipe or filter fabric.

Remove and replace all Cement Treated Permeable Base material which is greater than 1/2 inch below the grade shown in the Plans or is not covered with the next layer of material within five calendar days after initial placement or in the opinion of the Engineer is damaged or contaminated, at no additional cost to the Department.

288-6.2 Compaction: Compact the Cement Treated Permeable Base by one of the following methods.

1. One complete coverage with a steel-wheeled, two-axle tandem roller weighing between 4 and 10 tons in static mode.
2. By vibratory plates or screeds.

There will be no density requirements for Cement Treated Permeable Base.

288-6.3 Curing: Sprinkle the Cement Treated Permeable Base surface with a fine spray of water every two hours for a period of eight hours or cover with polyethylene sheets for three or four calendar days.

Begin the curing process the morning after placement of the base.

288-6.4 Surface Requirements: Ensure that the finished surface of the Cement Treated Permeable Base does not vary more than ±1/2 inch from the grade shown in the Plans.

The Engineer may approve removal of high spots to within the specified tolerance by a method which does not produce contaminating fines. Remove and replace Cement Treated Permeable Base material that is above tolerance, at no additional cost to the Department. Neither grinding nor milling will be permitted.

288-7 Sampling and Testing.

The Engineer will take random samples of the Cement Treated Permeable Base at the point of placement in accordance with FM 5-530 to determine the unit weight. Cement Treated Permeable Base not within ± 3 lb/ft^3 of the unit weight of the approved mix design will be rejected.

Remove and replace all rejected Cement Treated Permeable Base at no cost to the Department.

288-8 Subdrainage Pipe and Geotextile Material.

Place the subdrainage pipe and geotextile material (filter fabric) in accordance with the Plans and Standard Plans, Index 446-001.

288-9 Outlet Pipe.

Install outlet fittings and pipes concurrent with subdrainage pipe to provide positive gravity drainage and eliminate soil intrusion. The Engineer will restrict installation of additional sections of Cement Treated Permeable Base, until appropriate outlets are installed.

Ensure that all fittings and materials are designed and installed to eliminate soil intrusion into the system.

Connect the open end of the outlet pipe into either an existing drainage structure, existing ditch pavement or terminate with a concrete apron.

Do not block the drainage system at any time. Ensure that at the time of inspection and project acceptance, all outlet pipes and concrete aprons are clear of earth material, vegetation, and other debris.

288-10 Method of Measurement.

288-10.1 Cement Treated Permeable Base: The quantity of cement treated permeable base to be paid for will be the plan quantity, in cubic yards, completed and accepted, subject to 9-3.2.

288-10.2 Outlet Pipe: The quantity of outlet pipe to be paid for will be the length, in feet, completed and accepted, measured in place along the centerline and gradient of the outlet pipe.

288-11 Basis of Payment.

288-11.1 Cement Treated Permeable Base: Price and payment will be full compensation for work specified in this Section, including furnishing all labor, materials (including the cement treated permeable base material, geotextile, and subdrainage pipe), tools, equipment, and incidentals, necessary to complete the work.

288-11.2 Outlet Pipe: Price and payment will be full compensation for work specified in this Section, including removal of existing shoulder pavement, trench excavation, pipe and fittings, standard aprons, galvanized hardware cloth (rodent screens), grouting around and stubbing into existing or proposed inlets and drainage structures or paved ditches; restoration of ditch pavement and other areas disturbed by the Contractor, backfill in place, and disposal of excess materials and incidentals, necessary to complete the work.

Payment will be made under:

Item No. 288-	1-	Cement Treated Permeable Base - per cubic yard.
Item No. 446-	71- 1	Edgedrain Outlet Pipe - per foot.

SECTION 290
GRANULAR SUBBASE

290-1 Description.

Construct a granular subbase as a component of an optional base.

290-2 Materials.

Select one of the materials listed below and conform to the following requirements:

Graded Aggregate 204-2
Limerock .....Section 911
Bank Run Shell .....Section 911
Shell Rock .....Section 911
Cemented Coquina .....Section 911
Recycled Concrete Aggregate (RCA)* .....Section 911
*Do not use on interstate roadways.

290-3 Construction Methods.

For the subbase material selected, construct the subbase in conformance with the following:

Graded Aggregate .....Section 204
Limerock .....Section 200
Bank Run Shell .....Section 200
Shell Rock .....Section 200
Cemented Coquina .....Section 200
Recycled Concrete Aggregate (RCA)* .....Section 200
*Do not use on interstate roadways.

Straightedge and hard-planing provisions will not apply. Compact the subbase to a minimum of 98% of the maximum density as determined under FM 1-T180, Method D. Priming is not required.

When Granular Subbase is substituted for Subgrade on shoulders, achieve a minimum of 95% density of the maximum density as determined under FM 1-T180, Method D.

290-4 Thickness Requirements.

290-4.1 General: Do not substitute granular subbase materials in excess of the tolerance specified for the asphalt portion of the optional base.

290-4.2 Measurements: When the Department is ready to measure the finished subbase, provide the coring equipment and the operator and include this in the unit price for optional base. The Engineer will select the coring locations and make the acceptance measurements. Thickness measurements will be taken through 3 inch diameter holes. For subbase areas greater than 1,000 yd^2, the minimum frequency of measurement will be one per 200 feet of roadway. For smaller subbase areas, the minimum frequency of measurement will be one per 500 yd^2 of subbase.

290-4.3 Maximum Allowable Thickness: The maximum allowable thickness of the subbase is 4 1/4 inches. Remove and replace areas of subbase exceeding the maximum allowable thickness.

290-4.4 Minimum Allowable Thickness: The minimum allowable thickness of the subbase is 3-1/2 inches. Remove and replace areas not meeting the minimum allowable

thickness. If authorized by the Engineer, additional asphalt may be substituted to achieve the full combined optional base thickness.

SECTION 300
PRIME AND TACK COATS

300-1 Description.

Apply bituminous prime coats on previously prepared bases and apply bituminous tack coats on previously prepared bases and on existing pavement surfaces.

300-2 Materials.

Meet the following requirements:

Asphalt Emulsion for Prime Coat*	916-3
PG 52-28 Tack Coat*	916-2
Asphalt Emulsion for Tack Coat*	916-3
Sand	902-2, 902-6
Screenings	902-5

*Use products listed on the Department's APL.

300-2.1 Prime Coat: A copy of the Bill of Lading representing the material in the distributor tank must be in the truck and be always available.

Where prime coats are to be diluted, certify the dilution was done in accordance with the specific dilution requirements for each product and for each load of material used.

300-2.2 Cover Material for Prime Coat: Uniformly cover the primed base by a light application of cover material. The Contractor may use either sand or screenings for the cover material. For the sand, meet the requirements as specified in 902-2 or 902-6, and for the screenings, meet the requirements as specified in 902-5. If the primed base course will be exposed to general traffic, apply a cover material coated with 2 to 4% asphalt cement. Apply the asphalt coated material at approximately 10 pounds per square yard. Roll the entire surface of asphalt coated prime material with a traffic roller as required to produce a reasonably dense mat.

300-2.3 Tack Coat: Unless the Contract Documents call for a specific type or grade of tack coat, use PG 52-28 meeting the requirements of 916-2, heated to a temperature from 250 to 300ºF or use an undiluted emulsion listed on the APL, meeting the requirements of 916-3. Heat the emulsion to the temperature recommended by the tack coat manufacturer. A copy of the Bill of Lading representing the material in the distributor tank must be in the truck and be always available.

For night paving, use PG 52-28 tack coat. The Engineer may approve an emulsified tack coat for night paving if the Contractor demonstrates, at the time of use, the emulsion will break and not affect the progress of the paving operation.

300-3 Equipment.

300-3.1 Pressure Distributor: Provide a pressure distributor equipped with pneumatic tires having a sufficient width of rubber in contact with the road surface to avoid breaking the bond or forming a rut in the surface. Ensure the distance between the centers of openings of the outside nozzles of the spray bar is equal to the width of the application required, plus or minus two inches. Ensure the outside nozzle at each end of the spray bar has an area of opening greater than the opening of an interior nozzle by 25% to 75%. Ensure all other nozzles have uniform

openings. When the application covers less than the full width, the Contractor may allow the normal opening of the end nozzle at the junction line to remain the same as the interior nozzles. A trailer-mounted pressure distributor can be used for non-mainline applications, if approved by the Engineer. It shall have a self-contained heat system, clean out system, calibration chart, manhole, and shall meet the requirements herein.

Clean the distributor tank at a minimum of every twelve months and whenever the product type in the tank is changed. Remove all emulsion and asphalt material during cleaning. Additionally, clean the distributor tank if the quality of the tack or prime shot diminishes or buildup causes the calibration of the tank to be affected.

300-3.2 Sampling Device: Equip all pressure distributors and transport tanks with an approved spigot-type sampling device.

300-3.3 Temperature Sensing Device: Equip all pressure distributors and transport tanks with an approved dial type thermometer.

Use a thermometer with a temperature range from 50 to 500ºF, no greater than 25ºF increments, and a minimum dial diameter of two inches.

Locate the thermometer near the midpoint of the tank's length and within the middle third of the tank's height, or as specified by the manufacturer (if in a safe and easily accessible location). Enclose the thermometer in a well with a protective window or by other means as necessary to keep the instrument clean and in the proper working condition.

300-4 Contractor's Quality Control.

Provide the necessary quality control of the prime and tack coats and application in accordance with the Contract requirements. If the application rate varies by more than 0.01 gallon per square yard from the rate set by the Engineer or varies beyond the range established in 300-7 or 300-8, immediately make all corrections necessary to bring the application rate into the acceptable range. The Engineer may take additional measurements at any time. The Engineer will randomly check the Contractor's measurement to verify the application rate.

300-5 Cleaning Base and Protection of Adjacent Work.

Before applying any bituminous material, remove all loose material, dust, sand, dirt, caked clay, and other foreign material which might prevent proper bond with the existing surface for the full width of the application. Take particular care in cleaning the outer edges of the strip to be treated, to ensure the prime or tack coat will adhere.

When applying prime or tack coat adjacent to curb and gutter, valley gutter, or any other concrete surfaces, cover such concrete surfaces, except where they are to be covered with a bituminous wearing course, with heavy paper or otherwise protect them as approved by the Engineer, while applying prime or tack coat. Remove any bituminous material deposited on such concrete surfaces.

300-6 Weather Limitations.

Do not apply prime and tack coats when the air temperature in the shade and away from artificial heat is less than 40ºF at the location where the application is to be made or when weather conditions or the surface conditions are otherwise unfavorable.

300-7 Application of Prime Coat.

300-7.1 General: Clean the surface to be primed and ensure the moisture content of the base does not exceed the optimum moisture. Heat the prime coat material to the temperature recommended by the prime coat manufacturer. Apply the material with a pressure distributor. Determine the application amount based on the character of the surface. Use an amount sufficient to coat the surface thoroughly and uniformly with no excess.

The Contractor may elect to omit application of bituminous prime coat on previously prepared or exposed bases when an asphalt lift is placed within 24 hours of final preparation of such bases. Keep base moisture content within acceptable range. Protect finished base from rain and ensure base bonds adequately to the new lift of asphalt pavement. Apply prime to base when asphalt is not placed within 24 hours of final preparation of base. Apply prime to full depth reclamation and cement stabilized bases.

300-7.2 Application Rate: Use an application rate as defined in Table 300-1. Control the application rate within the minimum and plus 0.01 gallon per square yard of the minimum application rate. The minimum application rate may be adjusted by the Engineer to meet specific field conditions. Determine and record the application rate a minimum of twice per day, once at the beginning of each day's production and, as needed, to control the operation.

Table 300-1
Prime Coat - Minimum Application Rates

Base Type	Minimum Application Rate (gal/yd^2)
Limerock, Limerock Stabilized, Shell-Rock, Recycled Concrete Aggregate and Local Rock Bases	0.10
Sand-Clay, Cemented Coquina, Shell, and Shell Stabilized Bases	0.15

300-7.3 Sprinkling: If required by the Engineer, lightly sprinkle the base with water and roll it with a traffic roller in advance of the prime coat application.

300-7.4 Partial Width of Application: If traffic conditions warrant, the Engineer may require the application be made on only one-half the width of the base at one time, in which case, use positive means to secure the correct amount of bituminous material at the joint.

300-8 Application of Tack Coat.

300-8.1 General: Where the Engineer requires a tack coat prior to laying a bituminous surface, apply the tack coat as specified herein below. Coat the surface completely and uniformly with tack.

300-8.2 Where Required: Place a tack coat on all asphalt layers prior to constructing the next course. In general, the Engineer will not require a tack coat on primed bases except in areas that have become excessively dirty and cannot be cleaned, or in areas where the prime has cured to the extent all bonding effect has been lost.

300-8.3 Method of Application: Apply the tack coat with a pressure distributor except on small jobs, if approved by the Engineer, apply it by other mechanical devices or by hand methods. Heat the bituminous material to a suitable temperature as designated by the supplier.

300-8.4 Application Rate: Use an application rate defined in Table 300-2. Control the application rate within plus or minus 0.01 gallon per square yard of the target application rate. The target application rate may be adjusted by the Engineer to meet specific field conditions.

Determine and record the application rate a minimum of twice per day, once at the beginning of each day's production and again, as needed, to control the operation. When using PG 52-28, multiply the target application rate by 0.6.

Table 300-2 Tack Coat Application Rates		
Asphalt Mixture Type	Underlying Pavement Surface	Target Tack Rate (gal/yd^2)[1]
Base Course, Structural Course, Dense-Graded Friction Course, Open-Graded Friction Course	Newly Constructed Asphalt Layers	0.06
	Milled Asphalt Pavement Surface, Oxidized and Cracked Asphalt Pavement, Concrete Pavement	0.09
Note 1: Target tack application rates greater than those specified may be used upon approval of the Engineer.		

When using a meter to control the tack or prime application rate, manually measure the volume in the tank at the beginning and end of the application area for a specific target application rate. Perform this operation at a minimum frequency of once per production shift. Resolve any differences between the manually measured method and the meter to ensure the target application rate is met in accordance with this Section. Adjust the application rate if the manually measured application rate is greater than plus 0.02 or minus 0.01 gallons per square yard when compared to the target application rate.

300-8.5 Curing and Time of Application: When using a distributor, apply tack coat sufficiently in advance of placing bituminous mix to permit drying, but do not apply tack coat so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material. When using a spray paver, the requirements above do not apply.

300-8.6 Protection: Keep the tack coat surface free from traffic until the subsequent layer of bituminous hot mix has been laid.

300-9 Method of Measurement.

300-9.1 General: The quantity specified will be the volume, in gallons, of bituminous material actually applied and accepted. This application rate will be determined from measurements made by the Contractor and verified by the Engineer based on tank calibrations, as specified in 300-9.2. Where it is specified prime coat material is to be diluted with water, the amount specified for the application rate will be the volume after dilution.

300-9.2 Calibration of Tanks: Ensure all distributors used for applying tack or prime coats are calibrated prior to use by a reliable and recognized firm engaged in calibrating tanks. Submit a certification of calibration and the calibration chart to the Engineer prior to use. In lieu of a volumetrically calibrated distributor, use a distributor equipped with a calibrated meter approved by the Engineer.

300-9.3 Temperature Correction: Measure the volume and increase or decrease the volume actually measured to a corrected volume at a temperature of 60ºF.

Make the correction for temperature by applying the applicable conversion factor (K), as shown below.

For petroleum oils having a specific gravity above 0.966 at 60°F, K = 0.00035 per degree.

For petroleum oils having a specific gravity of between 0.850 and 0.966 at 60°F, K = 0.00040 per degree.

For emulsified asphalt, K = 0.00025 per degree.

When volume-correction tables based on the above conversion factors are not available, use the following formula in computing the corrections for volumetric change:

$$V = \frac{V^1}{K\,(T - 60) + 1}$$

Where:

V= Volume of bituminous material at 60ºF (pay volume).

V^1= Volume of bituminous material as measured.

K= Correction factor (Coefficient of Expansion).

T= Temperature (in ºF), of bituminous material when measured.

300-10 Basis of Payment.

There is no direct payment for the work specified in this Section, it is incidental to, and is to be included in the other items of related work.

SECTION 320
HOT MIX ASPHALT -
PLANT METHODS AND EQUIPMENT

320-1 General.

This Section specifies the basic equipment and operational requirements for hot mix asphalt (including warm mix asphalt) production facilities used in the construction of asphalt pavements and bases. Establish and maintain a quality control system that provides assurance that all materials and products submitted for acceptance meet Contract requirements.

320-2 Quality Control (QC) Requirements.

320-2.1 Minimum Producer QC Requirements: Perform as a minimum the following activities:

1. Stockpiles:
    a. Assure materials are placed in the correct stockpile;
    b. Assure good stockpiling techniques;
    c. Inspect stockpiles for separation, contamination, segregation, and other similar items;
    d. Properly identify and label each stockpile.
2. Incoming Aggregate:
    a. Obtain gradations and bulk specific gravity (G_{sb}) values from aggregate supplier for reference;
    b. Determine the gradation of all component materials and routinely compare gradations and G_{sb} values to mix design.
3. Cold Bins:
    a. Calibrate the cold gate/feeder belt for each material;
    b. Determine cold gate/feeder belt settings;
    c. Observe operation of cold feeder for uniformity;
    d. Verify accuracy of all settings;
    e. Verify that the correct components are being used, and that all modifiers or additives or both are being incorporated into the mix.
4. Batch Plants:
    a. Determine percent used and weight to be pulled from each bin to assure compliance with the mix design;
    b. Check mixing time;
    c. Check operations of weigh bucket and scales.
5. Drum Mixer Plants:
    a. Determine aggregate moisture content;
    b. Calibrate the weigh bridge on the charging conveyor.
6. Control Charts: Maintain QC data and charts (updated daily) for all QC Sampling and Testing and make available upon demand. Provide the following charts:
    a. All components used to determine the composite pay factor (No. 8 sieve, No. 200 sieve, asphalt binder content, air voids, and density);
    b. Gradation of incoming aggregate;
    c. Gradation, asphalt binder content and maximum specific gravity (G_{mm}) of RAP;

d. Any other test result or material characteristic (as determined by the Contractor) necessary for process control.

The above listed minimum activities are to be considered normal activities necessary to control the production of hot mix asphalt at an acceptable quality level. Depending on the type of process or materials, some of the activities listed may not be necessary and in other cases, additional activities may be required. The frequency of these activities will also vary with the process and the materials. When the process varies from the defined process average and variability targets, the frequency of these activities will be increased until the proper conditions have been restored.

320-2.2 Minimum Process Control Testing Requirements: Perform, as a minimum, the following activities at the testing frequencies provided in Table 320-1. QC tests used in the acceptance decision may be used to fulfill these requirements.

Table 320-1

Asphalt Plant - Materials Testing Frequencies

Material	Property	Minimum Testing Frequency
Aggregate	Gradation	Once per 1,000 tons of incoming aggregate
Asphalt Mix	Asphalt Binder Content	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Bulk Specific Gravity (G_{mb})	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Gradation	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Maximum Specific Gravity (G_{mm})	If daily production > 100 tons, once per day; If daily production > 1,000 tons, twice per day. *
Asphalt Mix	Temperature	Each of first 5 loads, then once every 5 loads thereafter, per day per mix design.
RAP	Asphalt Binder Content	Once per 1,000 tons RAP
RAP	Gradation	Once per 1,000 tons RAP
RAP	Maximum Specific Gravity (G_{mm})	Once per 5,000 tons RAP

*If less than 100 tons of mix is produced on each of successive days of production, resulting in a cumulative quantity of greater than 100 tons, then perform the indicated test.

320-2.3 Personnel Qualifications: Provide QC Technicians in accordance with Section 105.

320-2.4 Hot Mix Asphalt Testing Laboratory Requirements: Furnish a fully equipped asphalt laboratory at the production site. The laboratory must be qualified under the Department's Laboratory Qualification Program, as described in Section 105. In addition, the laboratory shall meet the following requirements:

1. Area - The effective working area of the laboratory shall be a minimum of 180 square feet, with a layout of which will facilitate multiple tests being run simultaneously by two technicians. This area does not include the space for desks, chairs and file cabinets. Any variations shall be approved by the Engineer.

2. Lighting - The lighting in the lab must be adequate to illuminate all areas of the work.

3. Temperature Control - Equip the lab with heating and air conditioning units that provide a satisfactory working environment.

4. Ventilation - Equip the lab with exhaust fans that will remove all hazardous fumes from within the laboratory in accordance with OSHA requirements.

5. Equipment and Supplies - Furnish the lab with the necessary sampling and testing equipment and supplies for performing contractor QC and Department Verification Sampling and Testing. A detailed list of equipment and supplies required for each test is included in the appropriate FDOT, AASHTO, or ASTM Test Method. In the event testing equipment goes out of service during production, the Contractor may elect to use replacement equipment at another laboratory qualified, as described in Section 105, for up to 72 hours upon notification of the Engineer.

6. Personal Computer - Provide a personal computer capable of running a Microsoft Excel™ spreadsheet program, along with a printer.

7. Communication - Provide a telephone and fax machine (with a private line) for the use of the testing facility's QC personnel. In addition, provide an internet connection capable of uploading data to the Department's database and for e-mail communications.

320-3 Requirements for All Plants.

320-3.1 General: Design, manufacture, coordinate, and operate the asphalt plant in a manner that will consistently produce a mixture within the required tolerances and temperatures specified.

320-3.2 Asphalt Plant Ticketing Systems: Use either a paper ticketing system or an electronic ticketing (E-Ticketing) system.

320-3.2.1 Electronic Weigh Systems for Paper Ticketing: Equip the asphalt plant with an electronic weigh system that has an automatic printout, is certified every six months by an approved certified scale technician, and meets monthly comparison checks with certified truck scales as specified in 320-3.2.1.4. Weigh all plant produced hot mix asphalt on the electronic weigh system, regardless of the method of measurement for payment.

Include, as a minimum, the following information on the printed delivery ticket:

1. Sequential load number
2. Project number
3. Date
4. Name and location of plant
5. Mix design number
6. Place for hand-recording mix temperature
7. Truck number
8. Gross, tare, and net tonnage per truck (as applicable)
9. Daily total tonnage of mix for the mix design

Print the delivery ticket with an original and at least one copy. Furnish the original to the Engineer at the plant and one copy to the Engineer at the paving site.

Utilize any one of the following three electronic weigh systems.

320-3.2.1.1 Electronic Weigh System on the Truck Scales: Provide an electronic weigh system on all truck scales, which is equipped with an automatic recordation system that is approved by the Engineer. Use scales of the type that directly indicate the total weight of the loaded truck. Use scales meeting the requirements for accuracy, condition, etc., of the Bureau of Weights and Measures of the Florida Department of Agriculture, and re-certify such fact every six months, either by the Bureau of Weights and Measures or by a registered scale technician.

320-3.2.1.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin: Provide an electronic weigh system on the hopper (hopper scales or load cells) beneath the surge or storage bin, which is equipped with an automatic recordation system approved by the Engineer.

320-3.2.1.3 Automatic Batch Plants with Printout: For batch plants, provide an approved automatic printer system which will print the individual or cumulative weights of aggregate and liquid asphalt delivered to the pugmill and the total net weight of the asphalt mix measured by hopper scales or load cell type scales. Use the automatic printer system only in conjunction with automatic batching and mixing control systems that have been approved by the Engineer.

320-3.2.1.4 Monthly Electronic Weigh System Comparison Checks: Check the accuracy of the electronic weighing system at the commencement of production and thereafter by one of the following two methods and maintain a record of the weights in the Scale Check Worksheet. The time period between scale checks shall not exceed 35 calendar days.

320-3.2.1.4.1 Electronic Weigh System on Truck Scales:

1. The Engineer will randomly select a loaded truck of asphalt mix, a loaded aggregate haul truck, or another vehicle type approved by the Engineer and record the truck number and gross weight from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. The gross weight of the loaded truck as shown on the Contractor's delivery ticket will be compared to the gross weight of the loaded truck from the other certified truck scale. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

4. If the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks, a fuel adjustment may be calculated by using the truck odometer readings for the distance measurement, and 6.1 miles per gallon for the fuel consumption rate, and 115 ounces per gallon for fuel weight.

5. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to weigh the truck on his certified scales used during production and then weigh it on another certified truck scale, as soon the other scale is available for the comparison checks.

In addition to the periodic checks as specified above, check the scales at any time the accuracy of the scales becomes questionable. When such inaccuracy does not appear to be sufficient to seriously affect the weighing operations, the Engineer will allow a period of two calendar days for the Contractor to conduct the required scale check.

However, in the event the indicated inaccuracy is sufficient to seriously affect the mixture, the Engineer may require immediate shut-down until the accuracy of the scales has been checked and necessary corrections have been made. Include the cost of all scale checks in the bid price for asphalt concrete, at no additional cost to the Department.

320-3.2.1.4.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin and Automatic Batch Plants with Printout:

1. The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

4. Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

5. Use the fuel adjustment as specified in 320-3.2.4.1(4), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

6. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the printed weight is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the printer. While the system is out of tolerance and before its adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.2.2 Electronic Weigh Systems for E-Ticketing: Equip the asphalt plant with an electronic weigh system that has an automatic printout, is certified every six months by an approved certified scale technician, and meets monthly comparison checks with certified truck scales as specified in 320-3.2.2.3. Weigh all plant produced hot mix asphalt on the electronic weigh system, regardless of the method of measurement for payment.

Include, as a minimum, the following information in the electronic delivery ticket:

1. Sequential load number
2. Project's Financial Identification Number (FIN)
3. Date
4. Name and location of plant
5. Mix design number
6. Separate, individual, data entry locations for recording mix temperature by:

a. Plant QC
b. Plant VT
c. Roadway QC
d. Roadway VT

7. Truck number
8. Gross, tare, and net tonnage per truck
9. Daily cumulative tonnage of mix for the mix design

320-3.2.2.1 Electronic Ticketing (E-Ticketing) System: Provide an e-Ticketing System (including any necessary software and hardware) capable of monitoring, collecting, storing, and reporting the information required by the Contract for all loads of asphalt mix delivered to the project. After each truck is loaded, electronically record and use a web service to upload the ticket information to the E-ticketing software database. The E-ticketing system shall provide each truck load's ticket information to users of the e-ticketing software.

E-ticketing software must provide the Engineer the ability to access real-time monitoring of asphalt truck load ticket information as described herein.

The e-Ticketing system shall be integrated with the Load Read-Out scale system at the asphalt plant site.

The e-ticketing system shall have offline capabilities to prevent data loss in the event of power loss or loss of connectivity.

320-3.2.2.1.1 E-Ticketing System Construction Requirements: Install and operate equipment in accordance with the manufacturer's specifications.

320-3.2.2.1.2 Data Deliverables: Provide to the Engineer a means of gathering report summaries by way of iOS or Android apps, web pages, or any other method at the disposal of the Engineer. The Engineer may request data at any time during paving operations. In addition to providing reports referenced in this specification, provide monthly reports, as well as, a final, end of project report in the e-ticketing software and in a comma separated value (.csv) file. Provide all e-ticketing database data required in this Section in the monthly and end of project reports and .csv files.

320-3.2.2.1.3 Real-Time Continuous e-Ticketing Data Items: Provide the Engineer access to the e-Ticketing system data viewer which displays the following information in real-time with a web-based or App-based system compatible with iOS, Windows, or Android environments:

1. Each Truck:
    a. Unique Truck ID
    b. Sequential Truck Load Number
    c. Mix Design Number
    d. Net Weight of material being transported (to the nearest 0.01 ton)
    e. Running Daily Total of Net Weight of material being transported (to the nearest 0.01 ton)
    f. Project's Financial Identification Number
2. Project Location

320-3.2.2.1.4 Daily Summary: Provide the following summary information to the Engineer electronically within 4 hours of beginning operations on the next working day:

1. List of Individual Loads

a. Contractor Name
b. Project's Financial Identification Number (FIN)
c. Unique Truck ID
d. Sequential Load Number
e. Net Weight for Payment (nearest 0.01 tons)
f. Net Weight of Waste (nearest 0.01 tons)
g. Date Paved
h. Mix Temperature Measurements (Plant QC, Plant VT, Roadway QC, and Roadway VT)
i. Time Loaded at Plant site

320-3.2.2.2 Electronic Weigh Systems: Utilize any one of the following three electronic weigh systems.

320-3.2.2.2.1 Electronic Weigh System on the Truck Scales: Provide an electronic weigh system on all truck scales, which is equipped with an automatic recordation system that is approved by the Engineer. Use scales of the type that directly indicate the total weight of the loaded truck. Use scales meeting the requirements for accuracy, condition, etc., of the Bureau of Weights and Measures of the Florida Department of Agriculture, and re-certify such fact every six months, either by the Bureau of Weights and Measures or by a registered scale technician.

320-3.2.2.2.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin: Provide an electronic weigh system on the hopper (hopper scales or load cells) beneath the surge or storage bin, which is equipped with an automatic recordation system approved by the Engineer.

320-3.2.2.2.3 Automatic Batch Plants: For batch plants, provide an electronic weigh system, which is equipped with an automatic recordation system, that is approved by the Engineer, which will directly indicate the individual or cumulative weights of aggregate and liquid asphalt delivered to the pugmill and the total net weight of the asphalt mix measured by hopper scales or load cell type scales. Use the electronic systems only in conjunction with automatic batching and mixing control systems that have been approved by the Engineer.

320-3.2.2.3 Monthly Electronic Weigh System Comparison Checks: Check the accuracy of the electronic weighing system at the commencement of production and thereafter by one of the following three methods and maintain a record of the weights in the Scale Check Worksheet. The time period between scale checks shall not exceed 35 calendar days.

320-3.2.2.3.1 Electronic Weigh System on Truck Scales:

1. The Engineer will randomly select a loaded truck of asphalt mix, a loaded aggregate haul truck, or another vehicle type approved by the Engineer and record the truck number and gross weight from the Contractor's delivery ticket.
2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.
3. The gross weight of the loaded truck as shown on the Contractor's delivery ticket will be compared to the gross weight of the loaded truck from the

other certified truck scale. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

4. If the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks, a fuel adjustment may be calculated by using the truck odometer readings for the distance measurement, and 6.1 miles per gallon for the fuel consumption rate, and 115 ounces per gallon for fuel weight.

5. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to weigh the truck on his certified scales used during production and then weigh it on another certified truck scale, as soon as the other scale is available for the comparison checks.

In addition to the periodic checks as specified above, check the scales at any time the accuracy of the scales becomes questionable. When such inaccuracy does not appear to be sufficient to seriously affect the weighing operations, the Engineer will allow a period of two calendar days for the Contractor to conduct the required scale check. However, in the event the indicated inaccuracy is sufficient to seriously affect the mixture, the Engineer may require immediate shut-down until the accuracy of the scales has been checked and necessary corrections have been made. Include the cost of all scale checks in the bid price for asphalt concrete, at no additional cost to the Department.

320-3.2.2.3.2 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin:

1. The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

4. Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

5. Use the fuel adjustment as specified in 320-3.2.2.3.1(4), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

6. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the printed weight is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the printer. While the system is out of tolerance and before its

adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.2.2.3.3 Electronic Weigh System on Hoppers Beneath a Surge or Storage Bin and Automatic Batch Plants with Printout:

1. The Engineer will randomly select a loaded truck of asphalt mix and record the truck number, and the net weight of the asphalt mix from the Contractor's delivery ticket.

2. Weigh the selected truck on a certified truck scale, which is not owned by the Contractor and record the gross weight for the comparison check. If another certified truck scale is not available, the Engineer may permit another set of certified truck scales owned by the Contractor to be used. The Engineer may elect to witness the scale check.

3. Deliver the asphalt mix to the project, then weigh the selected empty truck on the same certified truck scales. Record the tare weight of the truck.

4. Compare the net weight of the asphalt mix from the delivery ticket to the calculated net weight of the asphalt mix as determined by the certified truck scale weights. The maximum permissible deviation is 8 pounds per ton of load, based on the certified truck scale weight.

5. Use the fuel adjustment as specified in 320-3.2.1.4.1(4), when the distance from the asphalt plant to the nearest certified truck scale is enough for fuel consumption to affect the accuracy of the comparison checks.

6. During production, when an additional certified truck scale is not available for comparison checks, the Engineer may permit the Contractor to load a truck with aggregate from the pugmill, surge or storage bin, and follow the above procedures to conduct the comparison checks as soon as certified truck scale is available.

If the check shows a greater difference than the tolerance specified above, then recheck on a second set of certified scales. If the check and recheck indicate that the weight on the E-Ticket is out of tolerance, have a certified scale technician check the electronic weigh system and certify the accuracy of the E-Ticketing system. While the system is out of tolerance and before its adjustment, the Engineer may allow the Contractor to continue production only if provisions are made to use a set of certified truck scales to determine the truck weights.

320-3.3 Asphalt Binder: Meet the following requirements:

320-3.3.1 Transportation: Deliver the asphalt binder to the asphalt plant at a temperature not to exceed 370°F, and equip the transport tanks with sampling and temperature sensing devices meeting the requirements of 300-3.2.

320-3.3.2 Storage: Equip asphalt binder storage tanks to heat the liquid asphalt binder to the temperatures required for the various mixtures. Heat the material in such a manner that no flame comes in contact with the binder. Heat or insulate all pipe lines and fittings. Use a circulating system of adequate size to ensure proper and continuous circulation during the entire operating period. Locate a thermometer, reading from 200 to 400°F, either in the storage tank or in the asphalt binder feed line. Maintain the asphalt binder in storage within a range of 230 to 355°F in advance of mixing operations. Locate a sampling device on the discharge piping exiting the storage tank or at a location as approved by the Engineer. Provide a metal can of one quart capacity for binder sampling at the request of the Engineer.

320-3.4 Aggregate: Meet the following requirements:

320-3.4.1 Stockpiles: Place each aggregate component in an individual stockpile, and separate each from the adjacent stockpiles, either by space or by a system of bulkheads. Prevent the intermingling of different materials in stockpiles at all times. Identify each stockpile, including RAP, as shown on the mix design.

Form and maintain stockpiles in a manner that will prevent segregation. If a stockpile is determined to be segregated, discontinue the use of the material on the project until the appropriate actions have been taken to correct the problem.

320-3.4.2 Blending of Aggregates: Stockpile all aggregates prior to blending or placing in the cold feed bins. If mineral filler or hydrated lime is required in the mix, feed or weigh it in separately from the other aggregates.

320-3.4.2.1 Cold Feed Bin: Provide a separate cold feed bin for each component of the fine and coarse aggregate required by the mix design. Equip the cold feed bins with accurate mechanical means for feeding the aggregate uniformly into the dryer in the proportions required for the finished mix to maintain uniform production and temperature. When using RAP as a component material, prevent any oversized RAP from being incorporated into the completed mixture by the use of: a grizzly or grid over the RAP bin; in-line roller or impact crusher; screen; or other suitable means. If oversized RAP material appears in the completed recycled mix, take the appropriate corrective action immediately. If the appropriate corrective actions are not immediately taken, stop plant operations.

Use separate bin compartments in the cold aggregate feeder that are constructed to prevent any spilling or leakage of aggregate from one cold feed bin to another. Ensure that each cold feed bin compartment has the capacity and design to permit a uniform flow of aggregates. Mount all cold feed bin compartments over a feeder of uniform speed, which will deliver the specified proportions of the separate aggregates to the drier at all times. If necessary, equip the cold feed bins with vibrators to ensure a uniform flow of the aggregates at all times.

320-3.4.2.2 Gates and Feeder Belts: Provide each cold feed bin compartment with a gate and feeder belt, both of which are adjustable to assure the aggregate is proportioned to meet the requirements of the mix design.

320-3.4.3 Screening Unit: Remove any oversized pieces of aggregate by the use of a scalping screen. Do not return this oversized material to the stockpile for reuse unless it has been crushed and reprocessed into sizes that will pass the scalping screen. Ensure that the quantity of aggregates being discharged onto the screens does not exceed the capacity of the screens to actually separate the aggregates into the required sizes.

320-3.5 Dryer: Provide a dryer of satisfactory design for heating and drying the aggregate. Use a dryer capable of heating the aggregate to within the specified temperature range for any mix, and equip the dryer with an electric pyrometer placed at the discharge chute to automatically register the temperature of the heated aggregates.

320-3.6 Asphalt Binder Control Unit: Provide a satisfactory means, either by weighing, metering, or volumetric measuring, to obtain the proper amount of asphalt binder material in the mix, within the tolerance specified for the mix design.

320-3.7 Contractor's Responsibilities: Acceptance of any automatic delivery ticket printout, electronic weight delivery ticket, other evidence of weight of the materials or approval of any particular type of material or production method will not constitute agreement by the Department that such matters are in accordance with the Contract Documents and it shall be the Contractor's responsibility to ensure that the materials delivered to the project are in accordance with the Contract Documents.

320-4 Additional Requirements for Batch Plants.

320-4.1 Heating and Drying: Heat and dry the aggregate before screening. Control the temperature of the aggregate so the temperature of the completed mixture at the plant falls within the permissible range allowed by this Section.

320-4.2 Gradation Unit: Provide plant screens capable of separating the fine and coarse aggregates and of further separating the coarse aggregate into specific sizes. In addition, equip the gradation unit with a scalping screen to restrict the maximum size of the aggregates. In the event that the plant is equipped with cold feed bins that are capable of adequately controlling the gradation of the mixture, the use of plant screens is optional.

320-4.3 Hot Bins: Provide storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Provide hot bins with divided compartments to ensure separate and adequate storage of the appropriate fractions of the aggregate. Equip each compartment with an overflow chute of suitable size and location to prevent any backing up of material into other bins.

320-4.4 Weigh Box or Hopper: Equip the batch plant with a means for accurately weighing each bin size of aggregate and the mineral filler into the weigh box or hopper.

320-4.5 Pugmills: Utilize a pugmill capable of mixing the aggregate and the asphalt binder.

320-5 Additional Requirements for Drum Mixer Plants.

320-5.1 Weight Measurements of Aggregate: Equip the plant with a weigh-in-motion scale capable of measuring the quantity of aggregate (and RAP) entering the dryer.

320-5.2 Synchronization of Aggregate Feed and Asphalt Binder Feed: Couple the asphalt binder feed control with the total aggregate weight device, including the RAP feed, in such a manner as to automatically vary the asphalt binder feed rate as necessary to maintain the required proportions.

320-5.3 Hot Storage or Surge Bins: Equip the plant with either a surge bin or storage silo that is capable of storing an adequate amount of material to assure a uniform and consistent product.

320-6 Preparation of the Mixture.

320-6.1 Mixing: After the aggregate is dried and properly proportioned, mix the aggregate, along with any other components, with the asphalt binder to produce a thoroughly and uniformly coated mixture. Do not produce the mix by altering the component blend percentage of the RAP or sand by more than plus or minus 5.0% from the job mix formula on the approved mix design. For mix designs using fractionated RAP, the combined blend change for all RAP components must not exceed plus or minus 5.0%. The plus or minus 5.0% maximum component change does not apply to crushed virgin aggregate components during production.

320-6.2 Storage: If necessary, store the asphalt mixture in a surge bin or hot storage silo for a maximum of 72 hours. For FC-5 mixtures containing mineral fibers, store the asphalt mixture in a surge bin or hot storage silo for a maximum of one hour. For FC-5 mixtures containing cellulose fibers, store the asphalt mixture in a surge bin or hot storage silo for a maximum of 1-1/2 hours.

320-6.3 Mix Temperature: Produce the mixture with a temperature within the master range as defined in Table 320-2.

320-6.3.1 Test Requirements: Determine the temperature of the completed mixture using a quick-reading thermometer through a hole in the side of the loaded truck immediately after loading. Locate a 1/4 inch hole on both sides of the truck body within the

middle third of the length of the body, and at a distance from 6 to 10 inches above the surface supporting the mixture. If a truck body already has a hole located in the general vicinity of the specified location, use this hole. At the Engineer's discretion, the Contractor may take the temperature of the load over the top of the truck in lieu of using the hole in the side of the truck.

320-6.3.2 Test Frequency: The normal frequency for taking asphalt mix temperatures will be for each day, for each design mix on the first five loads and one out of every five loads thereafter. Take the temperature of the asphalt mix at the plant and at the roadway before the mix is placed at the normal frequency. Record the temperature on the front of the respective delivery ticket. The Engineer shall review the plant and roadway temperature readings and may take additional temperature measurements at any time.

If any single load at the plant or at the roadway is within the master range shown in Table 320-2 but does not meet the criteria shown in Table 320-3, the temperature of every load will be monitored until the temperature falls within the specified tolerance range in Table 320-3; at this time the normal frequency may be resumed. For warm mix asphalt, the Contractor may produce the first five loads of the production day and at other times when approved by the Engineer, at a hot mix asphalt temperature not to exceed 330°F for purposes of heating the asphalt paver. For this situation, the upper tolerances of Tables 320-2 and 320-3 as applied to the warm mix asphalt mix design do not apply.

For windrow paving, in addition to the truck load temperature measurements noted above, perform windrow temperature measurements at a frequency of one measurement per 500 feet of windrow placed. Check the temperature of the windrow asphalt mixture using a quick-reading thermometer or directly in front of the windrow material transfer vehicle, but not so close that paving must be stopped. Measure the temperature of the windrow beneath the exposed surface by shoveling away a portion of the windrow and then measuring the temperature. For windrow temperature measurements, the requirements of Table 320-2 and 320-3 apply.

320-6.3.3 Rejection Criteria: Reject any load or portion of a load of asphalt mix at the plant or at the roadway with a temperature outside of its respective master range shown in Table 320-2. Notify the Engineer of the rejection immediately. The maximum temperature for any load of mixture containing PG 76-22 PMA or High Polymer binder shall not exceed 355°F.

Table 320-2	
Mix Temperature Master Range Tolerance	
Location	Acceptable Temperature Tolerance
Plant	Mixing Temperature ±30°F*
Roadway (mix in truck)	Compaction Temperature ±30°F*
Roadway (mix in windrow)	Compaction Temperature +30°F*, -40°F
*Not to exceed 355°F for mixtures containing PG 76-22 PMA or High Polymer binder.	

Table 320-3	
Mix Temperature Tolerance from Verified Mix Design	
Any Single Measurement	±25°F

320-7 Transportation of the Mixture.

Transport the mix in trucks of tight construction, which prevents the loss of material and the excessive loss of heat and previously cleaned of all foreign material. After cleaning, thinly

coat the inside surface of the truck bodies with soapy water or an asphalt release agent as needed to prevent the mixture from adhering to the beds. Do not allow excess liquid to pond in the truck body. Do not use a release agent that will contaminate, degrade, or alter the characteristics of the asphalt mix or is hazardous or detrimental to the environment. Petroleum derivatives (such as diesel fuel), solvents, and any product that dissolves asphalt are prohibited. Provide each truck with a tarpaulin or other waterproof cover mounted in such a manner that it can cover the entire load when required. When in place, overlap the waterproof cover on all sides so that it can be tied down. Cover each load during cool and cloudy weather and at any time it appears rain is likely during transit with a tarpaulin or waterproof cover. Cover and tie down all loads of friction course mixtures.

SECTION 327
MILLING OF EXISTING ASPHALT PAVEMENT

327-1 Description.

Remove existing asphalt concrete pavement by milling to improve the rideability and cross slope of the finished pavement, to lower the finished grade adjacent to existing curb before resurfacing, or to completely remove existing pavement.

When milling to improve rideability, the Plans will specify an average depth of cut.

Take ownership of milled material.

327-2 Equipment.

Provide a milling machine capable of maintaining a depth of cut and cross slope to achieve the results specified in the Contract Documents. Use a machine with a minimum overall length (out-to-out measurement excluding the conveyor) of 18 feet and a minimum cutting width of 6 feet.

Equip the milling machine with a built-in automatic grade control system that can control the transverse slope and the longitudinal profile to produce the specified results.

To start the project, the Engineer will approve any commercially manufactured milling machine that meets the above requirements. If it becomes evident after starting milling that the milling machine cannot consistently produce the specified results, the Engineer will reject the milling machine for further use.

The Contractor may use a smaller milling machine when milling to lower the grade adjacent to existing curb or other areas where it is impractical to use the above described equipment.

Equip the milling machine with means to effectively limit the amount of dust escaping during the removal operation.

For complete pavement removal, the Engineer may approve the use of alternate removal and crushing equipment instead of the equipment specified above.

327-3 Construction.

327-3.1 General: Remove the existing raised pavement markers (RPMs) before milling. Include the cost of removing existing RPMs in the price for milling.

When milling to improve rideability or cross slope, remove the existing pavement to the average depth specified in the Plans, in a manner that will restore the pavement surface to a uniform cross slope and longitudinal profile. The Engineer may require the use of a stringline to ensure maintaining the proper alignment.

Establish the longitudinal profile of the milled surface in accordance with the milling plans. Ensure the final cross slope of the milled surface parallels the surface cross slope shown in the Plans or as directed by the Engineer. Establish the cross slope of the milled surface by a second sensing device near the outside edge of the cut or by an automatic cross slope control mechanism. The Plans may waive the requirement of automatic grade or cross slope controls where the situation warrants such action.

Operate the milling machine to minimize the amount of dust being emitted. The Engineer may require prewetting of the pavement.

Provide positive drainage of the milled surface and the adjacent pavement. Perform this operation on the same day as milling. Pave all milled surfaces no later than the day after the surface was milled.

If traffic is to be maintained on the milled surface before the placement of the new asphalt concrete, provide suitable transitions between areas of varying thickness to create a smooth longitudinal riding surface. Control milling operations to produce a pattern of striations and a texture that provide an acceptable riding surface.

Before opening an area which has been milled to traffic, sweep the pavement and gutters with a power broom or other approved equipment to remove, to the greatest extent practicable, fine material which will create dust under traffic. Sweep in a manner to minimize the potential for creation of a traffic hazard and to minimize air pollution. Do not sweep or allow milled asphalt into inlets.

Sweep the milled surface with a power broom before placing asphalt concrete.

In urban and other sensitive areas, use a street sweeper or other equipment capable of removing excess milled materials and controlling dust. Obtain the Engineer's approval of such equipment, contingent upon its demonstrated ability to do the work.

Perform the sweeping operation immediately after the milling operations or as directed by the Engineer.

327-3.1.1 Extended Time for Milled Surface Traffic: Upon approval of the Engineer, the time period for maintaining traffic on a milled surface may be extended up to 3 calendar days before paving is required, provided the Contractor can demonstrate the ability to produce a milled surface texture with continuous, longitudinal milling striations with no gaps in the longitudinal striations, and drop off conditions are not exceeded. Gaps in the milling striations and cases where gaps create a diagonal pattern or chevron appearance are to be milled again such that continuous, longitudinal striations are achieved prior to allowing traffic on the milled surface. Photos of acceptable and unacceptable surface texture are located at: https://www.fdot.gov/programmanagement/implemented/urlinspecs/milling-patterns

Maintain adequate drainage on the milled surface and at transitions between milled and non-milled surfaces on the same day as milling. At no cost to the Department, re-mill or pave any area the Engineer determines to have an unacceptable ride, does not provide adequate pavement structure, or does not provide adequate drainage.

If the Engineer determines the Contractor is unable to provide a milled surface meeting the Specification requirements above, at no cost to the Department, the Contractor will be required to pave all milled surfaces no later than the day after the surface was milled.

327-3.2 Quality Control Requirements: Furnish a four foot long electronic level accurate to 0.1 degree, approved by the Engineer for the control of cross slope. Make this electronic level available at the jobsite at all times during milling operations. Calibrate and compare electronic levels in accordance with 330-9.3.1 at a minimum frequency of once per day before any milling operation.

Multiple cuts may be made to achieve the required pavement configuration or depth of cut.

327-3.2.1 Cross Slope Measurement: Measure the cross slope of the milled surface by placing the level at the center of the lane and perpendicular to the roadway centerline. Record all the measurements to the nearest 0.1% on an approved form and submit the data to the Engineer.

327-3.2.1.1 Cross Slope Measurement Frequency:

1. Tangent Sections: Measure the cross slope at a minimum frequency of one measurement every 100 feet per lane. When the average absolute deviation is consistently within the acceptance tolerance in Table 327-1, upon approval by the Engineer, the frequency of the cross slope measurements can be reduced to one measurement every 200 feet.

2. Superelevated Sections: Measure the cross slope every 100 feet per lane within the length of full superelevation. For curves where the length of full superelevation is less than 250 feet, measure the cross slope at the beginning point, midpoint, and ending point of the fully superelevated section. For transition sections, measure the cross slope at control points identified in the Plans or, if not shown in the Plans, at a control point at a location of 0.0% cross slope.

327-3.2.1.2 Cross Slope Deviations and Corrections: Calculate the absolute deviation of each cross slope measurement and the average of the absolute deviations of ten consecutive cross slope measurements. The absolute deviation is the positive value of a deviation. In superelevated sections, when the number of measurements is less than ten, average the absolute deviation of all measurements.

If the average absolute deviation of any cross slope measurement falls outside the acceptance tolerance shown in Table 327-1, stop the milling operations and make adjustments until the problem is resolved to the satisfaction of the Engineer. If an individual cross slope deviation falls outside the acceptance tolerance as shown in Table 327-1, make corrections only in the deficient area to the satisfaction of the Engineer at no cost to the Department. For pavement with multiple cuts, the deficient areas not caused by the final cut may be left in place upon approval of the Engineer. All milling corrections shall be completed before placement of the asphalt course unless stated otherwise in the Plans or as determined by the Engineer.

The limits of deficient areas requiring correction may be verified and adjusted with more accurate measurement methods, including survey instruments, upon approval of the Engineer and at no cost to the Department.

Should the Contractor wish to have any required corrections waived, submit a request to the Engineer for approval. The Engineer may waive the corrections at no reduction in payment if the deficiencies are sufficiently separated so as not to significantly affect the final cross slope or project grade.

For intersections, tapers, crossovers, transitions at the beginning and end of the project, bridge approaches and similar areas, adjust the cross slope to match the actual site conditions, or as directed.

Table 327-1
Cross Slope Milling Acceptance Tolerance

Roadway Feature	Individual Absolute Deviation	Average Absolute Deviation
Tangent section (including turn lanes)	0.4%	0.2%
Superelevated curve	0.4%	0.2%
Shoulder	0.5%	0.5%

In the event the distance between two edges of deficient areas is less than 100 feet, the correction work shall include the area between the deficient areas.

327-3.3 Verification: The Engineer will verify the Contractor's cross slope measurements by randomly taking a minimum of ten cross slope measurements per lane per mile in tangent sections, at control points in transition sections, and a minimum of three cross slope measurements in fully superelevated sections. The Engineer will measure the cross slope of the milled surface by placing the level at the center of the lane and perpendicular to the roadway centerline.

327-3.3.1 Cross Slope Deviations and Corrections: If the average absolute deviation or an individual cross slope deviation falls outside the acceptance tolerance in Table 327-1, immediately make a comparison check at the QC test locations to verify the QC measurements in the section. If the comparisons are beyond the acceptable comparison tolerance in accordance with 327-3.2, stop the milling operation until the issue is resolved to the satisfaction of the Engineer. Correct any cross slope not meeting the individual deviation acceptance tolerance at no cost to the Department. The Engineer reserves the right to check the cross slope of the milled surface at any time by taking cross slope measurements at any location.

327-4 Milled Surface.

Provide a milled surface with a reasonably uniform texture, within 1/4 inch of a true profile grade, and with no deviation in excess of 1/4 inch from a straightedge applied to the pavement perpendicular to the centerline. Ensure the variation of the longitudinal joint between multiple cut areas does not exceed 1/4 inch. The Engineer may accept areas varying from a true surface in excess of the above stated tolerance without correction if the Engineer determines they were caused by a pre-existing condition which could not have reasonably been corrected by the milling operations. Correct any unsuitable texture or profile, as determined by the Engineer, at no cost to the Department.

The Engineer may require remilling of any area where a surface lamination causes a non-uniform texture to occur.

327-5 Method of Measurement.

The quantity to be paid for will be the plan quantity area, in square yards, over which milling is completed and accepted.

327-6 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including hauling off and stockpiling or otherwise disposing of the milled material.

Payment will be made under:

Item No. 327- 70- Milling Existing Asphalt Pavement - per square yard.

SECTION 330
HOT MIX ASPHALT -
GENERAL CONSTRUCTION REQUIREMENTS

330-1 Description.

This Section specifies the basic equipment and construction requirements for hot mix asphalt (including warm mix asphalt) pavements and bases. Establish and maintain a quality control system that provides assurance that all materials, products and completed construction submitted for acceptance meet Contract requirements.

330-1.1 Materials: Meet the following requirements:

Prime and Tack Coats .....Section 300

330-2 Quality Control (QC) Requirements.

330-2.1 Minimum QC Requirements: Perform as a minimum, the following activities necessary to maintain process control and meet Specification requirements:

1. Pavement Density: Monitor the pavement temperature with an infrared temperature device so compaction is completed before the surface temperature of the pavement drops to the extent that effective compaction may not be achieved or the rollers begin to damage the pavement. Monitor the roadway density with either 6-inch diameter roadway cores, a nuclear density gauge, or other density measuring device, at a minimum frequency of once per 1,500 feet of pavement.

2. Mix Temperature: Determine the mix temperature at the roadway for the first five loads and one out of every five loads thereafter.

3. Mix Spread Rate: Monitor the mix spread rate at the beginning of each day's production, and as needed to control the operations, at a minimum of once per 200 tons placed. When determining the spread rate, use, at a minimum, an average of five truckloads of mix.

4. Pavement Texture: Monitor the pavement texture to minimize pavement segregation. Use density gauges, infrared temperature measurement devices, or roadway cores at the beginning of each day's production, and as necessary, both at truck exchanges and during normal paving operations.

5. Reporting: Ensure the accuracy of the QC Roadway Reports on the Department's approved form to reflect the actual surface area of the finished work and be in compliance with the requirements of the Contract Documents.

6. Electronic Ticketing (E-Ticketing): When E-Ticketing is used, provide a tablet computer on site with the Paving Operation capable of running the E-Ticketing system software outlined in Section 320. Use the E-ticketing software to obtain truck ticket information and record mix temperatures. Use the E-ticketing data for entry into the Asphalt Roadway – Daily Report of Quality Control.

330-2.2 Personnel Qualifications: Provide QC Technicians in accordance with Section 105.

330-3 Limitations of Operations.

330-3.1 Weather Limitations: Do not transport asphalt mix from the plant to the roadway unless all weather conditions are suitable for the paving operations.

330-3.2 Limitations of Paving Operations:

330-3.2.1 General: Place the mixture only when the surface upon which it is to be placed has been previously prepared, is intact, firm, dry, clean, and the tack or prime coat, with acceptable spread rate, is properly broken or cured. Do not place friction course until the adjacent shoulder area has been dressed and grassed.

330-3.2.2 Ambient Air Temperature: Place the mixture only when the air temperature in the shade and away from artificial heat meets requirements of Table 330-1. The minimum ambient temperature requirement may be reduced by 5ºF when using warm mix technology, if mutually agreed to by both the Engineer and the Contractor.

Table 330-1

Ambient Air Temperature Requirements for Paving

Layer Thickness or Asphalt Binder Type	Minimum Temperature (°F)
≤ 1 inch	50
Any mixture > 1 inch containing a PG asphalt binder with a high temperature designation ≥ 76°C	45
Any mixture > 1 inch containing a PG asphalt binder with a high temperature designation < 76°C	40
FC-5[(1)]	65

[(1)]As an exception, place the mixture at temperatures no lower than 60ºF, only when approved by the Engineer based on the Contractor's demonstrated ability to achieve a satisfactory surface texture and appearance of the finished surface. For mixtures containing PG 76-22 binder, the minimum ambient temperature may be further reduced to 55ºF when using warm mix technology, if agreed to by both the Engineer and the Contractor.

330-3.2.3 Rain and Surface Conditions: Immediately cease transportation of asphalt mixtures from the plant when rain begins at the roadway. Do not place asphalt mixtures while rain is falling, or when there is water on the surface to be covered. Once the rain has stopped, standing water has been removed from the tacked surface to the satisfaction of the Engineer, and the temperature of the mixture caught in transit still meets the requirements as specified in 320-6.3, the Contractor may then place the mixture caught in transit.

For windrow paving, immediately cease dumping of asphalt material when rain begins at the roadway. Stop paving operations while rain is falling or where there is water on the surface to be covered. Remove windrowed asphalt mixture exposed to rain. Once the rain has stopped, standing water has been removed from the tacked surface to the satisfaction of the Engineer, and the temperature of the mixture caught in transit still meets the requirements as specified in 320-6.3, the Contractor may then windrow the remaining material caught in transit.

330-3.2.4 Wind: Do not place the mixture when the wind is blowing to such an extent that proper and adequate compaction cannot be maintained or when sand, dust, etc., are being deposited on the surface being paved to the extent the bond between layers will be diminished.

330-4 Surface Preparation.

330-4.1 Cleaning: Before placing the mixture, clean the surface of the base or underlying pavement of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.

330-4.1.1 Application over Asphalt Membrane Interlayer (AMI): Where an asphalt mix is to be placed over a newly constructed AMI, do not sweep or otherwise disturb the cover material before placing the asphalt mix, unless directed by the Engineer.

330-4.2 Tacking: Apply a tack coat on all existing pavement surfaces that are to be overlaid with an asphalt mix as specified in Section 300 and between successive layers of all asphalt mixes. Apply tack on a clean surface.

Do not place tack while rain is falling or when there is water on the surface to be tacked. Once the rain has stopped, standing water has been removed from the surface to be tacked to the satisfaction of the Engineer, the Contractor may then apply tack.

Apply a tack coat on freshly primed bases only when directed by the Engineer.

330-5 Paving Equipment.

330-5.1 General Requirements: Use mechanically-sound equipment capable of consistently meeting Specification requirements.

330-5.2 Asphalt Paver:

330-5.2.1 General: Provide a self-propelled asphalt paver that can be steered, and is equipped with a receiving and distribution hopper and a mechanical screed. Use a mechanical screed capable of adjustment to regulate the depth of material spread and to produce the desired cross slope.

When asphalt mix is placed in windrows, operate windrow pickup equipment so substantially all of the mixture deposited on the roadbed is picked up and loaded into the paver. Prevent the windrow pickup equipment from contaminating the mixture.

330-5.2.2 Automatic Screed Control: For all asphalt courses placed with an asphalt paver, equip the paver with automatic longitudinal screed controls of either the skid type, traveling stringline type, or non-contact averaging ski type with a minimum length of 25 feet. On the final layer of asphalt base, overbuild, structural courses, and friction courses, use the joint matcher instead of the skid, traveling stringline, or non-contact averaging ski on all passes after the initial pass. Equip the asphalt paver with electronic cross slope controls.

330-5.2.3 Screed Width: Provide an asphalt paver with a screed width greater than 8 feet when required to pave full width lanes. Do not use extendable screed strike-off devices that do not provide preliminary compaction of the mat in place of fixed screed extensions. Use a strike-off device only on irregular areas that would normally be done by hand and on shoulders 5 feet or less in width. When using the strike-off device on shoulders, instead of an adjustable screed extension, demonstrate the ability to obtain acceptable texture, density, and thickness.

When using an extendable screed device to extend the screed's width on the full width lane or shoulder by 24 inches or greater, the Engineer will require an auger extension, paddle, or kicker device unless the Contractor can demonstrate the ability to achieve an acceptable pavement with respect to density, surface texture, and pavement smoothness without such devices.

330-5.3 Rollers:

330-5.3.1 Steel-Wheeled Rollers: Provide compaction equipment capable of meeting the density requirements described in the Specifications. When density testing is not required, and the standard rolling pattern is used, provide a tandem steel-wheeled roller weighing 5 to 15 tons for breakdown rolling. For finish rolling, use a separate roller weighing 5 to 15 tons. Variations from these requirements shall be approved by the Engineer.

330-5.3.2 Traffic Rollers: Provide compaction equipment capable of meeting the density requirements described in the Specifications. When density testing is not required, and the standard rolling pattern is used, provide a self-propelled, pneumatic-tired traffic roller equipped with at least seven smooth-tread, low pressure tires, equipped with pads or scrapers on

each tire. Maintain the tire pressure between 50 and 55 psi or as specified by the manufacturer. Use rollers with a minimum weight of 6 tons. Do not use wobble-wheeled rollers. Variations from these requirements shall be approved by the Engineer.

330-5.3.3 Prevention of Adhesion: Do not allow the mixture to adhere to the wheels of any rollers. Do not use fuel oil or other petroleum distillates to prevent adhesion. Do not use any method which results in water being sprinkled directly onto the mixture.

330-5.4 Coring Equipment: Furnish a suitable saw or drill for obtaining the required density cores.

330-5.5 Hand Tools: Provide the necessary hand tools such as rakes, shovels, and other similar tools, and a suitable means for keeping them clean. Do not use diesel fuel or other petroleum-based solvents contained in an open container for cleaning purposes on the paver.

330-6 Placing Mixture.

330-6.1 Requirements Applicable to All Pavement Types:

330-6.1.1 Alignment of Edges: Place all asphalt mixtures by the stringline method to obtain an accurate, uniform alignment of the pavement edge. As an exception, pavement edges adjacent to curb and gutter or other true edges do not require a stringline. Control the unsupported pavement edge to ensure it will not deviate from the stringline more than plus or minus 1.5 inches.

330-6.1.2 Paving Width: If necessary due to the traffic requirements, place the mixture in strips in such a manner as to provide for the passage of traffic. As an option, where the road is closed to traffic, place the mixture to the full width with machines traveling in echelon.

330-6.1.3 Mix Temperature: Maintain the mix temperature at the time of paving within the master range as defined in 320-6.3. Take mix temperatures on the roadway at the minimum frequency indicated in 320-6.3. Any load, or portion of a load, of asphalt mix on the roadway with a temperature outside of the master range shall be rejected for use on the project. Immediately notify the Engineer of the rejection.

Remove any windrow material not meeting the temperature requirements of 320-6.3.2 from the area of deficient temperature and replace with new asphalt meeting the temperature requirements.

330-6.1.4 Speed of Paver: Establish the forward speed of the asphalt paver based on the rate of delivery of the mix to the roadway, but not faster than the optimum speed needed to adequately compact the pavement.

330-6.1.5 Thickness and Spread Rate of Layers: Construct each layer as defined in the following Table 330-2:

Table 330-2	
Thickness and Target Spread Rate Requirements	
Mix Type	Specification Section and Article
Type SP	334-1
Type FC	337-8
Type B	234-8
ATPB	287-8

330-6.1.5.1 Thickness Control: Ensure the spread rate is within plus or minus 10% of the target spread rate. When determining the spread rate, use, at a minimum, an average of five truckloads of mix and at a maximum, an average of 10 truckloads of mix, except for windrow paving, use an average of three truckloads of mix. When the average spread rate is beyond plus or minus 10% of the target spread rate, monitor the thickness of the pavement layer closely and adjust the construction operations.

When the average spread rate for two consecutive days is beyond plus or minus 10% of the target spread rate, stop the construction operation until the issue is resolved.

330-6.1.5.2 Maximum Spread Rate Tolerances: When an individual spread rate, measured in accordance with 330-6.1.5.1, is beyond plus or minus 20% of the target spread rate, stop the construction operation until the issue is resolved. Address the unacceptable pavement in accordance with 330-9.5. The following areas are exempt from a work stoppage based solely on the calculated spread rate: median crossovers, turnouts, variable thickness overbuild courses, leveling courses, miscellaneous asphalt pavement, as well as, turn lanes and ramps less than 1,000 feet.

As an exception, the Engineer may allow the Contractor to leave areas in place if it is determined by the Engineer that the deficiency is not a significant detriment to the pavement quality. For areas of deficient thickness, a reduction to the pay item quantity will be made in accordance with 330-9.5.2.

330-6.1.6 Correcting Defects: Before starting any rolling, check the surface; correct any irregularities; remove all drippings, sand accumulations from the screed, and fat spots from any source; and replace them with satisfactory material. Do not skin patch. When correcting a depression while the mixture is hot, scarify the surface and add fresh mixture.

330-6.1.7 Hand Work: In limited areas where the use of the paver is impossible or impracticable, the Contractor may place and finish the mixture by hand.

330-7 Compacting Mixture.

330-7.1 General Requirements: When density testing for acceptance is required, select equipment, sequence, and coverages of rolling to meet the specified density requirement. Regardless of the rolling procedure used, complete the final rolling before the surface temperature of the pavement drops to the extent effective compaction may not be achieved or the rollers begin to damage the pavement.

No vibratory compaction in the vertical direction will be allowed for layers one inch or less in thickness or, if the Engineer or Contract Documents limit compaction to the static mode only. Compact these layers in the static mode only. Other non-vertical vibratory modes of compaction will be allowed, if approved by the Engineer; however, no additional compensation, cost or time, will be made.

330-7.2 Standard Rolling Procedure: When density testing for acceptance is not required, propose an alternative rolling pattern to be approved by the Engineer or use the following standard rolling procedure:

1. Breakdown rolling: Provide two static coverages with a tandem steel-wheeled roller, following as close behind the paver as possible without pick-up, undue displacement, or blistering of the mix.

2. Intermediate rolling: Provide five static coverages with a pneumatic-tire roller, following as close behind the breakdown rolling operation as the mix will permit.

3. Finish rolling: Provide one static coverage with a tandem steel-wheeled roller, after completing the breakdown rolling and intermediate rolling, but before the surface pavement temperature drops to the extent effective compaction may not be achieved or the rollers begin to damage the pavement.

330-7.3 Rolling Procedures: Use procedures that will uniformly compact the pavement layer to the desired density level, while meeting the appropriate smoothness requirements, without damaging the pavement surface, crushing aggregate or leaving excessive roller marks, roller heads, or ripples. While rolling is in progress, monitor the surface continuously, and adjust the compaction operations to comply with the surface requirements.

330-7.4 Compaction of Areas Inaccessible to Rollers: Use hand tamps or other satisfactory means to compact areas which are inaccessible to a roller, such as areas adjacent to curbs, gutters, bridges, manholes, etc.

330-7.5 Correcting Defects: Do not allow the compaction equipment to deposit contaminants onto the pavement surface. Remove and replace any areas damaged by such deposits as directed by the Engineer. Correct any depressions that develop before completing the rolling by loosening the mixture and adding new mixture to bring the depressions to a true surface. Should any depression remain after obtaining the final compaction, remove the full depth of the mixture, and replace it with enough new mixture to form a true and even surface. Correct all defects before laying the subsequent course.

330-7.6 Use of Traffic Roller: Use a traffic roller on the first overbuild course. Use a traffic roller or vibratory roller (unless restricted by the Contract Documents) on the first structural layer placed on an AMI.

330-7.7 Compaction at Bridge Structures: Compact asphalt mixtures placed over bridge decks and approach slabs using static compaction only. Use the standard rolling procedure described in 330-7.2 or an alternative procedure approved by the Engineer.

330-8 Joints.

330-8.1 General: When laying fresh mixture against the exposed edges of joints, place it in close contact with the exposed edge to produce an even, well-compacted joint after rolling.

330-8.2 Transverse Joints: Place the mixture as continuously as possible to minimize transverse joints. When constructing permanent transverse joints, meet the surface requirements as defined in 330-9. Construct temporary transverse joints in such a manner to allow traffic to pass over it. When resuming the paving operation, construct a transverse joint by cutting back on the previously placed pavement at a location where the straightedge requirements are met. At the project limits, tie into the adjoining pavement layers as shown in the Plans.

330-8.3 Longitudinal Joints: Place each layer of pavement so all longitudinal construction joints are offset 6 to 12 inches laterally between successive layers. Plan offsets in advance so the longitudinal joints of the friction course are not in wheel path areas. The longitudinal joints for friction course layers should be within 6 inches of the lane edge or at the center of the lane. The Engineer may waive this requirement where offsetting is not feasible due to the sequence of construction.

330-8.4 Placing Asphalt Next to Concrete Pavement: When placing asphalt next to concrete pavement, construct the joint as shown in the Plans.

330-9 Surface Requirements.

330-9.1 General: Construct a smooth pavement with good surface texture and the proper cross-slope.

330-9.2 Texture of the Finished Surface of Paving Layers: Produce a finished surface of uniform texture and compaction with no pulled, torn, raveled, crushed or loosened portions and free of segregation, bleeding, flushing, sand streaks, sand spots, or ripples. Some examples of pavement deficiencies are displayed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Pavement.shtm. Address any pavement not meeting the requirements of this specification in accordance with 330-9.5.

For dense-graded structural and dense-graded friction course mixtures, in areas not defined as density testing exceptions per 334-5.1.2, obtain for the Engineer, three 6-inch diameter roadway cores at locations visually identified by the Engineer to be segregated. For areas that the Engineer identifies as being segregated, obtain and submit cores within 30 days of notification. The Engineer will determine the density of each core in accordance with FM 1-T166 and calculate the percent G_{mm} of the segregated area using the average G_{mb} of the roadway cores and the QC sublot G_{mm} for the questionable material. If the average percent G_{mm} is less than 89.5, address the segregated area in accordance with 330-9.5.

Do not use asphalt concrete mixtures containing aggregates that cause a different color appearance in the final wearing surface unless the section is greater than or equal to one mile in length and across the full width of the pavement, including shoulders and turn lanes. Exceptions to these requirements will be permitted if approved by the Engineer.

330-9.3 Cross Slope: Construct a pavement surface with cross slopes in compliance with the requirements of the Contract Documents. Furnish a four-foot-long electronic level accurate to 0.1 degree, approved by the Engineer for the control of cross slope. Make this electronic level available at the jobsite at all times during paving operations.

330-9.3.1 QC Calibration and Comparison: Calibrate the electronic levels a minimum of once per day before paving operations begin, in accordance with manufacturer's instructions.

Compare the QC level with the Verification level before paving operations begin, and at any time as directed. If the comparison between the QC and Verification levels is within plus or minus 0.2%, the QC level is considered to compare favorably and can be used for measurement and acceptance of cross-slopes. If the levels do not compare favorably, perform a second comparison using another calibrated electronic level (Department or Contractor) for resolution. If the resolution level compares favorably with the QC level, the QC level is considered to be verified. If the resolution level does not compare favorably with the QC level, discontinue the use of the QC electronic level and obtain another approved electronic level that meets the requirements of this specification. The Contractor assumes all risk associated with placing the pavement at the correct cross slope.

330-9.3.2 Cross Slope Measurement: Measure the cross slope of the compacted pavement surface by placing the level at the center of the lane and perpendicular to the roadway centerline. Record all measurements to the nearest 0.1% on an approved form and submit the data to the Engineer.

330-9.3.2.1 Cross Slope Measurement Frequency:

1. Tangent Sections: Measure the cross-slope at a minimum frequency of one measurement every 100 feet per lane. When the average absolute deviation is consistently within the acceptance tolerance in Table 330-3, upon the approval of the Engineer, the cross-slope measurements may be reduced to one measurement every 200 feet.
2. Superelevated Sections: Measure the cross slope every 100 feet per lane within the length of the full superelevation. For curves where the length of full

superelevation is less than 250 feet, measure the cross slope at the beginning point, midpoint, and ending point of the fully superelevated section. For transition sections, measure the cross slope at control points identified in the Plans, or if not shown in the Plans, at a control point at the location of 0.0% cross slope.

330-9.3.2.2 Cross Slope Deviations and Corrections: Calculate the absolute deviation of each cross-slope measurement and the average of the absolute deviations of ten consecutive cross slope measurements. The absolute deviation is the positive value of a deviation. In superelevated sections, when the number of measurements is less than ten, average the absolute deviation of all measurements.

If the average absolute deviation of any cross-slope measurement falls outside the acceptance tolerance shown in Table 330-3, stop the paving operation and make adjustments until the problem is resolved to the satisfaction of the Engineer.

Address, in accordance with 330-9.5, all individual cross slope deviations outside the acceptance tolerances shown in Table 330-3. Complete all corrections before placement of the final pavement surface layer. For pavement with multiple layers, the deficient areas for the structural course may be left in place, if approved by the Engineer. For friction course layers, make corrections in accordance with 330-9.5.

The limits of deficient areas requiring correction may be verified and adjusted with more accurate measurement methods, including survey instruments, upon approval of the Engineer and at no cost to the Department.

Should the Contractor wish to have any required corrections waived, submit a request to the Engineer for approval. The Engineer may waive the corrections at no reduction in payment if the deficiencies are sufficiently separated so as not to affect the pavement's overall traffic safety, surface drainage, ride quality, or surface texture.

For intersections, tapers, crossovers, transitions at the beginning and end of the project, bridge approaches and similar areas, adjust the cross slope to match the actual site conditions or as directed by the Engineer.

Table 330-3
Cross Slope Acceptance Tolerance

Roadway Feature	Individual Absolute Deviation	Average Absolute Deviation
Tangent section (including turn lanes)	0.4%	0.2%
Superelevated curve	0.4%	0.2%
Shoulder	0.5%	0.5%

In the event the distance between two edges of deficient areas is less than 100 feet, the correction work shall include the area between the deficient areas.

330-9.3.3 Verification: The Engineer will verify the Contractor's cross slope measurements by randomly taking a minimum of ten cross slope measurements per lane per mile in tangent sections, at control points in transition sections, and a minimum of three cross slope measurements in fully superelevated sections.

The Engineer will measure the cross slope of the compacted pavement surface by placing the level at the center of the lane and perpendicular to the roadway centerline.

330-9.3.3.1 Cross Slope Deviations and Corrections: If the average absolute deviation or an individual cross slope deviation falls outside of the acceptance tolerance in Table 330-3, immediately make a comparison check at the QC test locations to verify the QC measurements in the section. If the comparisons are beyond the acceptable comparison tolerance in accordance with 330-9.3.1, stop the paving operations until the issue is resolved to the satisfaction of the Engineer. Correct any cross slope not meeting the individual deviation acceptance tolerance in accordance with 330-9.5 at no cost to the Department. The Engineer reserves the right to check the pavement cross slope at any time by taking cross slope measurements at any location.

330-9.4 Pavement Smoothness: Construct a smooth pavement meeting the requirements of this Specification.

330-9.4.1 General: Furnish a 15-foot manual and a 15-foot rolling straightedge meeting the requirements of FM 5-509. Obtain a smooth surface on all pavement courses placed, and then straightedge all layers as required by this Specification.

330-9.4.2 Test Method: Perform all straightedge testing in accordance with FM 5-509 in the outside wheel path of each lane. The Engineer may require additional testing at other locations within the lane.

330-9.4.3 Traffic Control: Provide traffic control in accordance with Section 102 and Standard Plans, Index 102-607 or 102-619 during all testing. When traffic control cannot be provided in accordance with Index 102-607 or 102-619, submit an alternative Traffic Control Plan as specified in 102-4. Include the cost of this traffic control in the Contract bid prices for the asphalt items.

330-9.4.4 Process Control Testing: Assume full responsibility for controlling all paving operations and processes such that the requirements of these Specifications are met at all times.

330-9.4.5 QC Testing:

330-9.4.5.1 General: Straightedge the final Type SP structural layer and friction course layer in accordance with 330-9.4.2, with the exception that if the method of acceptance is by laser profiler, then straightedging of the friction course layer is not required unless otherwise stated in the Specifications. If the project's method of acceptance is by laser profiler, areas not suitable for testing with the laser profiler will be tested and accepted by straightedging. Test all pavement lanes and ramps where the width is constant and document all deficiencies in excess of 3/16 inch on a form approved by the Engineer.

330-9.4.5.2 Straightedge Exceptions: Straightedge testing will not be required in the following areas: shoulders, intersections, tapers, crossovers, sidewalks, shared use paths, parking lots, raised crosswalks, speed tables, and similar areas, or in the following areas when they are less than 250 feet in length: turn lanes, acceleration/deceleration lanes and side streets. The limits of the intersection will be from stop bar to stop bar for both the mainline and side streets.

As an exception, in the event the Engineer identifies an objectionable surface irregularity in the above areas, straightedge and address all deficiencies in excess of 3/8 inch in accordance with 330-9.5.

The Engineer may waive straightedge requirements for transverse joints at the beginning and end of the project, at the beginning and end of bridge structures, at manholes, and at utility structures if the deficiencies are caused by factors beyond the control of the Contractor, as determined by the Engineer. In addition, the Engineer may also waive the

straightedging requirements on ramps and superelevated sections where the geometrical orientation of the pavement results in an inaccurate measurement with the rolling straightedge.

330-9.4.5.3 Intermediate Layers and Temporary Pavement: When the design speed is 55 mph or greater and the intermediate Type SP layer or temporary pavement is to be opened to traffic, if the Engineer identifies an objectionable surface irregularity, straightedge and address all deficiencies in excess of 3/8 inch within 72 hours of placement in accordance with 330-9.5.

330-9.4.5.4 Final Type SP Structural Layer: Straightedge the final Type SP structural layer in accordance with 330-9.4.2, either behind the final roller of the paving train or as a separate operation. Notify the Engineer of the location and time of straightedge testing a minimum of 48 hours before beginning testing. The Engineer will verify the straightedge testing by observing the QC straight edging operations. Address all deficiencies in excess of 3/16 inch in accordance with 330-9.5.

When the final structural course is to be opened to traffic and the design speed is 55 mph or greater, if any defect is 3/8 inch or greater, the Engineer may require deficiencies to be corrected within 72 hours after opening to traffic.

330-9.4.5.5 Friction Course Layer: Where required per 330-9.4.5.1, and in areas noted in 330-9.4.6.2 as not suitable for testing with the Laser Profiler, straightedge the friction course layer in accordance with 330-9.4.2, either behind the final roller of the paving train or as a separate operation upon completion of all paving operations. Notify the Engineer of the location and time of straightedge testing a minimum of 48 hours before beginning testing. The Engineer will verify the straightedge testing by observing the QC straightedging operations. Address all deficiencies in excess of 3/16 inch in accordance with 330-9.5.

330-9.4.6 Acceptance:

330-9.4.6.1 Straightedge Acceptance: For areas of roadways where the design speed is less than 55 miles per hour, and for areas of roadways where the design speed is greater than or equal to 55 miles per hour which are noted in 330-9.4.6.2 as not suitable for testing with the Laser Profiler, acceptance for pavement smoothness of the friction course will be based on verified QC measurements using the straightedge as required by 330-9.4.5. The Engineer will verify the straightedge testing by observing the QC straightedging operations.

330-9.4.6.2 Laser Acceptance: For areas of high speed roadways where the design speed is equal to or greater than 55 miles per hour, acceptance testing for pavement smoothness of the friction course (for mainline traffic lanes only) will be based on the Laser Profiler. Ramps, acceleration and deceleration lanes, and other areas not suitable for testing with the Laser Profiler will be tested and accepted with the straightedge in accordance with 330-9.4.5.5 and 330-9.4.6.1.

The pavement smoothness of each lane will be determined by a Laser Profiler furnished and operated by the Department in accordance with FM 5-549 and a report issued with the Ride Number (RN) reported to one decimal place. If corrections are made, as required following Laser Acceptance, the pavement will not be retested for smoothness using the Laser Profiler.

For this testing, the pavement will be divided into 0.1 mile segments. Partial segments equal to or greater than 0.01 mile will be considered as a 0.1 mile segment. The pavement will be accepted as follows:

1. For segments with a RN greater than or equal to 4.0, the pavement will be accepted at full pay.

2. For segments with a RN less than 4.0, the Engineer will further evaluate the data in 0.01 mile intervals for both wheel paths.

If the RN is 3.5 or above for all 0.01 mile intervals in both wheel paths, the segment will be accepted at full payment.

If the RN is less than 3.5 for one or more 0.01 mile intervals, the segment will be tested with the rolling straightedge in both wheel paths in accordance with FM 5-509. If approved by the Engineer, this straightedging may be completed (in both wheel paths) as part of the QC straightedging operations described in 330-9.4.5.5, before testing with the laser profiler. Notify the Engineer of the location and time of straightedge testing a minimum of 48 hours before beginning testing. The Engineer will verify the straightedge testing by observing the QC straightedging operations. Address all deficiencies in excess of 3/16 inch in accordance with 330-9.5.

Test and accept areas at the beginning and ending of the project, bridge approaches and departures, and areas where the segment is less than 0.01 mile, with the straightedge in accordance with 330-9.4.5.5 and 330-9.4.6.1.

330-9.5 Unacceptable Pavement:

330-9.5.1 Corrections: Address all areas of unacceptable pavement at no cost to the Department. Retest all corrected areas and assure the requirements of these Specifications are met.

330-9.5.1.1 Structural Layers: Correct all deficiencies, as defined in the Specifications, in the Type SP structural layers by removing and replacing the full depth of the layer, extending a minimum of 50 feet on both sides (where possible) of the defective area for the full width of the paving lane.

The following options only apply if the structural layer is not the final surface layer:

1. As an option for high and low straightedge deficiencies 5/16 of an inch or less, pave over with friction course to correct the deficiency.

2. As an option for high straightedge deficiencies, mill the pavement surface the full lane width to a depth and length adequate to remove the deficiency.

3. As an option for low straightedge deficiencies 8/16 of an inch or less, mill the pavement surface the full lane width to a depth and length adequate to remove the deficiency.

330-9.5.1.2 Friction Course: Correct deficiencies in the friction course or final surface layer by removing and replacing the full depth of the layer, extending a minimum of 50 feet on both sides (where possible) of the defective area for the full width of the paving lane. As an exception, the Engineer may allow the Contractor to leave these areas in place if it is determined by the Engineer that the deficiency is not a significant detriment to the pavement quality. A reduction to the pay item quantity will be made in accordance with 330-9.5.2.

330-9.5.2 Reduction in Pay Item Quantity: When the Engineer elects to waive corrections, the Department will reduce the pay quantity for the pay item in question by the amount of material within the defective area. For all mix types, when the measured deficiency lane length is less than 5 feet, use 5 feet for the deficiency lane length when determining the pay reduction. When the pay quantity is in tons, the Department will base the reduction on the volume of material within the defective area (the deficiency lane length by the lane width by layer thickness) multiplied by the maximum specific gravity of the mix as determined through the following equation:

Quantity (tons) = L x W x t x G_{mm} x 0.0024

Where: L = Deficiency Lane length (ft.)
W = Lane width (ft.)
t = Layer thickness (in.)
G_{mm} = Maximum specific gravity from verified mix design

For FC-5 open-graded friction course, the Department will base the reduction on the area within the defective area (the deficiency lane length by lane width) multiplied by a spread rate of 80 pounds per square yard as determined through the following equation:

Quantity (tons) = L x W x 0.0044

Where: L = Deficiency Lane length (ft.)
W = Lane width (ft.)

330-10 Protection of Finished Surface.

Keep sections of newly compacted asphalt concrete, which are to be covered by additional courses, clean until the successive course is laid.

Do not dump embankment or base material directly on the pavement. Dress shoulders before placing the friction course on adjacent pavement.

Equip blade graders operating adjacent to the pavement during shoulder construction with a 2 inch by 8 inch or larger board, or other attachment providing essentially the same results, attached to their blades so it extends below the blade edge and protects the pavement surface from damage by the grader blade.

To prevent rutting or other distortion, protect sections of newly finished dense-graded friction course and the last structural layer before friction course from traffic until the surface temperature has cooled below 160ºF.

The Contractor may use artificial methods to cool the pavement to expedite paving operations. The Department may direct the Contractor to use artificial cooling methods when maintenance of traffic requires opening the pavement to traffic at the earliest possible time.

SECTION 334
SUPERPAVE ASPHALT CONCRETE

334-1 Description.

334-1.1 General: Construct a Superpave Asphalt Concrete pavement with the type of mixture specified in the Contract Documents, or when offered as alternates, as selected. Superpave mixes are identified as Type SP-9.5, Type SP-12.5 or Type SP-19.0.

Obtain Superpave Asphalt Concrete from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105. Producers must meet the requirements of Section 320 for plant and equipment and the general construction requirements of Section 330.

334-1.2 Traffic Levels: The requirements for Type SP Asphalt Concrete mixtures are based on the design traffic level of the project. The traffic levels for the project are as specified in the Contract Documents.

334-1.3 Gradation Classification: The Superpave mixes are classified as fine and are defined in 334-3.2.2.

The equivalent AASHTO nominal maximum aggregate size Superpave mixes are as follows:

Type SP-9.5..... 9.5 mm
Type SP-12.5..... 12.5 mm
Type SP-19.0..... 19.0 mm

334-1.4 Thickness: The total thickness of the Type SP asphalt layers will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined with other layers (as applicable) will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

$$\text{Spread rate (lb/yd}^2\text{)} = t \times G_{mm} \times 43.3$$

Where: t = Thickness (in.) (plan thickness or individual layer thickness)

G_{mm} = Maximum specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-3.2. For target purposes only, spread rate calculations should be rounded to the nearest whole number.

Note: Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lb/yd^2-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

334-1.4.1 Layer Thicknesses: The allowable layer thicknesses for Type SP Asphalt Concrete mixtures are as follows:

Type SP-9.5.....1 to 1-1/2 inches
Type SP-12.5.....1-1/2 to 3 inches
Type SP-19.0..... 2 to 4 inches

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on mixes when used as a structural course:

Type SP-9.5 - Limited to the top two structural layers, two layers maximum.

Type SP-9.5 - Do not place less than 1-1/2 inches thick for Traffic Level E applications.

Type SP-19.0 - Do not use for the final (top) structural layer below FC-5 mixtures. Type SP-19.0 mixtures are permissible for the layer directly below FC-9.5 and FC-12.5 mixtures. Do not use for the final (top) layer of shoulders.

334-1.4.2 Additional Requirements: The following requirements also apply to Type SP Asphalt Concrete mixtures:

1. A minimum 1-1/2 inch initial lift is required over an Asphalt Membrane Interlayer (AMI).

2. When construction includes the paving of adjacent shoulders (less than or equal to 5 feet wide), the layer thickness for the upper pavement layer and shoulder must be the same and paved in a single pass, unless called for differently in the Contract Documents.

3. All overbuild layers must be Type SP Asphalt Concrete designed at the traffic level as stated in the Contract Documents. Use the minimum and maximum layer thicknesses as specified above unless called for differently in the Contract Documents. On variable thickness overbuild layers, the minimum and maximum allowable thicknesses will be as specified below, unless called for differently in the Contract Documents.

Type SP-9.5..... 3/8 to 2 inches
Type SP-12.5..... 1/2 to 3 inches
Type SP-19.0.....1-1/2 to 4 inches

4. Variable thickness overbuild layers constructed using a Type SP-9.5 or SP-12.5 mixtures may be tapered to zero thickness provided the contract documents require a minimum of 1-1/2 inches of dense-graded mix placed over the variable thickness overbuild layer.

334-2 Materials.

334-2.1 General Requirements: Meet the following requirements:

Superpave PG Asphalt Binder* .....Section 916
Coarse Aggregate.....Section 901
Fine Aggregate.....Section 902
*Use products on the Department's Approved Product List (APL).

334-2.2 Superpave Asphalt Binder: Unless specified otherwise in the Contract Documents, use an asphalt binder grade as determined from Table 334-2.

High polymer binder mixtures may be used in lieu of mixtures with other specified binders at no additional cost to the Department, provided they meet the traffic level and mixture type requirements of the project.

High polymer binder may be substituted in a mixture at no additional cost to the Department when the mix design contains a maximum of 20% RAP.

334-2.3 Reclaimed Asphalt Pavement (RAP) Material:

334-2.3.1 General requirements: RAP may be used as a component of the asphalt mixture subject to the following requirements:

1. When using a PG 76-22 asphalt binder in friction course mixtures, limit the amount of RAP material used in the mix to a maximum of 20% by weight of total aggregate. As an exception, amounts greater than 20% RAP by weight of total aggregate can be used if no

more than 20% by weight of the total asphalt binder comes from the RAP material. When using a PG 76-22 asphalt binder in structural course mixtures, refer to 334-2.3.6. RAP is not allowed in mixtures containing High Polymer asphalt binder. High Polymer asphalt is defined in Section 916.

2. Assume full responsibility for the design, production and construction of asphalt mixes which incorporate RAP as a component material.

3. Use RAP from a Department approved stockpile or millings from a Department project.

4. Provide stockpiled RAP material that is reasonably consistent in characteristics and contains no aggregate particles which are soft or conglomerates of fines.

5. Provide RAP material having a minimum average asphalt binder content of 4.0% by weight of RAP. As an exception, when using fractionated RAP, the minimum average asphalt binder content for the coarse portion of the RAP shall be 2.5% by weight of the coarse portion of the RAP. The coarse portion of the RAP shall be the portion of the RAP retained on the No. 4 sieve. The Engineer may sample the stockpiles to verify that this requirement is met.

334-2.3.2 Material Characterization for Mix Design: Assume responsibility for establishing the asphalt binder content, gradation, and bulk specific gravity (G_{sb}) of the RAP material based on a representative sampling of the material by roadway cores or stockpile samples. For roadway core samples, assume responsibility for the degradation that will occur during the milling operation.

334-2.3.3 RAP Stockpile Approval: Prior to the incorporation of RAP into the asphalt mixture, stockpile the RAP material and obtain approval for the stockpile by one of the following methods:

1. Continuous stockpile: When RAP is obtained from one or multiple sources and is either processed, blended, or fractionated, and stockpiled in a continuous manner, assure an adequate number of test results are obtained for stockpile approval. Test the RAP material for gradation and asphalt content at a minimum frequency of one sample per 1,000 tons with a minimum of six test results. Test the RAP material for G_{mm} (for G_{sb} determination) at a minimum frequency of one sample per 5,000 tons with a minimum of two test results. Based on visual inspection and a review of the test data, the Engineer will determine the suitability of the stockpiled material. In addition, address the details and specifics of the processing, sampling, testing and actions to be taken in the Producer Quality Control (QC) Plan.

When RAP is added to the continuous stockpile after original approval of the stockpile as described above, test the RAP material for gradation and asphalt content at a minimum frequency of one sample per 1,000 tons with a minimum of six test results. Test the RAP material for G_{mm} (for G_{sb} determination) at a minimum frequency of one sample per 5,000 tons with a minimum of two test results. Monitor test results during crushing operations for conformance to the requirements of Table 334-1. After the minimum frequency of tests have been performed, the Engineer will review the test data and visually inspect the stockpiled material. The average gradation and G_{mm} of the added material shall be within the allowable ranges shown in Table 334-1 from the originally approved stockpile values. If the added RAP material does not meet the conditions of Table 334-1, then the Contractor must create a new stockpile when resuming crushing operations and the stockpile will receive a new number designation from the Department. The previously crushed material, which was added to

the continuous stockpile and did not meet the conditions of Table 334-1, may remain and that stockpile used until depleted.

Table 334-1 Allowable Ranges for Continuous RAP Stockpile Properties	
Characteristic	Limit from Original Approved Stockpile Gradation
No. 8 sieve and coarser	± 6.0%
No. 16 sieve	± 5.0%
No. 30 sieve	± 5.0%
No. 50 sieve	± 4.0%
No. 100 sieve	± 4.0%
No. 200 sieve	± 2.0%
G_{mm}	± 0.040

2. Non-continuous single stockpile: When an individual stockpile is being constructed, obtain representative samples at random locations and test the RAP material for gradation and asphalt content at a minimum frequency of one sample per 1,000 tons with a minimum of six test results. Test the RAP material for G_{mm} (for G_{sb} determination) at a minimum frequency of one sample per 5,000 tons with a minimum of two test results. Based on visual inspection and a review of the test data, the Engineer will determine the suitability of the stockpiled material. If the properties of the new stockpile compare with the properties of an existing stockpile within the ranges provided in Table 334-1, the RAP in the new stockpile may be added to the existing stockpile. Once the RAP stockpile has been approved, do not add additional material without prior approval of the Engineer.

Determine the asphalt binder content and gradation of the RAP material in accordance with FM 5-563 and FM 1-T 030, respectively. Establish the G_{sb} of the RAP material by using one of the following methods:

a. Calculate the G_{sb} value based upon the effective specific gravity (G_{se}) of the RAP material, determined on the basis of the asphalt binder content and maximum specific gravity (G_{mm}) of the RAP material. The Engineer will approve the estimated asphalt binder absorption value used in the calculation.

b. Measure the G_{sb} of the RAP aggregate, in accordance with FM 1-T 084 and FM 1-T 085. Obtain the aggregate by using a solvent extraction method.

334-2.3.4 Pavement Coring Report: When the Contract includes milling of the existing asphalt pavement, the Pavement Coring Report may be available on the Department's website.

334-2.3.5 Asphalt Binder for Mixes with RAP: Select the appropriate asphalt binder grade based on Table 334-2. The Engineer reserves the right to change the asphalt binder grade at design based on the characteristics of the RAP asphalt binder, and reserves the right to make changes during production.

Table 334-2 Asphalt Binder Grade for Mixes Containing RAP	
Percent RAP	Asphalt Binder Grade
0 - 15	PG 67-22
16 - 30	PG 58-22
>30	PG 52-28

334-2.3.6 Allowable RAP Percentages for Type SP Structural Mixtures with PG 76-22 Asphalt Binder: For Type SP structural mixtures using PG 76-22 asphalt binder, select the percentage of RAP material based on Table 334-3.

Table 334-3
Allowable RAP Percentages[1] in Type SP Structural Mixtures with PG 76-22 Asphalt Binder

		Coarse RAP	Intermediate RAP	Fine RAP
Gradation % Passing #16 Sieve[2]		≤ 40%	> 40% to ≤ 50%	> 50%
PG_{HT}[3] > 100.0° C	Allowable RAP Percentage	≤ 25%	≤ 20%	≤ 20%
PG_{HT}[3] ≤ 100.0° C		≤ 30%	≤ 25%	

Notes:
1. RAP aggregate by weight of total aggregate or RAP binder by weight of total binder.
2. RAP gradations based on ignition oven extraction of RAP material in accordance with FM 5-563.
3. PG_{HT}: asphalt binder high temperature continuous performance grade of RAP in accordance with Section 916.

334-2.4 Recycled Crushed Glass: Recycled crushed glass may be used as a component of the asphalt mixture subject to the following requirements:

1. Consider the recycled crushed glass a local material and meet all requirements specified in 902-6.
2. Limit the amount of recycled crushed glass to a maximum of 15% by weight of total aggregate.
3. Use an asphalt binder that contains an anti-stripping agent listed on the Approved Product List (APL). The anti-strip additive shall be introduced into the asphalt binder by the supplier during loading.
4. Do not use recycled crushed glass in friction course mixtures or in structural course mixtures which are to be used as the final wearing surface.

334-3 General Composition of Mixture.

334-3.1 General: Compose the asphalt mixture using a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and asphalt binder material. Size, grade and combine the aggregate fractions to meet the grading and physical properties of the mix design. Aggregates from various sources may be combined.

334-3.2 Mix Design:

334-3.2.1 General: Design the asphalt mixture in accordance with AASHTO R 35, except as noted herein. Prior to the production of any asphalt mixture, submit the proposed mix design with supporting test data indicating compliance with all mix design criteria to the Engineer. For all mix designs, include representative samples of all component materials, including asphalt binder. Allow the Director of the Office of Materials a maximum of four weeks to either conditionally verify or reject the mix as designed.

At no additional cost to the Department, for a Type SP mix the following Traffic Level substitutions are allowed:

Traffic Level E can be substituted for Traffic Level C.
Traffic Level C can be substituted for Traffic Level B.

The same traffic level and binder type that is used for the mainline traffic lanes may be placed in the shoulder at no additional cost to the Department, even if the conditions stated above are not met for the shoulder.

Warm mix technologies (additives, foaming techniques, etc.) listed on the Department's website may be used in the production of the mix. The URL for obtaining this information, if available, is: https://www.fdot.gov/materials/laboratory/asphalt/index.shtm.

When warm mix technologies are used, for mixtures containing a PG 52-28, PG 58-22, or PG 67-22 binder, a mixture will be considered a warm mix asphalt design if the mixing temperature is 285°F or less. For mixtures containing a PG 76-22 or High Polymer binder, a mixture will be considered a warm mix asphalt design if the mixing temperature is 305°F or less.

The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

334-3.2.2 Mixture Gradation Requirements: Combine the coarse and fine aggregate in proportions that will produce an asphalt mixture meeting all of the requirements defined in this specification and conform to the gradation requirements at design as defined in AASHTO M 323. Aggregates from various sources may be combined.

334-3.2.2.1 Mixture Gradation Classification: Plot the combined mixture gradation on an FHWA 0.45 Power Gradation Chart. Include the Control Points from AASHTO M 323, as well as the Primary Control Sieve (PCS) Control Point from AASHTO M 323. Fine mixes are defined as having a gradation that passes above the primary control sieve control point and above the maximum density line for all sieve sizes smaller than the primary control sieve and larger than the No. 30 sieve.

334-3.2.3 Aggregate Consensus Properties: For Traffic Level C and E mixtures, meet the following consensus properties at design for the aggregate blend. Aggregate consensus properties do not apply to Traffic Level B mixtures.

334-3.2.3.1 Coarse Aggregate Angularity: When tested in accordance with ASTM D5821, meet the percentage of fractured faces requirements specified in AASHTO M 323.

334-3.2.3.2 Fine Aggregate Angularity: When tested in accordance with AASHTO T 304, Method A, meet the uncompacted void content of fine aggregate specified in AASHTO M 323. For Traffic Level C and E base and structural course mixtures, a fine aggregate angularity value less than 45.0 and greater than or equal to 42.0 is allowable provided testing parameters of AASHTO T 340-10 (2019) meet the following requirements:

1. Rutting tests are performed on two gyratory specimens compacted to N_{des} level of gyrations with a height of 115 ± 5 mm and a diameter of 150 mm.
2. The air void (V_a) content of each gyratory specimen after compacting to N_{des} shall be within the following range: $3.0 \leq V_a \leq 4.8$.
3. Rutting tests are performed at 64.0 C.
4. The average rut depth for two specimens shall not exceed 4.5 mm.

334-3.2.3.3 Flat and Elongated Particles: When tested in accordance with ASTM D4791, (with the exception that the material passing the 3/8-inch sieve and retained on the No. 4 sieve shall be included), meet the requirements specified in AASHTO M 323.

Measure the aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (shortest dimension) of the aggregate particles.

334-3.2.3.4 Sand Equivalent: When tested in accordance with AASHTO T 176, meet the sand equivalent requirements specified in AASHTO M 323.

334-3.2.4 Gyratory Compaction: Compact the design mixture in accordance with AASHTO T 312, with the following exception: use the number of gyrations at N_{design} as defined in Table 334-4. Measure the inside diameter of gyratory molds in accordance with AASHTO T 312.

Table 334-4
Gyratory Compaction Requirements

Traffic Level	N_{design} Number of Gyrations
B	65
C	75
E	100

334-3.2.5 Design Criteria: Meet the requirements for nominal maximum aggregate size as defined in AASHTO M 323, as well as for relative density, VMA, VFA, and dust-to-binder ratio as specified in AASHTO M 323. $N_{initial}$ and $N_{maximum}$ requirements are not applicable.

334-3.2.6 Moisture Susceptibility:

1. For all traffic levels, use a liquid anti-strip agent listed on the APL at the specified dosage rate. Hydrated lime may be used instead of the liquid anti-strip agent.
2. Provide a mixture having a retained tensile strength ratio of at least 0.80 and a minimum tensile strength (unconditioned) of 100 psi in accordance with FM 1-T 283.

334-3.2.7 Additional Information: In addition to the requirements listed above, provide the following information with each proposed mix design submitted for verification:

1. The design traffic level and the design number of gyrations (N_{design}).
2. The source and description of the materials to be used.
3. The Department source number and the Department product code of the aggregate components furnished from a Department approved source.
4. The gradation and proportions of the raw materials as intended to be combined in the paving mixture. The gradation of the component materials shall be representative of the material at the time of use. Compensate for any change in aggregate gradation caused by handling and processing as necessary.
5. A single percentage of the combined mineral aggregate passing each specified sieve. Degradation of the aggregate due to processing (particularly material passing the No. 200 sieve) should be accounted for and identified.
6. The bulk specific gravity (G_{sb}) value for each individual aggregate and RAP component, as identified in the Department's aggregate control program.
7. A single percentage of asphalt binder by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1%.
8. A target temperature for the mixture at the plant (mixing temperature) and a target temperature for the mixture at the roadway (compaction temperature) in accordance with 320-6.3. Do not exceed a target temperature of 340°F for High Polymer asphalt binders, 330°F for PG 76-22 asphalt binders, and 315°F for unmodified asphalt binders.

9. Provide the physical properties at the optimum asphalt content, which must conform to all specified requirements.

10. The name of the Construction Training Qualification Program (CTQP) Qualified Mix Designer.

11. The ignition oven and maximum specific gravity (G_{mm}) calibration factors.

12. The warm mix technology, if used.

334-3.3 Mix Design Revisions: During production, the Contractor may request a target value revision to a mix design, subject to meeting the following requirements: the target change falls within the limits defined in Table 334-5, appropriate data exists demonstrating that the mix complies with production air voids specification criteria, and the mixture gradation meets the basic gradation requirements defined in 334-3.2.2.

Table 334-5
Limits for Potential Adjustments to Mix Design Target Values

Characteristic	Limit from Original Mix Design
Asphalt Binder Content [1]	±0.3%
Gradation and Aggregate Component [2]	
No. 8 sieve and Coarser	± 5.0%
No. 16 sieve	± 4.0%
No. 30 sieve	± 4.0%
No. 50 sieve	± 3.0%
No. 100 sieve	± 3.0%
No. 200 sieve	± 1.0%
Each Component of Aggregate Blend	± 5.0 %

[1] Reductions to the asphalt binder content will not be permitted if the VMA during production is lower than 1.0% below the design criteria.
[2] The Engineer may waive the limits for the individual sieves and component of the aggregate blend contingent upon the quality of the production data for the mixture. Revisions to FC-5 mixtures to be determined by the Engineer.

Submit all requests for revisions to mix designs, along with supporting documentation, to the Engineer. In order to expedite the revision process, the request for revision or discussions on the possibility of a revision may be made verbally, but must be followed up by a written request. The verified mix design will remain in effect until the Engineer authorizes a change. In no case will the effective date of the revision be established earlier than the date of the first communication between the Contractor and the Engineer regarding the revision.

A new design mix will be required if aggregate sources change, or for any substitution of an aggregate product with a different aggregate code, unless approved by the Engineer.

334-4 Producer Process Control (PC).

Assume full responsibility for controlling all operations and processes such that the requirements of these Specifications are met at all times. Perform any tests necessary at the plant and roadway for process control purposes. Enter all PC test data into the Department's database. The Engineer will not use these test results in the acceptance payment decision.

Address in the Producer QC Plan how PC failures will be handled. When a PC failure occurs, investigate, at a minimum, the production process, testing equipment and/or sampling

methods to determine the cause of the failure, and make any necessary changes to assure compliance with these Specifications. Obtain a follow up sample immediately after corrective actions are taken to assess the adequacy of the corrections. In the event the follow-up PC sample also fails to meet Specification requirements, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the QC Manager.

334-5 Acceptance of the Mixture.

334-5.1 General: The mixture will be accepted at the plant with respect to gradation (P_{-8} and P_{-200}), asphalt content (P_b), and volumetrics (volumetrics is defined as air voids at N_{design}). The mixture will be accepted on the roadway with respect to density of roadway cores. Acceptance will be on a LOT by LOT basis (for each mix design) based on tests of random samples obtained within each sublot taken at a frequency of one set of samples per sublot. A roadway LOT and a plant production LOT shall be the same. Acceptance of the mixture will be based on Contractor QC test results that have been verified by the Department.

334-5.1.1 Sampling and Testing Requirements: Obtain the samples in accordance with FM 1-T 168. Obtain samples at the plant of a sufficient quantity to be split into three smaller samples; one for QC, one for Verification testing and one for Resolution testing. Obtain each split sample of a sufficient quantity, approximately 40 pounds, for all required testing. The split samples for Verification testing and Resolution testing shall be reduced in size and stored in three boxes each. The approximate size of each box must be 12 inches x 8 inches x 4 inches. Provide, label, and safely store sample boxes in a manner agreed upon by the Engineer for future testing.

The asphalt content of the mixture will be determined in accordance with FM 5-563. The gradation of the recovered aggregate will be determined in accordance with FM 1-T 030. Volumetric testing will be in accordance with AASHTO T 312 and FM 1-T 209. Prior to testing volumetric samples, condition the test-sized sample for one hour, plus or minus five minutes, at the target roadway compaction temperature in a shallow, flat pan, such that the mixture temperature at the end of the one-hour conditioning period is within plus or minus 20°F of the roadway compaction temperature.

If one of the QC gyratory specimens is damaged, make an additional gyratory specimen.

For situations where two properly prepared gyratory specimens do not meet single-operator precision requirements for G_{mb} as provided in FM 1-T 166:

1. Retest both gyratory specimens in accordance FM 1-T 166.
2. Following the retest, if the newly measured G_{mb} values do not meet single-operator precision requirements, QC shall prepare a third gyratory specimen in accordance with AASHTO T 312 and test in accordance with FM 1-T 166. All three test results shall be input into MAC. The average G_{mb} will be determined by MAC after performing an outlier check in accordance with ASTM E178.

Test for roadway density in accordance with FM 1-T 166.

334-5.1.2 Acceptance Testing Exceptions: When the total combined quantity of hot mix asphalt for the project, as indicated in the Plans for Type B-12.5, Type SP and Type FC mixtures only, is less than 2,000 tons, the Engineer will accept the mix on the basis of visual inspection. The Engineer may require the Contractor to run process control tests for informational purposes, as defined in 334-4, or may run independent verification tests to determine the acceptability of the material.

Density testing for acceptance will not be performed on widening strips or shoulders with a width of 5 feet or less, open-graded friction courses, variable thickness overbuild courses, leveling courses, any SP-9.5 or SP-12.5 asphalt layer placed on subgrade with a layer thickness less than or equal to 3 inches, miscellaneous asphalt pavement, shared use paths, crossovers, gore areas, raised crosswalks, speed tables, or any course with a specified thickness less than 1 inch or a specified spread rate that converts to less than 1 inch as described in 334-1.4. Density testing for acceptance will not be performed on asphalt courses placed on bridge decks or approach slabs; compact these courses in static mode only per the requirements of 330-7.7. In addition, density testing for acceptance will not be performed on the following areas when they are less than 500 feet (continuous) in length: turning lanes, acceleration lanes, deceleration lanes, shoulders, parallel parking lanes, ramps, or unsignalized side streets with less than four travel lanes and speed limits less than 35 mph. Do not perform density testing for acceptance in situations where the areas requiring density testing is less than 50 tons within a sublot.

Density testing for acceptance will not be performed in intersections. The limits of the intersection will be from stop bar to stop bar for both the mainline and side streets. A random core location that occurs within the intersection shall be moved forward or backward from the intersection at the direction of the Engineer.

Where density testing for acceptance is not required, compact these courses (with the exception of open-graded friction courses) in accordance with the rolling procedure (equipment and pattern) as approved by the Engineer or with Standard Rolling Procedure as specified in 330-7.2. In the event that the rolling procedure deviates from the procedure approved by the Engineer, or the Standard Rolling Procedure, placement of the mix shall be stopped.

The density pay factor (as defined in 334-8.2) for areas not requiring density testing for acceptance will be paid at the same density pay factor as for the areas requiring density testing within the same LOT. If the entire LOT does not require density testing for acceptance, the LOT will be paid at a density pay factor of 1.00.

334-5.2 Full LOTs: Each LOT will be defined (as selected by the Contractor prior to the start of the LOT) as either (1) 2,000 tons, with each LOT subdivided into four equal sublots of 500 tons each, or (2) 4,000 tons, with each LOT subdivided into four equal sublots of 1,000 tons each. As an exception to this, the initial LOT of all new mix designs shall be defined as 2,000 tons, subdivided into four equal sublots of 500 tons each. Before the beginning of a LOT, the Engineer will develop a random sampling plan for each sublot and direct the Contractor on sample points, based on tonnage, for each sublot during construction.

334-5.3 Partial LOTs: A partial LOT is defined as a LOT size that is less than a full LOT. A partial LOT may occur due to the following:

l. The completion of a given mix type or mix design on a project.

2. Closure of the LOT due to time. LOTs will be closed 30 calendar days after the start of the LOT. Time periods other than 30 calendar days may be used if agreed to by both the Engineer and the Contractor, but under no circumstances shall the LOT be left open longer than 90 days.

3. A LOT is terminated per 334-5.4.4.

All partial LOTs will be evaluated based on the number of tests available, and will not be redefined. If a LOT is closed before the first plant random sample is obtained, then the LOT will be visually accepted by the Engineer and the LOT pay factor will be 1.00.

334-5.4 QC Sampling and Testing: Obtain all samples randomly as directed by the Engineer.

Should the Engineer determine that the QC requirements are not being met or that unsatisfactory results are being obtained, or should any instances of falsification of test data occur, acceptance of the Producer's QC Plan will be suspended and production will be stopped.

334-5.4.1 Lost or Missing Verification/Resolution Samples: In the event that any of the Verification and/or Resolution asphalt mixture samples that are in the custody of the Contractor are lost, damaged, destroyed, or are otherwise unavailable for testing, the minimum possible pay factor for each quality characteristic as described in 334-8.2 will be applied to the entire LOT in question, unless called for otherwise by the Engineer. Specifically, if the LOT in question has more than two sublots, the pay factor for each quality characteristic will be 0.55. If the LOT has two or less sublots, the pay factor for each quality characteristic will be 0.80. If only the roadway cores are lost, damaged, destroyed, or are otherwise unavailable for testing, then the minimum possible pay factor for density will be applied to the entire LOT in question. In either event, the material in question will also be evaluated in accordance with 334-5.9.5.

If any of the Verification and/or Resolution samples that are in the custody of the Department are lost, damaged, destroyed or are otherwise unavailable for testing, the corresponding QC test result will be considered verified, and payment will be based upon the Contractor's data.

334-5.4.2 Plant Sampling and Testing Requirements: Obtain one random sample of mix per sublot in accordance with 334-5.1.1 as directed by the Engineer. Test the QC split sample for gradation, asphalt binder content and volumetrics in accordance with 334-5.1.1. Complete all QC testing within one working day from the time the samples were obtained.

334-5.4.3 Roadway Sampling and Testing Requirements: Obtain five 6 inch diameter roadway cores within 24 hours of placement at random locations as directed by the Engineer within each sublot. Test these QC samples for density (G_{mb}) in accordance with 334-5.1.1. Obtain a minimum of three cores per sublot at random locations as identified by the Engineer in situations where the sublot/LOT was closed or terminated before the random numbers were reached or where it is impractical to cut five cores per sublot. Do not obtain cores any closer than 12 inches from an unsupported edge. The Engineer may adjust randomly generated core locations for safety purposes or as the Engineer deems necessary. Do not perform density testing for acceptance in a sublot if the plant random sample for that sublot has not been obtained. Maintain traffic during the coring operation; core the roadway, patch the core holes (within three days of coring); and trim the cores to the proper thickness prior to density testing.

Density for the sublot shall be based on the average value for the cores cut from the sublot with the target density being a percentage of the maximum specific gravity (G_{mm}) of the sublot, as defined in the Contract. Once the average density of a sublot has been determined, do not retest the samples unless approved by the Engineer. Ensure proper handling and storage of all cores until the LOT in question has been accepted.

334-5.4.4 Individual Test Tolerances for QC Testing: Terminate the LOT if any of the following QC failures occur:

1. An individual test result of a sublot for air voids does not meet the requirements of Table 334-6,

2. The average sublot density does not meet the requirements of Table 334-6,

3. Two consecutive test results within the same LOT for gradation or asphalt binder content do not meet the requirements of Table 334-6,

When a LOT is terminated due to a QC failure, stop production of the mixture until the problem is resolved to the satisfaction of the QC Manager and/or Asphalt Plant Level II technician responsible for the decision to resume production after a QC failure, as identified in Section 105. In the event that it can be demonstrated that the problem can immediately be or already has been resolved, it will not be necessary to stop production. When a LOT is terminated, make all necessary changes to correct the problem. Do not resume production until appropriate corrections have been made. Prior to resuming production, inform the Engineer of the problem and corrections made to correct the problem. After resuming production, sample and test the material to verify that the changes have corrected the problem. Summarize this information and provide it to the Engineer prior to the end of the work shift when production resumes.

In the event that a QC failure is not addressed as defined above, the Engineer's approval will be required prior to resuming production after any future QC failures.

Address any material represented by a failing test result, as defined above in this subarticle, in accordance with 334-5.9.5. Any LOT terminated under this subarticle will be limited to a maximum Pay Factor of 1.00 (as defined in 334-8.2) for all quality characteristics and will include all material placed up to the point when the LOT was terminated.

In the event that a G_{mm} test result differs by more than 0.040 from the mix design G_{mm}, investigate the causes of the discrepancy and report the findings and proposed actions to the Engineer.

Table 334-6
Master Production Range

Characteristic	Tolerance (1)
Asphalt Binder Content (%)	Target ±0.55
Passing No. 200 Sieve (%)	Target ±1.50
Air Voids (%)	2.30 – 6.00
Density (minimum % G_{mm})(2)	89.50

(1) Tolerances for sample size of n = 1 from the verified mix design
(2) Based on an average of three to five randomly located cores

334-5.5 Verification Testing: In order to determine the validity of the Contractor's QC test results prior to their use in the Acceptance decision, the Engineer will run verification tests.

334-5.5.1 Plant Testing: At the completion of each LOT, the Engineer will test a minimum of one Verification split sample randomly selected from the LOT. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed. Verification samples shall be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. In lieu of the 1-1/2 hours reheating procedure, the mixture may be reheated to within plus or minus 20°F of the roadway compaction temperature using a microwave oven. Stir the mixture as necessary during the reheating process to maintain temperature uniformity. Subsequently, condition and test the mixture as described in 334-5.1.1.

The Verification test results will be compared with the QC test results based on the between-laboratory precision values shown in Table 334-7.

Table 334-7 Between-Laboratory Precision Values	
Property	Maximum Difference
G_{mm}	0.016
G_{mb} (gyratory compacted samples)	0.022
G_{mb} (roadway cores)	0.014
P_b	0.44%
P_{-200}	FM 1-T 030 (Figure 2)
P_{-8}	FM 1-T 030 (Figure 2)

If all of the specified mix characteristics compare favorably, then the LOT will be accepted, with payment based on the Contractor's QC test data for the LOT.

If any of the results do not compare favorably, then the Resolution samples from the LOT will be sent to the Resolution laboratory for testing, as described in 334-5.6.

334-5.5.2 Roadway Testing: At the completion of each LOT, the Engineer will determine the density (G_{mb}) of each core (previously tested by QC) as described in 334-5.1.1 from the same sublot as the plant samples. For situations where roadway density is not required for the random sublot chosen, then another sublot shall be randomly chosen for roadway density cores only. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed.

The individual Verification test results will be compared with individual QC test results by the Engineer based on the between-laboratory precision values given in Table 334-7.

If each of the core test results compare favorably, then the LOT will be accepted with respect to density, with payment based on the Contractor's QC test data for the LOT.

If any of the results do not compare favorably, then the core samples from the LOT will be sent to the Resolution laboratory for testing as specified in 334-5.6.

334-5.6 Resolution System:

334-5.6.1 Plant Samples: In the event of an unfavorable comparison between the Contractor's QC test results and the Engineer's Verification test results on any of the properties identified in Table 334-7, the Resolution laboratory will test all of the split samples from the LOT for only the property (or properties) in question. Resolution samples shall be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. In lieu of the 1-1/2 hours reheating procedure, the mixture may be reheated to within plus or minus 20°F of the roadway compaction temperature using a microwave oven. Stir the mixture as necessary during the reheating process to maintain temperature uniformity. Subsequently, condition and test the mixture as described in 334-5.1.1.

334-5.6.2 Roadway Samples: In the event of an unfavorable comparison between the Contractor's QC test data and the Engineer's Verification test data on the density results, the Resolution laboratory will test all of the cores from the LOT. Testing will be as described in 334-5.1.1.

334-5.6.3 Resolution Determination: The Resolution test results (for the property or properties in question) will be compared with the QC test results based on the between-laboratory precision values shown in Table 334-7.

If the Resolution test results compare favorably with all of the QC results, then acceptance and payment for the LOT will be based on the QC results, and the Department will bear the costs associated with Resolution testing. No additional compensation, either monetary or time, will be made for the impacts of any such testing.

If the Resolution test results do not compare favorably with all of the QC results, then acceptance and payment for the LOT will be based on the Resolution test data for the LOT, and the costs of the Resolution testing will be deducted from monthly estimates. No additional time will be granted for the impacts of any such testing.

In addition, the material failure requirements of 334-5.4.4 apply to the Resolution test data. Address any material represented by the failing test results in accordance with 334-5.9.5. For this situation, the LOT will be limited to a maximum Pay Factor of 1.00 (as defined in 334-8.2) for all quality characteristics.

In the event of an unfavorable comparison between the Resolution test results and QC test results, make the necessary adjustments to assure that future comparisons are favorable.

334-5.7 Independent Verification (IV) Testing:

334-5.7.1 Plant: The Contractor shall provide sample boxes and take samples as directed by the Engineer for IV testing. Obtain enough material for three complete sets of tests (two samples for IV testing by the Engineer and one sample for testing by the Contractor). If agreed upon by both the Engineer and the Contractor, only one sample for IV testing by the Engineer may be obtained. IV samples will be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. The Contractor's split sample, if tested immediately after sampling, shall be reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. If the Contractor's sample is not tested immediately after sampling, then the sample shall be reheated at the target roadway compaction temperature for 1-1/2 hours, plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. For the IV and Contractor's samples, in lieu of the 1-1/2 hours reheating procedure, the mixture may be reheated to within plus or minus 20°F of the roadway compaction temperature using a microwave oven. Stir the mixture as necessary during the reheating process to maintain temperature uniformity. Subsequently, condition and test the mixture as described in 334-5.1.1. The Contractor's test results shall be provided to the Engineer within one working day from the time the sample was obtained.

If any of the IV test results do not meet the requirements of Table 334-6, then a comparison of the IV test results and the Contractor's test results, if available, will be made. If a comparison of the IV test results and the Contractor's test results meets the precision values of Table 334-7 for the material properties in question, or if the Contractor's test results are not available, then the IV test results are considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

If a comparison of the IV test results and the Contractor's test results does not meet the precision values of Table 334-7 for the material properties in question, then the second IV sample shall be tested by the Engineer for the material properties in question. If a comparison between the first and second IV test results does not meet the precision values of Table 334-7 for the material properties in question, then the first IV test results are considered unverified for the material properties in question and no action shall be taken, with the following exception: if the first and second IV test results do not meet the precision values of Table 334-7 and the first IV test result and Contractor's test result do not meet the precision values of Table 334-7, yet all three test results do not meet the requirements of Table 334-6, then address any material represented by the failing test results in accordance with 334-5.9.5.

If a comparison between the first and second IV test results meets the precision values of Table 334-7 for the material properties in question, then the first IV sample is considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

The Engineer has the option to use the IV sample for comparison testing as specified in 334-6.

334-5.7.1.1 Asphalt Binder and Mixture Sampling for Determination of Asphalt Binder Quality: At the Department's request, obtain an asphalt binder sample from the asphalt plant storage tank and a corresponding asphalt mixture sample using binder from the same storage tank. Samples of asphalt binder and mixture shall be sampled the same day. The asphalt binder from the storage tank and the asphalt binder recovered from the asphalt mixture will be tested by the Department for compliance with Contract Documents.

334-5.7.2 Roadway: Obtain five 6-inch diameter roadway cores within 24 hours of placement, as directed by the Engineer, for IV testing. In situations where it is impractical to cut five cores per sublot, obtain a minimum of three cores per sublot at random locations, as identified by the Engineer. These independent cores will be obtained from the same LOTs and sublots as the Independent Verification Plant samples, or as directed by the Engineer. The density of these cores will be obtained as described in 334-5.1.1. If the average of the results for the sublot does not meet the requirements of Table 334-6 for density, then a comparison of the IV G_{mm} test results and the Contractor's G_{mm} test results, if available, will be made in accordance with the procedure provided in 334-5.7.1. Address any material represented by the failing test results in accordance with 334-5.9.5.

334-5.8 Surface Tolerance: The asphalt mixture will be accepted on the roadway with respect to surface tolerance in accordance with the applicable requirements of 330-9.

334-5.9 Minimum Acceptable Quality Levels:

334-5.9.1 PFs Below 0.90: In the event that an individual pay factor for any quality characteristic of a LOT falls below 0.90, take steps to correct the situation and report the actions to the Engineer. In the event that the pay factor for the same quality characteristic for two consecutive LOTs is below 0.90, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.2 CPFs Less Than 0.90 and Greater Than or Equal to 0.80: If the composite pay factor for the LOT is less than 0.90 and greater than or equal to 0.80, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.3 CPFs Less Than 0.80 and Greater Than or Equal to 0.75: If the CPF for the LOT is less than 0.80 and greater than or equal to 0.75, address the defective material in accordance with 334-5.9.5.

334-5.9.4 CPFs Less Than 0.75: If the CPF for the LOT is less than 0.75, remove and replace the defective LOT at no cost to the Department, or as approved by the Engineer.

334-5.9.5 Defective Material: Assume responsibility for removing and replacing all defective material placed on the project, at no cost to the Department.

As an exception to the above and upon approval of the Engineer, obtain an engineering analysis in accordance with Section 6 by an independent laboratory (as approved by the Engineer) to determine the disposition of the material. The engineering analysis must be signed and sealed by a Professional Engineer licensed in the State of Florida.

The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material.

Any material that remains in place will be accepted with a CPF as determined by 334-8, or as determined by the Engineer.

If the defective material is due to a high air void failure, gradation, asphalt binder content or density failure, upon the approval of the Engineer the Contractor may perform delineation tests on roadway cores in lieu of an engineering analysis to determine the limits of the defective material that may require removal and replacement. Prior to any delineation testing, all sampling locations shall be approved by the Engineer. All delineation sampling and testing shall be monitored and verified by the Engineer. For materials that are defective due to low air voids, an engineering analysis is required.

When evaluating defective material by engineering analysis or delineation testing, at a minimum, evaluate all material located between passing QC, PC or IV test results. Any additional PC samples obtained in the same work shift after an IV sample has been obtained shall include enough material for three complete sets of tests (PC, IV and IV check samples) in the event the Contractor requests using the PC test results for engineering analysis or delineation. These additional PC samples must compare with verified IV test results as determined by the comparison process of 334-5.7.1 in order to be used for engineering analysis or delineation. Exceptions to this requirement shall be approved by the Engineer.

334-6 Comparison Testing.

At the start of the project (unless waived by the Engineer) and at other times as determined necessary by the Engineer, provide split samples for comparison testing with the Engineer. The purpose of these tests is to verify that the testing equipment is functioning properly and that the testing procedures are being performed correctly. In the event that the Engineer determines that there is a problem with the Contractor's testing equipment and/or testing procedures, immediately correct the problem to the Engineer's satisfaction. In the event that the problem is not immediately corrected, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the Engineer.

If so agreed to by both the Contractor and the Engineer, the split sample used for comparison testing may also be used for the QC sample. The split sample used for comparison testing must also meet the requirements for IV testing described in 334-5.7.

334-7 Method of Measurement.

For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), the quantity to be paid for will be the weight of the mixture, in tons. For each pay item, excluding overbuild, the pay quantity will be based on the quantity placed on the project, limited to 110% of the adjusted plan quantity for the pay item. The adjusted plan quantity will be determined by dividing the pay item's original plan quantity (including any Engineer approved quantity revisions) by the design G_{mm} stated in 334-1.4, then multiplying it by the tonnage-weighted average G_{mm} of the mixes used for the pay item.

The bid price for the asphalt mix will include the cost of the liquid asphalt and the tack coat application as directed in 300-8. There will be no separate payment or unit price adjustment for the asphalt binder material in the asphalt mix. For the calculation of unit price adjustments of bituminous material, the average asphalt content will be based on the percentage specified in 9-2.1.2. The weight will be determined as provided in 320-3.2 (including the provisions for the automatic recordation system).

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

334-8 Basis of Payment.

334-8.1 General: Price and payment will be full compensation for all the work specified under this Section (including the applicable requirements of Sections 320 and 330).

For materials accepted in accordance with 334-5, based upon the quality of the material, a pay adjustment will be applied to the bid price of the material as determined on a LOT by LOT basis. The pay adjustment will be assessed by calculating a Pay Factor for the following individual quality characteristics: pavement density, air voids, asphalt binder content, and the percentage passing the No. 200 and No. 8 sieves. The pay adjustment will be computed by multiplying a Composite Pay Factor (CPF) for the LOT by the bid price per ton.

334-8.2 Pay Factors:

334-8.2.1 Partial LOTs: For Partial LOTs where no random sample is obtained due to insufficient tonnage, a CPF of 1.00 shall be applied.

334-8.2.2 Two or Less Sublot Test Results: In the event that two or less sublot test results are available for a LOT, Pay Factors will be determined based on Table 334-8, using the average of the accumulated deviations from the target value. (Except for density, deviations are absolute values with no plus or minus signs.) Use the 1-Test column when there is only one sublot test result and use the 2-Tests column when there are two sublots.

Table 334-8 Small Quantity Pay Table		
Pay Factor	1 Sublot Test Deviation	2 Sublot Test Average Deviation
Asphalt Binder Content		
1.05	0.00-0.23	0.00-0.16
1.00	0.24-0.45	0.17-0.32
0.90	0.46-0.55	0.33-0.39
0.80	>0.55	>0.39
No. 8 Sieve		
1.05	0.00-2.25	0.00-1.59
1.00	2.26-4.50	1.60-3.18
0.90	4.51-5.50	3.19-3.89
0.80	>5.50	>3.89
No. 200 Sieve		
1.05	0.00-0.55	0.00-0.39
1.00	0.56-1.10	0.40-0.78
0.90	1.11-1.50	0.79-1.06
0.80	>1.50	>1.06
Air Voids		
1.05	0.00-0.50	0.00-0.35
1.00	0.51-1.00	0.36-0.71
0.90	1.01-1.70	0.72-1.20
0.80	1.71-2.00	1.21-1.41
0.70	2.01-2.50	1.42-1.77
0.55	>2.50	>1.77
Density (1) Target = 93.00 percent of G_{mm}		
1.05	+ (0.00-3.50), - (0.00-0.50)	+ (0.00-3.25), - (0.00-0.35)
1.00	+ (3.51-4.50), - (0.51-1.00)	+ (3.26-4.25), - (0.36-0.71)
0.95	+ (4.51-5.00), - (1.01-2.00)	+ (4.26-4.75), - (0.72-1.41)
0.90	+ (5.01-5.50), - (2.01-3.00)	+ (4.76-5.25) – (1.42-2.12)
0.80	+ (>5.50), - (>3.00)	+ (>5.25), - (>2.12)
Density (1) Target = 92.00 percent of G_{mm}		
1.05	+ (0.00-4.50), - (0.00-0.50)	+ (0.00-4.25), - (0.00-0.35)
1.00	+ (4.51-5.50), - (0.51-1.00)	+ (4.26-5.25), - (0.36-0.71)
0.95	+ (5.51-6.00), - (1.01-1.50)	+ (5.26-5.75), - (0.72-1.41)
0.90	+ (6.01-6.50), - (1.51-2.00)	+ (5.76-6.25) – (1.42-2.12)
0.80	+ (>6.50), - (>2.00)	+ (>6.25), - (>2.12)

(1). Each density test result is the average of three to five randomly located cores. The target density is 93.00 percent of G_{mm} (92.00 percent when compaction is limited to the static mode or for layers specified to be one inch thick). When compaction is limited to the static mode, no vibratory mode in the vertical direction will be allowed. Other vibratory modes will be allowed, if approved by the Engineer. In this case, the target density is 92.00 percent of G_{mm}.

334-8.2.3 Three or More Sublot Test Results: When three or more sublot test results are available for a LOT, the variability-unknown, standard deviation method will be used to determine the estimated percentage of the LOT that is within the specification limits. The

number of significant figures used in the calculations will be in accordance with requirements of AASHTO R 11/ASTM E29, Absolute Method.

334-8.2.3.1 Percent Within Limits: The percent within limits (PWL) and Pay Factors for the LOT will be calculated as described below. Variables used in the calculations are as follows:

x = individual test value (sublot)
n = number of tests (sublots)
s = sample standard deviation
$\Sigma(x^2)$ = summation of squares of individual test values
$(\Sigma x)^2$ = summation of individual test values squared
Q_U = upper quality index
USL = upper specification limit (target value plus upper specification limit from Table 334-9)
Q_L = lower quality index
LSL = lower specification limit (target value minus lower specification limit from Table 334-9)
P_U = estimated percentage below the USL
P_L = estimated percentage above the LSL

1. Calculate the arithmetic mean $(\overline{X})$ of the test values:

$$\overline{X} = \frac{\sum x}{n}$$

2. Calculate the sample standard deviation (s):

$$s = \sqrt{\frac{n\sum\left(x^2\right) - \left(\sum x\right)^2}{n(n-1)}}$$

3. Calculate the upper quality index (Q_U):

$$Q_U = \frac{\text{USL} - \overline{\text{X}}}{\text{s}}$$

4. Calculate the lower quality index (Q_L):

$$Q_L = \frac{\overline{X} - LSL}{s}$$

5. From Table 334-10, determine the percentage of work below the USL (P_U).

6. From Table 334-10, determine percentage of work above the LSL (P_L) Note: If USL or LSL is not specified; percentages within (USL or LSL) will be 100.

7. If Q_U or Q_L is a negative number, then calculate the percent within limits for Q_U or Q_L as follows: enter Table 334-10 with the positive value of Q_U or Q_L and obtain the corresponding percent within limits for the proper sample size. Subtract this number from 100.00. The resulting number is the value to be used in the next step (Step 8) for the calculation of quality level.

8. Calculate the percent within limits (PWL) = $(P_U + P_L) - 100$

9. Calculate the Pay Factor (PF) for each quality characteristic using the equation given in 334-8.2.3.2.

Table 334-9
Specification Limits

Quality Characteristic	Specification Limits
Passing No. 8 sieve (percent)	Target ± 3.1
Passing No. 200 sieve (percent)	Target ± 1.0
Asphalt Content (percent)	Target ± 0.40
Air Voids (percent)	4.00 ± 1.20
Density, vibratory mode (percent of G_{mm}):	93.00 + 4.00, - 1.20
Density, static mode (percent of G_{mm}):	92.00 + 5.00, - 1.50 (1)

(1): No vibratory mode in the vertical direction will be allowed. Other vibratory modes will be allowed, if approved by the Engineer.

Table 334-10
Percent Within Limits

Quality Index	Percent within Limits for Selected Sample Size	
	n = 3	n = 4
0.00	50.00	50.00
0.05	51.38	51.67
0.10	52.76	53.33
0.15	54.15	55.00
0.20	55.54	56.67
0.25	56.95	58.33
0.30	58.37	60.00
0.35	59.80	61.67
0.40	61.26	63.33
0.45	62.74	65.00
0.50	64.25	66.67
0.55	65.80	68.33
0.60	67.39	70.00
0.65	69.03	71.67
0.70	70.73	73.33

Table 334-10 Percent Within Limits		
Quality Index	Percent within Limits for Selected Sample Size	
	n = 3	n = 4
0.75	72.50	75.00
0.80	74.36	76.67
0.85	76.33	78.33
0.90	78.45	80.00
0.95	80.75	81.67
1.00	83.33	83.33
1.05	86.34	85.00
1.10	90.16	86.67
1.15	97.13	88.33
1.20	100.00	90.00
1.25	100.00	91.67
1.30	100.00	93.33
1.35	100.00	95.00
1.40	100.00	96.67
1.45	100.00	98.33
1.50	100.00	100.00
1.55	100.00	100.00
1.60	100.00	100.00
1.65	100.00	100.00
1.70	100.00	100.00
1.75	100.00	100.00
1.80	100.00	100.00
1.85	100.00	100.00
1.90	100.00	100.00
1.95	100.00	100.00
2.00	100.00	100.00
2.05	100.00	100.00
2.10	100.00	100.00
2.15	100.00	100.00
2.20	100.00	100.00
2.25	100.00	100.00
2.30	100.00	100.00
2.35	100.00	100.00
2.40	100.00	100.00
2.45	100.00	100.00

Table 334-10 Percent Within Limits		
Quality Index	Percent within Limits for Selected Sample Size	
	n = 3	n = 4
2.50	100.00	100.00
2.55	100.00	100.00
2.60	100.00	100.00
2.65	100.00	100.00

334-8.2.3.2 Pay Factors (PF): Pay Factors will be calculated by using the following equation:

Pay Factor = (55 + 0.5 x PWL) / 100

The PWL is determined from Step (8) of 334-8.2.3.1.

334-8.3 Composite Pay Factor (CPF): A CPF for the LOT will be calculated based on the individual PFs with the following weighting applied: 40% Density (D), 25% Air Voids (V_a), 20% asphalt binder content (P_b), 10% Passing No. 200 (P_{-200}) and 5% Passing No. 8 (P_{-8}). Calculate the CPF by using the following formula:

CPF = [(0.400 x PF D) + (0.250 x PF V_a) + (0.200 x PF P_b) + (0.100 x PF P_{-200}) + (0.050 x PF P_{-8})]

Where the PF for each quality characteristic is determined in either 334-8.2.2 or 334-8.2.3, depending on the number of sublot tests. Note that the number after each multiplication will be rounded to the nearest 0.01.

The pay adjustment shall be computed by multiplying the CPF for the LOT by the bid price per ton.

334-8.4 Payment: Payment will be made under:

Item No. 334- 1- Superpave Asphaltic Concrete - per ton.

SECTION 337
ASPHALT CONCRETE FRICTION COURSES

337-1 Description.

Construct an asphalt concrete friction course pavement with the type of mixture specified in the Contract Documents, or when offered as alternates, as selected. This Section specifies mixes designated as FC-5, FC-9.5, and FC-12.5.

Obtain Superpave asphalt concrete friction course from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105. Producers must meet the plant and equipment requirements of Section 320, as modified herein. Meet the general construction requirements of Section 330, as modified herein.

337-2 Materials.

337-2.1 General Requirements: Meet the requirements specified in Division III as modified herein. The Engineer will base continuing approval of material sources on field performance. Warm mix technologies (additives, foaming techniques, etc.) listed on the Department's website may be used in the production of the mix. The URL for obtaining this information is: https://www.fdot.gov/materials/laboratory/asphalt/index.shtm.

337-2.2 Asphalt Binder: Meet the requirements of Section 916, and any additional requirements or modifications specified herein for the various mixtures.

337-2.3 Coarse Aggregate: Meet the requirements of Section 901, and any additional requirements or modifications specified herein for the various mixtures.

337-2.4 Fine Aggregate: Meet the requirements of Section 902, and any additional requirements or modifications specified herein for the various mixtures.

337-2.5 Hydrated Lime: Meet the requirements of AASHTO M 303, Type 1. Provide certified test results for each shipment of hydrated lime indicating compliance with the specifications.

337-2.6 Liquid Anti-Strip Additive: Meet the requirements of 916-4 and be listed on the Department's Approved Product List (APL).

337-2.7 Fiber Stabilizing Additive (Required for FC-5 only): Use either a mineral or cellulose fiber stabilizing additive. Meet the following requirements:

337-2.7.1 Mineral Fibers: Use mineral fibers (made from virgin basalt, diabase, or slag) treated with a cationic sizing agent to enhance the disbursement of the fiber, as well as to increase adhesion of the fiber surface to the bitumen. Meet the following requirements for physical properties:

1. Size Analysis
   - Average fiber length: 0.25 inch (maximum)
   - Average fiber thickness: 0.0002 inch (maximum)
2. Shot Content (ASTM C612)
   - Percent passing No. 60 Sieve: 90 - 100
   - Percent passing No. 230 Sieve: 65 - 100

Provide certified test results for each batch of fiber material indicating compliance with the above tests.

337-2.7.2 Cellulose Fibers: Use cellulose fibers meeting the following requirements:

1. Fiber length: 0.25 inch (maximum)
2. Sieve Analysis
    a. Alpine Sieve Method
        Percent passing No. 100 sieve: 60-80
    b. Ro-Tap Sieve Method
        Percent passing No. 20 sieve: 80-95
        Percent passing No. 40 sieve: 45-85
        Percent passing No. 100 sieve: 5-40
3. Ash Content: 18% non-volatiles (plus or minus 5%)
4. pH: 7.5 (plus or minus 1.0)
5. Oil Absorption: 5.0% (plus or minus 1.0) (times fiber weight)
6. Moisture Content: 5.0% by weight (maximum)

Provide certified test results for each batch of fiber material indicating compliance with the above tests.

337-3 General Composition of Mixes.

337-3.1 General: Use a bituminous mixture composed of aggregate (coarse, fine, or a mixture thereof), asphalt binder, and in some cases, fibers and/or hydrated lime. Size, uniformly grade and combine the aggregate fractions in such proportions that the resulting mix meets the requirements of this Section.

337-3.2 Specific Component Requirements by Mix:

337-3.2.1 FC-5:

337-3.2.1.1 Aggregates: Use an aggregate blend which consists of either 100% Class A friction aggregate or 100% Class B and/or C aggregates in accordance with Table 337-1. Do not blend Class A aggregate with Class B or C aggregate for FC-5 mixtures.

A list of aggregates approved for use in friction course may be available on the Department's website. The URL for obtaining this information, if available, is: https://mac.fdot.gov/.

337-3.2.1.2 Asphalt Binder: Use an asphalt binder as called for in the Contract Documents meeting the requirements of Section 916. High polymer binder may be substituted in a mixture with PG 76-22 binder at no additional cost to the Department.

337-3.2.1.3 Hydrated Lime: Add hydrated lime at a dosage rate in accordance with Table 337-1.

337-3.2.1.4 Liquid Anti-Strip Additive: Use a liquid anti-strip additive at the approved dosage rate as indicated on the APL for all mixtures.

337-3.2.1.5 Fiber Stabilizing Additive: Add either mineral fibers at a dosage rate of 0.4% by weight of the total mix, or cellulose fibers at a dosage rate of 0.3% by weight of total mix.

337-3.2.2 FC-9.5 and FC-12.5:

337-3.2.2.1: Aggregates: Use an aggregate blend of approved friction course aggregates in accordance with Table 337-1. For classifications that allow non-friction aggregate, up to 20% RAP and the remaining fine aggregate from other sources of aggregate not approved for friction courses may be used. Mixtures utilizing High Polymer (HP) binder are not allowed to contain RAP.

A list of aggregates approved for use in friction course may be available on the Department's website. The URL for obtaining this information, if available, is: https://mac.fdot.gov/.

337-3.2.2.2: Asphalt Binder: Use an asphalt binder as called for in the Contract Documents meeting the requirements of Section 916. High polymer binder may be substituted in a mixture with PG 76-22 binder at no additional cost to the Department.

Table 337-1 Friction Aggregate Classification			
Classification	Minimum percentage of approved friction course aggregates for FC-5 mixtures	Minimum percentage of approved friction course aggregates for FC-9.5 and FC-12.5 mixtures	Percentage of hydrated lime required in FC-5 mixtures
A	100	100	0
B	100	60	1.0
C	100	60	1.5

337-3.3 Grading Requirements:

337-3.3.1 FC-5: Use a mixture having a gradation at design within the ranges shown in Table 337-2.

Table 337-2 FC-5 Gradation Design Range									
3/4 inch	1/2 inch	3/8 inch	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
100	85-100	60-75	15-25	5-10	--	--	--	--	2-5

337-3.3.2 FC-9.5: Meet the design gradation requirements for a SP-9.5 Superpave fine mix as defined in 334-3.2.2.

337-3.3.3 FC-12.5: Meet the design gradation requirements for a SP-12.5 Superpave fine mix as defined in 334-3.2.2.

337-4 Mix Design.

337-4.1 FC-5: The Department will design the FC-5 mixtures. Furnish the materials and all appropriate information (source, gradation, etc.) as specified in 334-3.2.7. The Department will have three weeks to design the mix.

The Department will establish the design binder content for FC-5 within the following ranges based on aggregate type:

Table 337-3 FC-5 Percent Binder Content	
Aggregate Classification	Percent Binder Content
A	6.0 - 7.5
B or C	6.5 - 8.0

337-4.2 FC-9.5 and FC-12.5: Provide a mix design conforming to the requirements of 334-3.2 unless otherwise designated in the plans. Where the plans call for an FC-12.5, an FC-9.5 may be substituted for the FC-12.5 at no additional cost provided the thickness requirements of 334-1.4.1 are met.

337-4.3 Revision of Mix Design: For FC-5, FC-9.5 and FC-12.5, meet the requirements

of 334-3.3. For FC-5, all revisions must fall within the gradation limits defined in Table 337-2.

337-5 Contractor's Process Control.

Provide the necessary process control of the friction course mix and construction in accordance with the applicable provisions of 320-2, 330-2 and 334-4.

The Engineer will monitor the spread rate periodically to ensure uniform thickness. Perform quality control procedures for daily monitoring and control of spread rate variability. If the spread rate varies by more than 5% of the spread rate set by the Engineer in accordance with 337-8, immediately make all corrections necessary to bring the spread rate into the acceptable range.

337-6 Acceptance of the Mixture.

337-6.1 FC-9.5 and FC-12.5: Meet the requirements of 334-5.

337-6.2 FC-5: Meet the requirements of 334-5 with the following exceptions:

1. The mixture will be accepted with respect to gradation ($P_{-3/8}$, P_{-4}, and P_{-8}), and asphalt binder content (P_b) only.
2. Testing in accordance with AASHTO T 312 and FM 1-T 209 (and conditioning prior to testing) will not be required as part of 334-5.1.1.
3. The standard LOT size of FC-5 will be 2,000 tons, with each LOT subdivided into four equal sublots of 500 tons each.
4. The Between-Laboratory Precision Values described in Table 334-7 are modified to include ($P_{-3/8}$, P_{-4}, and P_{-8}) with a maximum difference per FM 1-T 030 (Figure 2).
5. Table 334-6 (Master Production Range) is replaced by Table 337-4.
6. The mixture will be accepted on the roadway with respect to surface tolerance in accordance with 334-5.8. No density testing will be required for these mixtures.

Table 337-4
FC-5 Master Production Range

Characteristic	Tolerance (1)
Asphalt Binder Content (%)	Target ± 0.60
Passing 3/8 inch Sieve (%)	Target ± 7.50
Passing No. 4 Sieve (%)	Target ± 6.00
Passing No. 8 Sieve (%)	Target ± 3.50
(1) Tolerances for sample size of n = 1 from the verified mix design	

337-6.2.1 Individual Test Tolerances for FC-5 Production: Terminate the LOT if any of the following Quality Control (QC) failures occur:

1. An individual test result of a sublot for asphalt binder content does not meet the requirements of Table 337-4,
2. Two consecutive test results within the same LOT for gradation on any of the following sieve sizes ($P_{-3/8}$, P_{-4}, and P_{-8}) do not meet the requirements of Table 337-4. The two consecutive failures must be on the same sieve.

When a LOT is terminated due to a QC failure, stop production of the mixture until the problem is resolved to the satisfaction of the QC Managers and/or Asphalt Plant Level II Technicians responsible for the decision to resume production after a QC failure, as identified in Section 105. In the event that it can be demonstrated that the problem can

immediately be or already has been resolved, it will not be necessary to stop production. When a LOT is terminated, make all necessary changes to correct the problem. Do not resume production until appropriate corrections have been made. Inform the Engineer of the problem and corrections made to correct the problem. After resuming production, sample and test the material to verify that the changes have corrected the problem. Summarize this information and provide it to the Engineer prior to the end of the work shift when production resumes.

In the event that a QC failure is not addressed as defined above, the Engineer's approval will be required prior to resuming production after any future QC failures.

Address any material represented by a failing test result in accordance with 334-5.9.5. Any LOT terminated under this Subarticle will be limited to a maximum Pay Factor of 1.00 (as defined in 337-12.3) for each quality characteristic.

337-7 Special Construction Requirements.

337-7.1 Hot Storage of FC-5 Mixtures: When using surge or storage bins in the normal production of FC-5, do not leave mixtures containing mineral fibers in the surge or storage bin for more than one hour. Do not leave mixtures containing cellulose fibers in the surge or storage bin for more than 1-1/2 hours.

337-7.2 Longitudinal Grade Controls for Open-Graded Friction Courses: On FC-5, use either longitudinal grade control (skid, ski or traveling stringline) or a joint matcher.

337-7.3 Temperature Requirements for FC-5:

337-7.3.1 Air Temperature at Laydown: Meet the requirements of Table 330-1.

337-7.3.2 Temperature of the Mix: Heat and combine the asphalt binder and aggregate in a manner to produce a mix having a temperature, when discharged from the plant, meeting the requirements of 320-6.3. Meet all requirements of 330-6.1.3 at the roadway. The target mixing temperature shall be established by the Contractor. The target mixing temperature may be reduced when using warm mix technology.

337-7.4 Compaction of FC-5: Provide two, static steel-wheeled rollers, with an effective compactive weight in the range of 135 to 200 pounds per linear inch (PLI), determined as follows:

$$\text{PLI} = \frac{\text{Total Weight of Roller (pounds)}}{\text{Total Width of Drums (inches)}}$$

(Any variation of this equipment requirement must be approved by the Engineer.) Establish an appropriate rolling pattern for the pavement in order to effectively seat the mixture without crushing the aggregate. In the event that the roller begins to crush the aggregate, reduce the number of coverages or the PLI of the rollers. If the rollers continue to crush the aggregate, use a tandem steel-wheel roller weighing not more than 135 PLI of drum width.

337-7.5 Temperature Requirements for FC-9.5 and FC-12.5:

337-7.5.1 Air Temperature at Laydown: Meet the requirements of Table 330-1.

337-7.5.2 Temperature of the Mix: Heat and combine the asphalt binder and aggregate in a manner to produce a mix having a temperature, when discharged from the plant, meeting the requirements of 320-6.3. Meet all requirements of 330-6.1.3 at the roadway.

337-7.6 Prevention of Adhesion: To minimize adhesion to the drum during the rolling operations, the Contractor may add a small amount of liquid detergent to the water in the roller.

At intersections and in other areas where the pavement may be subjected to cross-

traffic before it has cooled, spray the approaches with water to wet the tires of the approaching vehicles before they cross the pavement.

337-7.7 Transportation Requirements of Friction Course Mixtures: Cover all loads of friction course mixtures with a tarpaulin, or waterproof cover, meeting requirements of 320-7.

337-8 Thickness of Friction Courses.

337-8.1 FC-9.5 and FC-12.5: The thickness of the friction course layer will be the plan thickness as shown in the Contract Documents. For construction purposes, the plan thickness will be converted to spread rate as defined in 334-1.4.

Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lb/yd^2-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

337-8.2 FC-5: The total thickness of the FC-5 layer will be the plan thickness as shown in the Contract Documents. For construction purposes, the plan thickness will be converted to spread rate based on the combined aggregate bulk specific gravity of the asphalt mix being used as shown in the following equation:

$$\text{Spread rate (lb/yd}^2) = t \times G_{sb} \times 40.5$$

Where: t = Thickness (in.) (Plan thickness)

G_{sb} = Combined aggregate bulk specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-3.2.

Plan quantities are based on a G_{sb} of 2.635, corresponding to a spread rate of 80 pounds per square yard for a 3/4 inch layer. Pay quantities will be based on the actual combined aggregate bulk specific gravity (G_{sb}) of the mix being used.

337-9 Special Equipment Requirements for FC-5.

337-9.1 Fiber Supply System: Use a separate feed system to accurately proportion the required quantity of fibers into the mixture in such a manner that uniform distribution is obtained. Interlock the proportioning device with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes. Control the proportion of fibers to within plus or minus 10% of the amount of fibers required. Provide flow indicators or sensing devices for the fiber system, interlocked with plant controls so that an alarm will be activated if introduction of the fiber fails. Stop production of the asphalt mixture and resume production once the fiber supply system is operating correctly.

When a batch plant is used, add the fiber to the aggregate in the weigh hopper or as approved and directed by the Engineer. Increase the batch dry mixing time by 8 to 12 seconds, or as directed by the Engineer, from the time the aggregate is completely emptied into the pugmill. Ensure that the fibers are uniformly distributed prior to the addition of asphalt binder into the pugmill.

When a drum-mix plant is used, add and uniformly disperse the fiber with the aggregate prior to the addition of the asphalt binder. Add the fiber in such a manner that it will not become entrained in the exhaust system of the drier or plant.

337-9.2 Hydrated Lime Supply System: For FC-5 mixes containing Class B or C aggregate, use a separate feed system to accurately proportion the required quantity of hydrated lime into the mixture in such a manner that uniform coating of the aggregate is obtained prior to

the addition of the asphalt binder. Add the hydrated lime in such a manner that it will not become entrained in the exhaust system of the drier or plant. Interlock the proportioning device with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes and to ensure that all mixture produced is properly treated with hydrated lime. Control the proportion of hydrated lime to within plus or minus 10% of the amount of hydrated lime required. Provide flow indicators or sensing devices for the hydrated lime system, interlocked with plant controls so that an alarm will be activated if introduction of the hydrated lime fails. Stop production of the asphalt mixture and resume production once the hydrated lime supply system is operating correctly. The addition of the hydrated lime to the aggregate may be accomplished by Method A or B as follows:

337-9.2.1 Method A - Dry Form: Add hydrated lime in a dry form to the mixture according to the type of asphalt plant being used.

When a batch plant is used, add the hydrated lime to the aggregate in the weigh hopper or as approved and directed by the Engineer. Increase the batch dry mixing time by eight to twelve seconds, or as directed by the Engineer, from the time the aggregate is completely emptied into the pugmill. Uniformly distribute the hydrated lime prior to the addition of asphalt binder into the pugmill.

When a drum-mix plant is used, add and uniformly disperse the hydrated lime to the aggregate prior to the addition of the asphalt binder. Add the hydrated lime in such a manner that it will not become entrained in the exhaust system of the drier or plant.

337-9.2.2 Method B - Hydrated Lime/Water Slurry: Add the required quantity of hydrated lime (based on dry weight) in a hydrated lime/water slurry form to the aggregate. Provide a solution consisting of hydrated lime and water in concentrations as directed by the Engineer. Use a plant equipped to blend and maintain the hydrated lime in suspension and to mix it with the aggregates uniformly in the proportions specified.

337-9.3 Hydrated Lime Pretreatment: For FC-5 mixes containing Class B or C aggregate, as an alternative to 337-9.2, pretreat the aggregate with hydrated lime prior to incorporating the aggregate into the mixture. Use a feed system to accurately proportion the aggregate and required quantity of hydrated lime and mix them in such a manner that uniform coating of the aggregate is obtained. Control the proportion of hydrated lime to within plus or minus 10% of the amount required. Aggregate pretreated with hydrated lime in this manner shall be incorporated into the asphalt mixture within 45 days of pretreatment.

337-9.3.1 Hydrated Lime Pretreatment Methods: Pretreat the aggregate using one of the following two methods:

Pretreatment Method A - Dry Form: Add the required quantity of hydrated lime in a dry form to the aggregate. Assure that the aggregate at the time of pretreatment contains a minimum of 3% moisture over saturated surface dry (SSD) conditions. Utilize equipment to accurately proportion the aggregate and hydrated lime and mix them in such a manner as to provide a uniform coating.

Pretreatment Method B - Hydrated Lime/Water Slurry: Add the required quantity of hydrated lime (based on dry weight) in a hydrated lime/water slurry form to the aggregate. Provide a solution consisting of hydrated lime and water in a concentration to provide effective treatment. Use equipment to blend and maintain the hydrated lime in suspension, to accurately proportion the aggregate and hydrated lime/water slurry, and to mix them to provide a uniform coating.

337-9.3.2 Blending QC Records: Maintain adequate QC records for the Engineer's review for all pretreatment activities. Include as a minimum the following information (for each batch or day's run of pretreatment): pretreatment date, aggregate certification information, certified test results for the hydrated lime, aggregate moisture content prior to blending, as-blended quantities of aggregate and hydrated lime, project number, customer name, and shipping date.

337-9.3.3 Certification: In addition to the aggregate certification, provide a certification with each load of material delivered to the hot mix asphalt plant, that the material has been pretreated in conformance with these specifications. Include also the date the material was pretreated.

337-10 Failing Material.

Meet the requirements of 334-5.9. For FC-5, use the Master Production Range defined in Table 337-4 in lieu of Table 334-6.

337-11 Method of Measurement.

For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), the quantity to be paid for will be the weight of the mixture, in tons. For each pay item, the pay quantity will be based on the quantity placed on the project, limited to 110% of the adjusted plan quantity for the pay item. For dense-graded mixes, the adjusted plan quantity will be determined by dividing the pay item's original plan quantity (including any Engineer approved quantity revisions) by the design G_{mm} stated in 334-1.4, then multiplying it by the tonnage-weighted average G_{mm} of the mixes used for the pay item. For open graded mixes, the adjusted plan quantity will be determined by dividing the pay item's original plan quantity (including any Engineer approved quantity revisions) by the design G_{sb} stated in 337-8.2, then multiplying it by the tonnage-weighted average G_{sb} of the mixes used for the pay item.

The bid price for the asphalt mix will include the cost of the asphalt binder (asphalt rubber (or polymer), asphalt cement, ground tire rubber, anti-stripping additive, blending and handling) and the tack coat application as directed in 300-8, as well as fiber stabilizing additive and hydrated lime (if required). There will be no separate payment or unit price adjustment for the asphalt binder material in the asphalt mix. The weight will be determined as provided in 320-3.2 (including the provisions for the automatic recordation system).

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

337-12 Basis of Payment.

337-12.1 General: Price and payment will be full compensation for all the work specified under this Section (including the applicable requirements of Sections 320 and 330).

Based upon the quality of the material, a pay adjustment will be applied to the bid price of the material as determined on a LOT by LOT basis. The pay adjustment will be assessed by calculating a Pay Factor for individual quality characteristics. The pay adjustment will be computed by multiplying a Composite Pay Factor for the LOT by the bid price per ton.

337-12.2 FC-9.5 and FC-12.5: Meet the requirements of 334-8.

337-12.3 FC-5: Meet the requirements of 334-8 with the following exceptions:

1. Pay factors will be calculated for asphalt binder content and the percentages passing the 3/8 inch, the No. 4, and the No. 8 sieves only.

2. Table 337-5 replaces Table 334-8.
3. Table 337-6 replaces Table 334-9.
4. The Composite Pay Factor equation in 334-8.3 is replaced with the following:

CPF = [(0.20 x PF 3/8 inch) + (0.30 x PF No. 4) + (0.10 x PF No. 8) + (0.40 x PF AC)]

Table 337-5 Small Quantity Pay Table for FC-5		
Pay Factor	1-Test Deviation	2-Test Average Deviation
Asphalt Binder Content (%)		
1.05	0.00-0.25	0.00-0.18
1.00	0.26-0.50	0.19-0.35
0.90	0.51-0.60	0.36-0.42
0.80	>0.60	>0.42
3/8 inch Sieve (%)		
1.05	0.00-3.25	0.00-2.30
1.00	3.26-6.50	2.31-4.60
0.90	6.51-7.50	4.61-5.30
0.80	>7.50	>5.30
No. 4 Sieve (%)		
1.05	0.00-2.50	0.00-1.77
1.00	2.51-5.00	1.78-3.54
0.90	5.01-6.00	3.55-4.24
0.80	>6.00	>4.24
No. 8 Sieve (%)		
1.05	0.00-1.50	0.00-1.06
1.00	1.51-3.00	1.07-2.12
0.90	3.01-3.50	2.13-2.47
0.80	>3.50	>2.47

Table 337-6 Specification Limits for FC-5	
Quality Characteristic	Specification Limits
Asphalt Binder Content (%)	Target ± 0.45
Passing 3/8 inch sieve (%)	Target ± 6.00
Passing No. 4 sieve (%)	Target ± 4.50
Passing No. 8 sieve (%)	Target ± 2.50

337-12.4 Payment: Payment will be made under:

Item No. 337- 7- Asphaltic Concrete Friction Course - per ton.

SECTION 338
VALUE ADDED ASPHALT PAVEMENT

338-1 Description.

Construct value added asphalt pavement consisting of asphalt concrete structural course and asphalt concrete friction course, subject to a three year warranty period after final acceptance of the Contract in accordance with 5-11.

For purposes of this Specification, the Responsible Party, as designated herein, is responsible for performance of the value added asphalt pavement including continued responsibility for performing all remedial work associated with pavement distresses exceeding threshold values determined in accordance with this Section, and as to which notice was provided to the Responsible Party.

The work specified in this Section will not be paid for directly, but will be considered as incidental to other Contract items.

338-2 Materials and Construction Requirements.

Meet the following requirements:

Hot Bituminous Mixtures - Plant, Methods and Equipment.....Section 320
Hot Bituminous Mixtures - General Construction Requirements.....Section 330
Superpave Asphalt Concrete.....Section 334
Asphalt Concrete Friction Courses.....Section 337

338-3 Responsible Party.

Prior to any value added asphalt pavement being placed on the project, the Contractor shall designate a Responsible Party to accept responsibility for maintaining the value added asphalt pavement, when remedial work is required. When the scope of the asphalt work is only milling and resurfacing, and there is no construction of the embankment, subgrade or base below the pavement included in the Contract, the Responsible Party may be either the Contractor or the Department approved subcontractor performing the value added asphalt pavement work. When the construction of the embankment, subgrade or base below the pavement is included in the Contract, in addition to the construction of the asphalt concrete structural course and asphalt concrete friction course, the Contractor shall be considered as the Responsible Party.

When the Responsible Party is a subcontractor, the subcontractor must be pre-qualified with the Department in the category of asphalt, and such designation must be made to the Department by the Contractor. The proposed subcontractor must execute and submit to the Department a form, provided by the Department, prior to or concurrent with the Contractor's request to sublet any value added asphalt pavement work, stipulating that the subcontractor assumes all responsibility as the Responsible Party for the value added asphalt pavement within the three-year warranty period. Failure to timely designate the Responsible Party will result in the Contractor being the Responsible Party unless otherwise agreed to in writing by the Department.

Upon final acceptance of the Contract in accordance with 5-11, the Contractor's responsibility for maintenance of all the work or facilities within the project limits of the Contract will terminate in accordance with 5-11; with the sole exception that the obligations set

forth in this Section for value added asphalt pavement will continue thereafter to be the responsibility of the Responsible Party as otherwise provided in this Section.

338-4 Statewide Disputes Review Board.

The Statewide Disputes Review Board in effect for this Contract will resolve any and all disputes that may arise involving administration and enforcement of this Specification. The Responsible Party and the Department acknowledge that use of the Statewide Disputes Review Board is required, and the determinations of the Statewide Disputes Review Board for disputes arising out of this Specification will be binding on both the Responsible Party and the Department, with no right of appeal by either party.

Meet the requirements of 8-3.

338-5 Pavement Evaluation and Remedial Work.

338-5.1 General: The Department's Pavement Condition Survey Program, along with observations by the Engineer, will be used as the basis for determining the extent and the magnitude of the pavement distresses occurring on the project. In the event the level of distress exceeds any of the threshold values defined below, remedial work as described in 338-5.5 by the Responsible Party will be required.

The Department will monitor the pavement for distresses and may require remedial action at any time. For evaluation purposes, the project will be subdivided into LOTs of 0.1 mile per lane. When the segment is less than 0.1 mile, the segment will be called a partial LOT. For purposes of threshold values and remedial work, partial lots and lots will be treated as lots. The Department may conduct a Pavement Condition Survey of the value added pavement following the final acceptance of the project, and at intermediate times throughout the warranty period with findings provided when considered by the Department to be the obligation of the Responsible Party.

The final survey, if determined by the Engineer to be necessary, will be conducted before the end of the warranty period with results provided to the Responsible Party for those conditions exceeding contract threshold values requiring remedial action that the Department believes to be an obligation of the Responsible Party. The Department will be responsible for all costs associated with the surveys.

If the survey findings, intermediate or final, are to be disputed by the Responsible Party, written notification must be submitted to the Engineer within 30 calendar days of the date of receipt of the information from the Department.

During the warranty period, the Responsible Party may monitor the project using nondestructive methods and may participate with the Department in the Pavement Condition Surveys upon request. The Responsible Party shall not conduct any coring, milling or other destructive methods without prior approval by the Engineer.

338-5.2 Category 1 Pavement: For purposes of this Specification, Category 1 pavement is defined as mainline roadways, access roads and frontage roads with a design speed of 55 mph and greater.

Threshold values and associated remedial work for Category 1 value added asphalt pavement are specified in Table 338-1.

Table 338-1 Category 1 Pavements		
Type of Distress	Threshold Values	Remedial Work
Rutting [1]	Depth > 0.25 inch	Remove and replace the distressed LOT(s) to the full depth of all layers and to the full lane width [2]
Ride [3]	RN < 3.5 IRI > 110 inches/mile	Remove and replace the friction course layer for the full length and the full lane width of the distressed LOT(s)[4]
Settlement/Depression[5]	Depth ≥ 1/2 inch	Propose the method of correction to the Engineer for approval prior to beginning remedial work
Cracking [6]	Cumulative length of cracking > 30 feet for Cracks > 1/8 inch	Remove and replace the distressed LOT(s) to the full depth of all layers, and to the full lane width [7]
Raveling and/or Delamination affecting the Friction Course [8]	Any length	Remove and replace the distressed area(s) to the full distressed depth and the full lane width for the full distressed length plus 50' on each end
Pot holes and Slippage Area(s) [8]	Observation by Engineer	Remove and replace the distressed area(s) to the full distressed depth and the full lane width for the full distressed length plus 50' on each end
Bleeding [9]	Loss of surface texture due to excess asphalt, individual area ≥ 10 sf.	Remove and replace the distressed area(s) to the full distressed depth and the full lane width for the full distressed length plus 50' on each end

(1) Rutting: Rut depth to be determined by Laser Profiler in accordance with the Flexible Pavement Condition Survey Handbook. For any LOT that cannot be surveyed by Laser Profiler, the rut depth will be determined manually in accordance with the Flexible Pavement Condition Survey Handbook, with the exception that the number of readings per LOT will be one every 20 feet. For a partial LOT, a minimum of three measurements not exceeding 20 feet apart will be made. When the average of the measurements obtained manually exceeds 0.30 inch or if any individual measurement exceeds 0.6 inch, remedial work will be required.
(2) Remedial Work for Rutting: The Contractor may propose removal and replacement of less than the full depth of all layers by preparation and submittal of a signed and sealed engineering analysis report, demonstrating the actual extent of the distressed area(s). Remedial work must be performed in accordance with Table 338-1 unless approved otherwise by the Engineer.
(3) Ride: Ride Number (RN) and International Roughness Index (IRI) to be established by Laser Profiler in accordance with FM 5-549. Use RN Warranty Threshold for projects that used RN for construction acceptance and International Roughness Index (IRI) Warranty Threshold for projects that used IRI for construction acceptance.
(4) If the deficient ride is due to underlying asphalt layers; base, subgrade, or embankment which were constructed by the Responsible Party, propose the method of correction to the Engineer for approval prior to beginning the remedial work.
(5) Settlement/Depression: Depth of the settlement/depression to be determined by a 6 foot manual straightedge.
(6) Cracking: Beginning and ending of 1/8 inch cracking will be determined as the average of three measurements taken at one foot intervals. The longitudinal construction joint at the lane line will not be considered as a crack.
(7) Remedial Work for Cracking: The Contractor may propose removal and replacement of less than the full depth of all layers by preparation and submittal of a signed and sealed engineering analysis report, demonstrating the actual extent of the distressed area(s). Remedial work must be performed in accordance with Table 338-1 unless approved otherwise by the Engineer.
(8) Raveling, Delamination, Pot holes, Slippage: As defined and determined by the Engineer in accordance with the examples displayed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Pavement.shtm
(9) Bleeding: Bleeding to be defined and determined by the Engineer in accordance with the examples displayed at the following URL: https://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Pavement.shtm

338-5.3 Category 2 Pavement: For purposes of this Specification, Category 2 pavement is defined as mainline roadways, access roads and frontage roads with a design speed less than 55 mph, approach transition and merge areas at toll booths, ramps, acceleration and deceleration lanes (including tapers), turn lanes, parking areas, rest areas, weigh stations, and agricultural inspection stations.

Threshold values and associated remedial work for Category 2 value added asphalt pavement are specified in Table 338-2.

Table 338-2
Category 2 Pavements

Type of Distress	Threshold Values	Remedial Work
Rutting(1)	Measured by Laser Profiler: See Table 338-1	See Table 338-1
	Manual Measurement: Avg. Depth > 0.4 inch	Remove and replace 1.5 inch(1a) the full lane width for the area plus 50 feet
Cracking	Cumulative length of cracking > 300 feet for Cracks > 1/8 inch	See Table 338-1
Surface Deterioration (2)	See Table 338-1	See Table 338-1
Settlement/Depression(3)	Depth ≥ 1/2 inch	See Table 338-1

(1) Rutting: Rut depth to be determined by Laser Profiler in accordance with the Flexible Pavement Condition Survey Handbook. For any LOT that cannot be surveyed by the Laser Profiler, the rut depth will be determined manually in accordance with the Flexible Pavement Condition Survey Handbook, with the exception that the number of readings per LOT will be one every 20 feet. For partial LOT, minimum of three measurements not exceeding 20 feet apart will be checked. When the average of the measurements obtained manually exceeds 0.40 inch, or if any individual measurement exceeds 0.6 inch, remedial work will be required.
(1a) If pavement has an open graded friction course, remove and replace 2.0 inches.
(2) Surface Deterioration: As used in Table 338-2, Surface Deterioration includes Raveling and/or Delamination affecting the Friction Course; Pot holes; Slippage Area(s); and Bleeding; all as defined and footnoted in Table 338-1.
(3)Settlement/Depression: Depth of the settlement/depression to be determined by a 6 foot manual straightedge.

338-5.4 Category 3 Pavement: For purposes of this Specification, Category 3 pavement is defined as bicycle paths, walking paths, median crossovers, shoulders and other areas as determined by the Engineer.

Threshold values and associated remedial work for Category 3 value added asphalt pavement are specified in Table 338-3.

Table 338-3 Category 3 Pavements		
Type of Distress	Threshold Values	Remedial Work
Rutting	N/A	N/A
Cracking	Cumulative length of cracking > 500 feet for Cracks > 1/8 inch	See Table 338-1
Surface Deterioration (1)	See Table 338-1	See Table 338-1
Settlement/Depression(2)	Depth ≥ 1/2 inch	See Table 338-1

(1) Surface Deterioration: As used in Table 338-3, Surface Deterioration includes Raveling and/or Delamination affecting the Friction Course; Pot holes; Slippage Area(s); and Bleeding; all as defined and footnoted in Table 338-1. Raveling of FC-5 for Category 3 Pavements is excluded from this requirement.

(2) Settlement/Depression: Depth of the settlement/depression to be determined by a 6-foot manual straightedge.

338-5.5 Remedial Work: The Responsible Party will perform all necessary remedial work described within this Section at no cost to the Department. If the pavement distresses exceed threshold values and it is determined that the cause of the distress is due to the embankment, subgrade, base or other activities performed by the Contractor, the Responsible Party will be responsible for performing all remedial work associated with the pavement distress. Should an impasse develop in any regard as to the need for remedial work or the extent required, the Statewide Disputes Review Board will render a final decision by majority vote.

Remedial work will not be required if any one of the following conditions is found to apply:

a. Determination that the pavement thickness design as provided by the Department is deficient. The Department will make available a copy of the original pavement thickness design package and design traffic report to the Responsible Party upon request. The Responsible Party is responsible for performing all remedial work associated with the pavement distress if the pavement design is provided by the Contractor.

b. Determination that the Accumulated ESALs (Number of 18 Kip Equivalent Single Axle Loads in the design lane) has increased by 25% or more than the Accumulated ESALs used by the Department for design purposes for the warranty period for the pavement design life. In calculating ESALs, the average annual daily traffic (AADT) will be obtained from the Department's traffic count data and the T24 (percent heavy trucks during a 24 hour period) will be obtained from the Department's traffic classification survey data.

c. Determination that the deficiency was due to the failure of the existing underlying layers that were not part of the Contract work.

d. Determination that the deficiency was the responsibility of a third party or its actions, unless the third party was performing work included in the Contract.

e. Determination that raveling of open-graded friction course (FC-5) in a turn lane, turn out, or median cross over was caused by turning movements and not a materials or construction issue.

If a measured distress value indicates remedial action is required per Table 338-1, Table 338-2 and/or Table 338-3, the Responsible Party must begin remedial work within 45 calendar days of notification by the Department or a ruling of the Statewide Disputes Review Board. The Disputes Review Board will determine the allowable duration for the completion of the remedial work, but not to exceed six months.

In the event remedial action is necessary and forensic information is required to determine the source of the distress, the Department may core and/or trench the pavement. The Responsible Party will not be responsible for damages to the pavement as a result of any forensic activities conducted by the Department.

As applicable to distress criteria for rutting, ride and cracking for Category 1 and Category 2 pavements, when two LOTs requiring remedial action are not separated by three or more LOTs not requiring remedial action, the remedial work shall be required for the total length of all such contiguous LOTs, including the intermediate LOTs not requiring remedial action.

Additionally, for Category 1 and Category 2 pavements, where such areas of remedial action are required due to raveling, slippage or bleeding are separated by less than 1,000 feet, the remedial work will be required for the entire area contiguous to the distressed areas, including intermediate areas otherwise requiring no remedial action.

The Responsible Party has the first option to perform all remedial work that is determined by the Department to be their responsibility. If, in the opinion of the Engineer, the problem poses an immediate danger to the traveling public and the Responsible Party cannot provide temporary mitigation for the defect within 4 hours of written notification and restore the pavement to its original design condition within 72 hours of written notification, the Engineer has the authority to have the remedial work performed by other forces. Temporary mitigation includes the use of traffic control systems such as barricades, drums, or other approved devices to secure the area including lane closures if necessary, and constructing temporary repairs making it safe for the roadway user until the defect can be restored to its original design condition. The Responsible Party is responsible for all incurred costs of the work performed by other forces should the problem (remedial work) be determined to be the responsibility of the Responsible Party. Remedial work performed by other forces does not alter any of the requirements, responsibilities or obligations of the Responsible Party.

The Responsible Party must complete all remedial work to the satisfaction of the Engineer. Any disputes regarding the adequacy of the remedial work will be resolved by the Statewide Disputes Review Board. Approval of remedial work does not relieve the Responsible Party from continuing responsibility under the provisions of this Specification.

Notify the Engineer in writing prior to beginning any remedial work. Meet the requirements of the Specifications when performing any remedial work. Perform all signing and traffic control in accordance with the current edition of the Department's Standard Plans. Provide maintenance of traffic during remedial work at no additional cost to the Department. Lane closure restrictions listed in the original Contract will apply to remedial work. Written requests to obtain permission for lane closures for either forensic investigation or remedial work must be made to the Engineer 48 hours in advance of any lane closures. Do not perform any lane closures until written permission is given by the Engineer.

If remedial work necessitates a corrective action to overlying asphalt layers, pavement markings, signal loops, adjacent lanes, roadway shoulders, or other affected Contract work, perform these corrective actions using similar products at no additional cost to the Department.

338-6 Responsible Party's Failure to Perform.

Should the Responsible Party fail to timely submit any dispute to the Statewide Disputes Review Board, fail to satisfactorily perform any remedial work, or fail to compensate the Department for any remedial work performed by the Department and determined to be the Responsible Party's responsibility in accordance with this Specification, the Department will

suspend, revoke or deny the Responsible Party's certificate of qualification under the terms of Section 337.16(d)(2), Florida Statutes, for a minimum of six months or until the remedial work has been satisfactorily performed (or full and complete payment for remedial work performed by others made to the Department), whichever is longer. Should the Responsible Party choose to challenge the Department's notification of intent for suspension, revocation or denial of qualification and the Department's action is upheld, the Responsible Party will have its qualification suspended for an additional minimum of six months.

The remedial work is not an obligation of the Contractor's bond required by Section 337.18, Florida Statutes.

SECTION 339
MISCELLANEOUS ASPHALT PAVEMENT

339-1 Description.

Construct asphalt pavement in areas where vehicular traffic does not travel, such as pavement under guardrail, bicycle paths, median pavement, sidewalks, etc.

Also, chemically treat the underlying soil to prevent plant growth.

339-2 Materials.

Meet the following requirements:

Hot Bituminous Mixtures .....Section 320
Herbicide..... 7-1.7

For the pavement, use any plant-mixed hot bituminous mixture meeting the requirements of a mix design verified by the Engineer, except do not use open-graded friction course (FC-5). For bicycle paths, use a mixture that produces a finished pavement which will not distort or maunder bicycle or mower wheel loads.

In general, the Engineer will accept the mixture on the basis of visual inspection with no further testing required.

339-3 Foundation and Soil Treatment.

Shape the soil in areas where pavement is to be constructed, to a surface true to the lines, grades and typical sections shown in the Plans. Compact the soil to a firm state.

Immediately before placing the pavement, uniformly apply a pre-emergent herbicide in accordance with the requirements of 7-1.7, to the foundation soil. Ensure that the herbicide carries an approved label for use under paved surfaces, and that herbicide is applied in accordance with directions on the label.

Prevent damage to any adjacent vegetation during herbicide application. Replace, at no expense to the Department, any plants damaged as the result of soil treatment outside designated areas.

339-4 Placing Mixture.

Uniformly place the hot bituminous mixture by machine or hand methods at the rate of spread or dimensions indicated in the Plans or as otherwise directed by the Engineer. If posts are to be constructed within the pavement area, the Contractor may cut holes for installation through the completed pavement. After completing installation of posts and compaction of the backfill material, patch the area around each post with fresh hot bituminous mixture.

If directed by the Engineer, place miscellaneous asphalt pavement prior to placement of the final surface course.

339-5 Compacting Mixture.

Uniformly compact the hot bituminous mixture with lightweight rollers or vibratory compactors as directed by the Engineer. The Contractor may use hand tamps for compaction in areas which are inaccessible to other compaction equipment.

The Engineer will not require a specific density.

339-6 Surface Requirements.

Provide a finished surface that is reasonably smooth, of uniform texture, and shaped so as to drain without ponding of water.

Upon completion of the pavement, shape the surface of the adjacent earth to match the pavement edges.

339-7 Method of Measurement.

For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), the quantity to be paid for will be the weight of the mixture in tons. For each pay item, the pay quantity will be based on the quantity placed on the project, limited to 110% of the adjusted plan quantity for the pay item. The adjusted plan quantity will be determined by dividing the original plan quantity (including any Engineer approved quantity revisions) by the design G_{mm} stated in 334-1.4, then multiplying it by the tonnage-weighted average G_{mm} of the mixes used on the project for the pay item. The plan quantity will be determined based on a spread rate of 100 pounds per square yard per inch of design thickness of asphalt placed over the area shown in the Plans.

Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

339-8 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including shaping and compacting the foundation, soil sterilization treatment, furnishing of the bituminous material used in the mixture, and shaping of adjacent earth surfaces.

Payment will be made under:

Item No. 339- 1- Miscellaneous Asphalt Pavement - per ton.

SECTION 341
ASPHALT MEMBRANE INTERLAYER

341-1 Description.

Construct an asphalt membrane interlayer composed of a separate application of asphalt binder covered with a single application of aggregate. Obtain asphalt binder from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 916.

341-2 Materials.

Meet the following requirements:

Bituminous Material (PG 76-22 Asphalt Binder)*.....Section 916

Coarse Aggregate Cover Material (Size No. 6 stone, slag, or gravel) .....
.....Section 901

*Use products listed in the Department's Approved Product List (APL).

341-3 Equipment.

341-3.1 Power Broom: Provide a power broom for cleaning the existing pavement capable of removing all loose material from the surface.

341-3.2 Spreading Equipment: Provide a self-propelled aggregate spreader that can be adjusted to accurately apply the cover material at the specified rate and that spreads the material uniformly.

341-3.3 Rollers: Provide self-propelled, pneumatic-tired traffic type rollers equipped with at least 7 smooth-tread, low-pressure tires, and capable of carrying a gross load of at least 8 tons. Maintain a minimum tire inflation pressure of 90 psi, or as specified by the manufacturer, such that in no two tires the air pressure varies more than 5 psi. Load the traffic roller as directed by the Engineer.

341-3.4 Mixing Equipment: Use mixing equipment for asphalt binder designed for that purpose and capable of producing and maintaining a homogeneous mixture of asphalt cement at the specified temperature.

341-3.5 Pressure Distributor: Use a pressure type distributor to apply asphalt binder capable of maintaining a homogeneous mixture of asphalt cement at the specified temperature and consistently apply the material in a uniform manner.

341-4 Contractor's Quality Control.

Provide the necessary quality control of the asphalt binder, and interlayer construction in accordance with the Contract requirements. If the rate of application varies by more than 5% from the rate set by the Engineer in accordance with 341-6, immediately make all corrections necessary to bring the spread rate into the acceptable range. The Engineer may take additional measurements at any time. The Engineer will randomly check the Contractor's measurement to verify the spread rate.

341-5 Construction Procedure.

341-5.1 Preparation of Surface: Prior to application of the asphalt binder, clean the existing pavement as specified in 300-5.

341-5.2 Application of Asphalt Binder: Apply the asphalt binder only under the following conditions:

1. The air temperature is above 50ºF and rising.
2. The pavement is absolutely dry.
3. The wind conditions are such that cooling of the asphalt binder will not be so rapid as to prevent good bonding of the aggregate.

Uniformly apply the asphalt binder, at the rate of 0.6 to 0.8 gal/yd^2, as directed by the Engineer. Use an application rate corrected to 60ºF, in accordance with 300-9.3. Determine the rate of application after each application operation.

341-5.3 Application of Cover Material: Immediately after application of the asphalt binder, uniformly spread the cover material at a rate of 0.26 and 0.33 ft^3/yd^2. The Engineer will set the exact rate. Determine the application rate at the beginning of each day's production, and as needed to control the operation, a minimum of twice per day. Maintain an application rate such that the pavement is covered uniformly with aggregate, and is one aggregate layer thick. For the cover material, use aggregate that is reasonably free of any adherent coatings and that does not contain excessive moisture. Immediately after the application of cover material, check the surface to ensure a uniform distribution of cover material and a smooth surface.

Do not separate the application of the asphalt binder and the application of the cover material by more than 300 feet, unless approved by the Engineer.

341-5.4 Rolling: In order to ensure maximum embedment of the aggregate, cover the entire width of the mat immediately by traffic rollers. For the first coverage, provide a minimum of three traffic rollers in order to accomplish simultaneous rolling in echelon of the entire width of the spread.

After initial rolling, immediately correct all portions of the completed surface, that the Engineer deems defective (not properly covered by aggregates, fat spots, excessive free aggregate, etc.).

Following the first coverage, make additional coverages with traffic rollers as directed by the Engineer.

341-5.5 Traffic Control: For the normal sequence of construction operations, place the first course of asphalt concrete overlay over the membrane prior to opening to traffic.

341-6 Unacceptable Asphalt Membrane Interlayer.

If the asphalt membrane interlayer is unacceptable due to incorrect blending, application rate, or not meeting the requirements of this Section, or damaged prior to placement of the asphalt concrete layer, remove and replace it as directed by the Engineer at no additional cost to the Department. Do not apply excessive amounts of asphalt binder.

341-7 Placement of Asphalt Concrete Overlay.

Ensure that the thickness and temperature of the initial layer of asphalt concrete placed on top of the asphalt membrane interlayer are such that the overlay bonds to the interlayer and the underlying layer without voids or excessive binder. Core the asphalt overlay as directed by the Engineer to evaluate the binder and aggregate spread rates, as well as the effectiveness of the asphalt concrete overlay in producing a well-bonded interlayer.

341-8 Method of Measurement.

341-8.1 Asphalt Membrane Interlayer: The quantity to be paid for will be plan quantity, in square yards, completed and accepted.

341-8.2 Bituminous Material (Asphalt Binder-Interlayer): The quantity will be the volume, in gallons, determined as provided in 300-9.

341-8.3 Submittal of Certification of Quantities for Bituminous Material: Prepare and submit a Certification of Quantities to the Engineer in accordance with 9-2.1.2.

341-9 Basis of Payment.

341-9.1 Asphalt Membrane Interlayer: Price and payment will be full compensation for all work specified in this Section, including furnishing cover materials, handling, spreading, rolling, bituminous material, and other incidental work necessary to complete this item.

341-9.2 Payment Items: Payment will be made under:

Item No. 341- 1- Asphalt Membrane Interlayer - per square yard.

SECTION 346
STRUCTURAL PORTLAND CEMENT CONCRETE

346-1 Description.

Use a Department-approved concrete mix design composed of a mixture of portland cement, aggregate, water, admixtures, and supplementary cementitious materials. Deliver the portland cement concrete to the site of placement in a freshly mixed, unhardened state.

Obtain concrete from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105. If the concrete production facility's Quality Control (QC) Plan is suspended, the Contractor is solely responsible to obtain the services of another concrete production facility with an accepted QC Plan or await the reacceptance of the concrete production facility's QC Plan prior to the placement of any further concrete on the project. There will be no changes in the Contract Time because of the suspension, as described. Bear all delay costs and other costs associated with the concrete production facility's QC Plan acceptance or reacceptance.

346-2 Materials.

346-2.1 General: Meet the following requirements:

Coarse Aggregate	Section 901
Fine Aggregate*	Section 902
Portland Cement and Blended Cement	Section 921
Water	Section 923
Admixtures**	Section 924
Supplementary Cementitious Materials	Section 929
Materials for Concrete Repair**	Section 930
Non-Shrink Grout*	Section 934

*Use only silica sand except as provided in 902.

**Use products listed on the Department's Approved Product List (APL).

Do not use materials containing hard lumps, crusts, or frozen matter, or that is contaminated with materials exceeding the specified limits in the above listed Sections.

346-2.2 Types of Cement: Unless a specific type of cement is designated in the Contract Documents, use Type I, Type IL, Type IP, Type IT, Type IS, Type II, or Type III cement in all classes of concrete. Use Type IL, Type IT, or Type II for all mass concrete elements.

Use only the types of cements designated for each environmental classification in structural concrete as shown in Table 346-1. A mix design for a more aggressive environment may be used in a less aggressive environmental condition.

Table 346-1 Cement Use by Environmental Classification			
Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment (1)
Bridge Superstructures			
Precast Superstructure and Prestressed Elements	Type I or Type III	Type I, Type IL, Type II, Type III, Type IP, or Type IS	Type II, Type IL, Type III (2), Type IT or Ternary Blend
Cast in Place	Type I	Type I, Type IL, Type II, Type IP, or Type IS	Type II, Type IL, Type IT or Ternary Blend
Bridge Substructures, Drainage Structures, and other Structures			
All Elements	Type I or Type III	Type I, Type IL, Type II, Type IP, or Type IS	Type II, Type IL, Type IT or Ternary Blend

Notes:
(1) Cements used in a more aggressive environment may also be used in a less aggressive environment.
(2) Type III cement may be used in an Extremely Aggressive Environment for precast superstructure and prestressed elements when the ambient temperature at the time of concrete placement is 60°F and below.

346-2.3 Supplementary Cementitious Materials: Supplementary cementitious materials (SCMs) are required in all classes of concrete specified in Table 346-3. Nonreinforced concrete Class I (Seal) and Class I (Pavement), are exempted, and Class II when used in slightly aggressive environments.

The quantity of portland cement that is replaced with SCMs must be on an equal weight replacement basis of the total cementitious materials in accordance with Table 346-2. When using Type IP, IS or IT blended cements, the total quantity of SCMs, including the blended cement added separately at the concrete plant shall meet the requirements of Table 346-2.

346-2.3.1 Highly Reactive Pozzolans: Materials that have a very high degree of pozzolanic reactivity due to their very fine particle sizes, including silica fume, metakaolin and ultrafine fly ash.

346-2.3.2 Binary Concrete Mixes: Concrete mixes containing portland cement and one SCM.

346-2.3.3 Ternary Concrete Mixes: Concrete mixes containing portland cement and any two SCMs.

Table 346-2 Cementitious Materials Concrete Mix Proportions (%) (Environmental classification is extremely aggressive, unless otherwise noted)						
Application	Portland Cement	Coal Ash Type F	Slag	Highly Reactive Pozzolans (4 and 5)		
				Silica Fume	Metakaolin	Ultra-Fine Fly Ash
General Use	50-82	18-50				
	51-79	18-40		3-9		
	63-77	15-25			8-12	
	63-77	15-25				8-12
	30-45	10-20	45-60			
	30-50		50-70			
	36-43		50-55	7-9		
	33-42		50-55		8-12	
	33-42		50-55			8-12
Precast / Prestressed	70-85 (1)	15-30 (1)				
	50-82	18-50				
	51-79	18-40		7-9		
	63-77	15-25			8-12	
	63-77	15-25				8-12
	30-40	10-20	50-60			
	30-50		50-70			
	36-43		50-55	7-9		
	33-42		50-55		8-12	
	33-42		50-55			8-12
Drilled Shaft	50-82	18-50				
	38-42		58-62			
	30-40	10-20	50-60			
Mass Concrete	50-82 (2)	18-50 (2)				
	50-65 (3)	35-50 (3)				
	66-78	15-25		7-9		
	63-77	15-25			8-12	
	63-77	15-25				8-12
	30-40	10-20	50-60			
	30-50		50-70			
	36-43		50-55	7-9		
	33-42		50-55		8-12	
	33-42		50-55			8-12

(1) Slightly Aggressive and Moderately Aggressive environments.
(2) For Concrete with Core Temperature T≤165°F.
(3) For Concrete with Core Temperature T≥165°F.
(4) A minimum concrete Surface Resistivity (SR) value of 29 kΩ-cm is required.
(5) Highly reactive pozzolans may be used below the specified ranges to enhance strength and workability when it is not required by the Contract Documents. A minimum concrete Surface Resistivity (SR) value is not required.

346-2.4 Aggregates: Produce all concrete using Size No. 57, 67 or 78 coarse aggregates. Use Size No. 8, and Size No. 89 alone, only when approved by the Engineer.

Use Size No. 4 or larger blended with smaller size coarse aggregate as two components.

346-2.4.1 Optimized Aggregate Gradation: Improve the aggregate packing density at the Contractor's option, by adding an intermediate-size coarse aggregate in accordance with FM 5-621 to produce combined aggregate gradation of fine, intermediate, and coarse aggregate sizes for the concrete mixes.

346-2.4.2 Lightweight fine aggregate (LWFA) for internal curing: At the Contractor's option, use LWFA to reduce the early-age concrete cracking by replacing some of normal fine aggregate with saturated LWFA.

346-2.5 Admixtures: Ensure admixtures are used in accordance with the manufacturer's recommendations and meeting the requirements of Section 9.2, Volume II of the Materials Manual.

346-3 Classification of Concrete.

346-3.1 General: The classifications of concrete are designated as Class I (Seal), Class I (Pavement), Class II, Class II (Bridge Deck), Class III, Class IV, Class IV (Drilled Shaft), Class V, Class VI, and Class VII. The 28-day specified minimum compressive strength, maximum water to cementitious materials ratio and target slump of each class are detailed in Table 346-3. The required air content for all classes of concrete is less than or equal to 6.0%.

For purposes of this Specification the concrete is further classified as follows:

1. Conventional Concrete: The target slump is described in Table 346-3 with a tolerance of ± 1.5 inches.
2. Increased Slump Concrete: The maximum target slump is 7 inches with a tolerance of ± 1.5 inches when a Type F, G, I or II admixture is used.
3. Slip-form Concrete: The target slump is 1.5 inches with a tolerance of ± 1.5 inches. For Class I (Pavement), meet the requirements of Section 350.
4. Flowing Concrete: Request Engineer's authorization to use flowing concrete for cast-in-place applications. The target slump is 9 inches with a tolerance of ± 1.5 inches.
5. Self-Consolidating Concrete (SCC): Request Engineer's authorization to use SCC for cast-in-place applications The minimum target slump flow is 22.5 inches with a tolerance of ± 2.5 inches.

346-3.2 Concrete Class Substitutions: The Engineer may allow the substitution of a higher class concrete in lieu of the specified class concrete when the substituted concrete mixes are included as part of the QC Plan, or for precast concrete, the Precast Concrete Producer QC Plan. The substituted higher class concrete must meet or exceed the requirements of the specified class concrete.

When the average compressive strength is less than the specified minimum compressive strength of the higher class mix design, notify the Engineer. Acceptance is based on the requirements in Table 346-3 for the specified class concrete.

346-3.3 Acceptance Requirements: The specified minimum 28-day strengths, maximum water to cementitious materials ratio (w/cm), and target slumps for each class of concrete are given in Table 346-3. For lightweight concrete, acceptance requirements also include the hardened density specified in the Contract Documents.

The calculation of the water to cementitious materials ratio (w/cm) is based on the total mass of cementitious materials including portland cement and any SCMs used in the mix.

Table 346-3 Compressive Strength, w/cm, and Slump of Concrete Classes			
Class of Concrete	28-day Specified Minimum Compressive Strength (f'c) (psi)	Maximum Water to Cementitious Materials Ratio (pounds per pounds)	Target Slump Value (inches)
I (Seal)	3,000	0.53	8
I (Pavement) (1) (5)	3,000	0.50	1.5 or 3
II (3)	3,400	0.53	3 (2)
II (Bridge Deck)	4,500	0.44	3 (2)
III	5,000	0.44	3 (2)
IV	5,500	0.41(4)	3 (2)
IV (Drilled Shaft)	4,000	0.41	8.5
V	6,500	0.37(4)	3 (2)
VI	8,500	0.37(4)	3 (2)
VII	10,000	0.37(4)	3 (2)

Notes:
(1) Meet the requirements of Section 350.
(2) For increased slump concrete, flowing concrete, SCC and slip form concrete meet the requirements of 346-3.1.
(3) For precast three-sided culverts, box culverts, endwalls, inlets, manholes and junction boxes, the target slump value and air content will not apply. The maximum allowable slump is 6 inches, except as noted in (2). The Contractor is permitted to use concrete meeting the requirements of ASTM C478 (4,000 psi) in lieu of the specified Class II concrete for precast endwalls, inlets, manholes and junction boxes.
(4) When silica fume or metakaolin is required, the maximum water to cementitious material ratio will be 0.35. When ultrafine fly ash is used, the maximum water to cementitious material ratio will be 0.30.
(5) If 28-day strength is 2,500 or greater, concrete may be accepted if 28-day compressive strength is reached by 56 days.

346-3.4 Acceptance of concrete at 56 days: Use concrete mix designs meeting the specified compressive strength at 56 days at the Contractor's option. Submit the request to the Engineer for approval. After the Engineer's approval, notify the concrete producer to initiate the mix design approval process at least 90 days prior to the anticipated concrete placement.

346-3.5 Durability for Concrete Construction:

346-3.5.1 Minimum Cementitious Materials Content: Ensure that the produced concrete meets the minimum amount of cementitious materials content in Table 346-4.

Table 346-4 Minimum Amount of Total Cementitious Materials Content (pounds per cubic yard of concrete)			
Concrete Class	Environmental Classification		
	Extremely Aggressive	Moderately Aggressive	Slightly Aggressive
I (Seal) (1), I (Pavement) (1), and II,	470		
II (Bridge Deck), III (2), IV, IV (Drilled Shaft), V, VI and VII	600	550	510

Notes:
(1) Request the use of concrete mixes with a lower amount of total cementitious materials content at the Contractor's option. The mix design must meet the requirements of Section 9.2 Volume II of the Materials Manual.
(2) When precast three-sided culverts, box culverts, endwalls, inlets, manholes or junction boxes require a Class III concrete, minimum cementitious materials content may be reduced to 470 pounds per cubic yard.

346-3.5.2 Chloride Content Limits: Use the following maximum allowable chloride content limits for the concrete application and/or exposure environment shown:

Table 346-5 Chloride Content Limits for Concrete Construction		
Application/Exposure Environment		Maximum Allowable Chloride Content, (pounds per cubic yard of concrete)
Non-Reinforced Concrete		No Test Needed
Reinforced Concrete	Slightly Aggressive Environment	0.70
	Moderately or Extremely Aggressive Environment	0.40
Prestressed Concrete		0.40

Suspend concrete placement immediately for every mix design if chloride test results exceed the limits of Table 346-5 until corrective measures are made. Submit an Engineering Analysis Scope in accordance with 6-4 by a Specialty Engineer knowledgeable in the areas of corrosion and corrosion control, to determine if the material meets the intended service life of the structure on all concrete produced from the mix design failing chloride test results to the previous passing test results.

346-3.5.3 Surface Resistivity Test: Ensure that the concrete meets or exceeds a Sr value of 29 kΩcm at 28 days or 56 days if specified, when a highly reactive pozzolan is specified in the Contract Documents.

346-4 Special Types of Concrete.

346-4.1 Drilled Shaft Concrete: Notify the Engineer at least 48 hours before placing drilled shaft concrete. Obtain slump loss test results demonstrating that the drilled shaft concrete maintains a slump of at least 5 inches throughout the concrete elapsed time before drilled shaft concrete operations begin.

Perform the slump loss test at the anticipated ambient temperature for drilled shaft placements greater than 30 cubic yards and an elapsed time of greater than five hours.

Obtain slump loss test results from an approved laboratory or from a field demonstration. Slump loss test results for drilled shafts requiring 30 cubic yards of concrete or less and a maximum elapsed time of five hours or less may be done in a laboratory. Obtain all other slump loss test results in the field.

The concrete elapsed time is defined in Section 455. Obtain the Engineer's approval for use of slump loss test results including elapsed time before concrete placement begins.

Test each load of concrete for slump to ensure that it is within the limits of this Section. Initially cure acceptance cylinders for 48 hours before transporting them to the laboratory.

If the elapsed time during placement exceeds the slump loss test data, submit an Engineering Analysis Scope in accordance with 6-4 by a Specialty Engineer knowledgeable in concrete foundations, to determine if the shaft is structurally sound and free from voids. At the direction of the Engineer, excavate the drilled shaft for inspection. Obtain approval from the Engineer before placing any additional shafts.

346-4.2 Mass Concrete: When the Contract Documents designate any structure as mass concrete, use a Specialty Engineer to develop and administer a Mass Concrete Control Plan (MCCP). Develop the MCCP in accordance with Section 9.4 Volume II of the Materials Manual. Provide the Specialty Engineer a list of all concrete elements identified. Use a sequential identification code for each element indicating the bridge or structure number, location and type of element, least dimension size, and environmental exposure.

Record core and differential temperatures for all structures included in the MCCP and monitor only the elements specified therein. Ensure that the concrete core temperatures do not exceed the maximum allowable temperature of 180°F and that the differential temperatures between the element core and surface do not exceed the maximum allowable temperature differential of 35°F. Submit the MCCP to the Engineer for approval at least 21 calendar days prior to the first anticipated mass concrete placement.

Do not place concrete until the proposed MCCP has been approved. Any modifications must be submitted as addenda to the original MCCP and must be approved in writing by the Engineer.

Install temperature measuring sensors and recording devices for all mass concrete elements in accordance with the MCCP. Do not add local additional insulation or external sources of heat around the surface sensors that affect the temperature readings.

Ensure that, prior to the first concrete placement of each concrete element the Specialty Engineer or approved designee personally inspects the installation of the temperature measuring devices and verifies that the temperature data acquisition equipment is properly functioning. The Specialty Engineer shall be available for immediate consultation during the monitoring period of any mass concrete element.

Use temperature data acquisition equipment to record temperature readings in accordance with the MCCP.

Within three workings days of the completion of temperature recording for each concrete element, submit the Mass Concrete Field Report in accordance with Section 9.4, Volume II of the Materials Manual.

For a group of elements, the Engineer may approve a monitoring reduction if the first element placed does not exceed either the maximum temperature or maximum temperature differential. Request written approval from the Engineer at least 14 calendar days prior to the anticipated date of the intended reduced monitoring. If approved, monitoring of the recorded temperatures is not required for the remaining elements meeting all of the following requirements:

1. All elements have the same dimensions.
2. All elements have the same concrete mix design.
3. All elements have the same insulation R value and active cooling measures (if used).
4. Ambient temperatures during concrete placement for all elements are within minus 10°F of the ambient temperature during placement of the initial element.
5. Use the same temperature control measures used for the initial monitored element and keep them in place for at least the same length of time as for the initial element.

Resume monitoring of the temperatures for all elements if directed by the Engineer.

Instrumentation and temperature monitoring are not required for miscellaneous drilled shafts supporting sign, signal, lighting or Intelligent Transportation System (ITS) structures when the as built diameter is six feet or less, and the total cementitious materials content of the concrete mix design is less than or equal to 752 pounds per cubic yard.

Monitoring of the recorded temperatures is not required for any mass concrete substructure element meeting all of the following requirements:

1. The minimum cross-sectional as-built dimension of the element is six feet or less.

2. Insulation with an R-value of at least 2.5 must be provided for at least 72 hours following the completion of concrete placement.

3. The environmental classification of the concrete element is slightly aggressive or moderately aggressive.

4. The concrete mix design meets the mass concrete proportioning requirements of 346-2.3.

5. The total cementitious material content of the concrete mix design is less than or equal to 752 pounds per cubic yard.

6. Temperature of the concrete is 95°F or less at placement.

Implement immediate corrective action as directed by the Specialty Engineer when either the core temperature or the temperature differential of any mass concrete element exceeds its maximum allowable value. The approval of the MCCP shall be revoked.

Submit an Engineering Analysis Scope in accordance with 6-4 for approval, which addresses the structural integrity and durability of any mass concrete element that is not cast in compliance with the approved MCCP, or which exceeds the allowable core temperature or temperature differential.

Submit all analyses and test results requested by the Engineer for any noncompliant mass concrete element. Submit a revised MCCP and do not place any mass concrete elements until a revised MCCP has been approved in writing by the Engineer.

The Department will not provide compensation for additional costs or loss of time due to additional analyses, tests, or other impacts on production caused by not monitoring the recorded temperatures.

346-4.3 Flowing Concrete and Self-Consolidating Concrete (SCC): Use Flowing concrete or SCC when shown in the Contract Documents or to facilitate concrete placement in structures of complex geometric shape or highly reinforcement.

Perform a field demonstration mockup using an approved mix design. Submit the mockup design to the Engineer for approval including the location of the sawcut.

Cast a partial or full-scale mockup(s) and demonstrate through the successful production the ability to produce and place flowing concrete or SCC.

The design, production, and evaluation product must meet the following requirements:

1. Use the proposed mix design(s).

2. Produce the mockup(s) at the jobsite, using the intended placement and curing methods, such as the use of ready-mix trucks, pumps, chutes, hopper, consolidation equipment, etc. The mockup shall contain reinforcing steel, mass concrete cooling pipes if required during construction, and other embedded items typical of the cast element.

3. Meet the requirements of the plastic properties including the cutoff time.

4. Meet the hardened properties and durability requirement when specified in the Contract Documents.

5. Concrete will be produced in the proposed concrete plant(s).

6. Concrete plant(s) representative(s) must be present during mockup demonstration.

7. Notify the Engineer at least 7 days prior to mockup production.

8. If the production of the structural element that will be represented in the mockup requires concrete from multiple concrete plants, the concrete from each plant must be represented in the mockup.

9. Sawcut the mockup's entire cross-section. Inspect and report for voids, honeycombing, and rock pockets, mix segregation, and other inclusions developed during placement of the concrete.

10. Determine the Coarse Aggregate Index of concrete in accordance with FM 5-617.

11. Complete the demonstration of a successful mockup prior to the beginning of concrete placement operations.

Based on the inspection results of the field demonstration mockup, the acceptance of using flowing concrete or SCC in the structural element or section of the element is at the Engineer's discretion.

The required mockup demonstration may be omitted at the Contractor's request. Submit documentation indicating successful experience of furnishing and placing flowing concrete or SCC on similar Department projects. Such documentation must list projects by date of completion, name or project reference number, structural elements or type of unit placed, quantity of concrete furnished, names and experience of personnel, and contact information for verification.

346-4.4 Lightweight Concrete: Submit the fresh and hardened concrete density for mix design approval. The hardened density is the equilibrium density in ASTM C567. Ensure that the hardened density of the mix design is within ± 2 lb/ft^3 of the hardened density specified in the Contract Documents.

During production, the freshly mixed concrete density must be within ± 3 lb/ft^3 of the approved mix design fresh density.

346-5 Sampling and Testing Methods.

Perform concrete sampling and testing in accordance with the following methods:

Table 346-7
Concrete Sampling and Testing Methods

Description	Method
Slump of Hydraulic Cement Concrete	ASTM C143
Air Content of Freshly Mixed Concrete by the Pressure Method (1)	ASTM C231
Air Content of Freshly Mixed Concrete by the Volumetric Method (1)	ASTM C173
Making and Curing Test Specimens in the Field (2)	ASTM C31
Compressive Strength of Cylindrical Concrete Specimens(3)	ASTM C39
Obtaining and Testing Drilled Core and Sawed Beams of Concrete	ASTM C42
Density of Structural Lightweight Concrete	ASTM C567
Initial Sampling of Concrete from Revolving Drum Truck Mixers or Agitators	FM 5-501

Table 346-7 Concrete Sampling and Testing Methods	
Description	Method
Low Levels of Chloride in Concrete and Raw Materials	FM 5-516
Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete	ASTM C138
Temperature of Freshly Mixed Portland Cement Concrete	ASTM C1064
Sampling Freshly Mixed Concrete (4)	ASTM C172
Static Segregation of Self-Consolidating Concrete using Column Techniques	ASTM C1610
Slump Flow of Self-Consolidating Concrete	ASTM C1611
Relative Viscosity of Self-Consolidating Concrete	ASTM C1611
Visual Stability Index of Self-Consolidating Concrete	ASTM C1611
Passing Ability of Self-Consolidating Concrete by J-Ring	ASTM C1621
Rapid Assessment of Static Segregation Resistance of Self-Consolidating Concrete Using Penetration Test	ASTM C1712
Aggregate Distribution of Hardened Self-Consolidating Concrete	FM 5-617
Hardened Visual Stability Index of Self-Consolidating Concrete	AASHTO R 81
Fabricating Test Specimens with Self-Consolidating Concrete	ASTM C1758
Concrete Resistivity as an Electrical Indicator of its Permeability	AASHTO T 358
(1) The Department will use the same type of meter for Verification testing as used for QC testing. When using pressure type meters, use an aggregate correction factor determined by the concrete producer for each mix design to be tested. Record and certify test results for correction factors for each type of aggregate at the concrete production facility. (2) Provide curing facilities that have the capacity to store all QC, Verification, and Resolution cylinders simultaneously for the initial curing. Cylinders will be delivered to the testing laboratory in their molds. The laboratory will remove the specimens from the molds and begin final curing. (3) Lightweight concrete also includes hardened specimen density. The ASTM C567 may be used in lieu of ASTM C39 to verify the density. (4) Take the test sample from the middle portion of the batch in lieu of collecting and compositing samples from two or more portions, as described in ASTM C172.	

346-6 Quality Control.

346-6.1 General: Perform QC activities to ensure materials, methods, techniques, personnel, procedures and processes utilized during production meet the specified requirements. For precast/prestressed concrete operations, ensure that the QC testing is performed by the producer.

Accept the responsibility for QC inspections on all phases of work. Ensure all materials and workmanship incorporated into the project meet the requirements of the Contract Documents.

346-6.2 Concrete Mix Design: Provide concrete that has been produced in accordance with a Department approved mix design, in a uniform mass free from balls and lumps.

For slump target values in excess of 6 inches, including flowing concrete and SCC, utilize a grate over the conveyance equipment to capture any lumps or balls that may be present in the mix. The grate must cover the entire opening of the conveyance equipment and have an opening that is a maximum of 2-1/2 inches in any one direction. Remove the lumps and balls from the grate and discard them. Discharge the concrete in a manner satisfactory to the Engineer. Perform demonstration batches to ensure complete and thorough placements in complex elements, when requested by the Engineer.

Do not place concretes of different compositions such that the plastic concretes may combine, except where the Plans require concrete with a surface resistivity value of

29 kΩcm or below and one with higher than 29 kΩ-cm values in a continuous placement. Produce these concretes using separate mix designs. For example, designate the mix with calcium nitrite as the original mix and the mix without calcium nitrite as the redesigned mix. Ensure that both mixes contain the same cement, coal ash or slag, coarse and fine aggregates and admixtures. Submit both mixes for approval as separate mix designs, both meeting all requirements of this Section. Ensure that the redesigned mix exhibits plastic and hardened qualities which are additionally approved by the Engineer as suitable for placement with the original mix. The Engineer will approve the redesigned mix for commingling with the original mix and for a specific project application only. Alternately, place a construction joint at the location of the change in concretes as approved by the Engineer.

346-6.3 Delivery Certification: Ensure that an electronic delivery ticket is furnished with each batch of concrete before unloading at the placement site. The delivery ticket may be proprietary software or in the form of an electronic spreadsheet, but shall be printed. Ensure that the materials and quantities incorporated into the batch of concrete are printed on the delivery ticket. Include the following information on the delivery ticket:

1. Arrival time at jobsite,
2. Time that concrete mix has been completely discharged,
3. Number of revolutions upon arrival at the jobsite,
4. Total gallons of water added at the jobsite,
5. Additional mixing revolutions when water is added,
6. Total number of revolutions.

Items (3) through (6) do not apply to non-agitating concrete transporting vehicles.

Ensure the batcher responsible for production of the batch of concrete signs the delivery ticket, certifying the batch of concrete was produced in accordance with the Contract Documents.

Sign the delivery ticket certifying that the design mix maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

346-6.4 Plastic Property Tolerances: Reject concrete with slump or air content that does not fall within the specified tolerances, except as noted below, and immediately notify the concrete production facility that an adjustment of the concrete mixture is required.

If a load does not fall within the tolerances, test each subsequent load and the first adjusted load. If failing concrete is not rejected or adjustments are not implemented, the Engineer may reject the concrete and terminate further production until the corrections are implemented.

At the Contractor's risk, water may be added at the placement site immediately after completion of the initial slump or slump flow test, either to correct a low slump or slump flow, or to increase the concrete workability, provided the addition of water does not exceed the water to cementitious materials ratio as defined by the mix design.

After adding water at the placement site depending on the type of concrete, perform the following tests:

1. Except for SCC, perform a slump test to confirm the concrete is within the slump tolerance range. If the slump is outside the tolerance range, reject the load.
2. For SCC, perform a slump flow and rapid assessment of static segregation resistance. Do not reject SCC exceeding the high-end slump flow tolerance if it has passed the rapid assessment of static segregation resistance test. Reject the load if the slump flow

is below the low-end tolerance. As an exception, the Engineer may accept the concrete if the rejection compromises the structural integrity of the element or produces other detrimental effects. Minimum vibration may be needed in accordance with Section 400.

If an adjustment is made at the concrete production facility, perform a slump test on the next load to ensure the concrete is within the slump tolerance ranges.

Except for SCC, do not place concrete represented by slump test results outside of the tolerance range. Include water missing from the water storage tanks upon arrival at the project site in the jobsite water added.

Do not allow concrete to remain in a transporting vehicle to reduce slump.

346-7 Mixing and Delivering Concrete.

346-7.1 General Requirements: Operate all concrete mixers at speeds and volumes per the manufacturer's design or recommendation as stipulated on the mixer rating plate.

346-7.2 Transit Truck Mixing: Produce a completely uniform mixed concrete in a truck mixer for a minimum of 70 revolutions at the mixing speed designated by the truck manufacturer.

` Prior to starting the discharge of the concrete at the jobsite, when water is added, record the added quantity and mix the concrete 30 additional drum mixing revolutions. Do not make more than two mix adjustments. Seek approval from the Engineer prior to using a central mixer and depositing the batch into a truck mixer.

346-7.2.1 Transit Time: Ensure compliance with Table 346-8 between the initial introduction of water into the mix and completely discharging all the concrete from the truck. Reject concrete exceeding the maximum transit time. The Engineer may approve an extension of the transit time which will be identified on the approved mix design.

Table 346-8	
Maximum Allowable Transit Time	
Non-Agitator Trucks	Agitator Trucks
45 minutes	60 minutes
75 minutes (1)	90 minutes (1)
Note: (1) When a water-reducing and retarding admixture (Type D, Type G, or Type II) is used.	

346-7.2.2 Placement Time: All the concrete in a load must be in its final placement position a maximum of 15 minutes after the transit time or cutoff time has expired unless a time extension is approved by the Engineer. As an exception, the Engineer may accept concrete that exceeds the transit time or cutoff time if the load passes the slump or slump flow tests. Place concrete in continuous manner in accordance with Section 400.

For Class IV (Drilled Shaft) mixes, placement time may be extended provided the slump loss time of the first concrete placed is not exceeded throughout the elapsed time.

The Engineer may perform Independent Verification (IV) testing to verify the plastic and hardened properties of the concrete when a time extension is granted.

346-7.3 On-site Batching and Mixing: Use a mixer of sufficient capacity to prevent delays that may be detrimental to the quality of the work. Ensure that the accuracy of batching equipment is in accordance with requirements of this Section.

346-7.4 Concreting in Cold Weather: Do not mix or place concrete when the air temperature is below 40ºF. Protect the fresh concrete from freezing in accordance with Section 400. The requirements of concreting in cold weather are not applicable to precast concrete mixing and placement operations occurring in a temperature controlled environment.

346-7.5 Concreting in Hot Weather: Hot weather concreting is defined as the production, placing and curing of concrete when the concrete temperature at placing exceeds 85ºF but is 100ºF or less.

Unless the specified hot weather concreting measures are in effect, reject concrete exceeding 85ºF at the time of placement. Concrete pavement slab replacement mix designs are exempt from this requirement. Regardless of special measures taken, reject concrete exceeding 100ºF. Predict the concrete temperatures at placement time and implement hot weather measures to avoid production shutdown.

346-7.6 Sample Location: Obtain acceptance samples from the point of final placement.

Where concrete buckets are used to discharge concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge of the bucket. When the concrete is discharged directly from the mixer into the bucket and the bucket is discharged within 20 minutes, samples may be obtained from the discharge of the mixer.

Where conveyor belts, troughs, pumps, or chutes are used to transport concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge end of the entire conveyor belt, trough, pump, or chute system.

Where concrete is placed in a drilled shaft or other element using a tremie pipe and a concrete pump, samples will be obtained from the discharge of the pump line at the location of the tremie hopper.

For all other placement methods, prior to each placement, obtain Department approval for sampling at the discharge of the mixer in lieu of sampling at the point of final placement. Submit the sampling correlation procedure to the Engineer for approval prior to the placement of the concrete. Once the comparative sampling correlation is approved by the Engineer, apply this correlation to the plastic properties tolerances for samples obtained from the discharge of mixer.

Where a concrete pump is used to deposit concrete directly into a drilled shaft which is a wet excavation without the use of a tremie, or other applications as approved by the Engineer, ensure the discharge end of the pump line remains immersed in the concrete at all times after starting concrete placement.

346-8 Plastic Concrete Sampling and Testing.

QC tests include air content, temperature, slump, and preparing cylinders for testing at later dates with the following exceptions:
with the following exceptions:

For Class I (Pavement), the air content testing is not required.

For Lightweight concrete, tests also include the plastic density (unit weight).

For SCC, QC tests also include slump flow in lieu of slump, visual stability index, and rapid assessment of static segregation.

In addition, calculate the water to cementitious materials ratio in accordance with FM 5-501 for compliance to the approved mix design.

Ensure that each truck has a rating plate and a valid mixer identification card issued by the Department. Ensure that the revolution counter on the mixer is working properly, and

calibration of the water dispenser has been performed within the last twelve months. Reject any concrete batches that are delivered in trucks that do not have mixer identification cards. Remove the mixer identification card when a truck mixer is discovered to be in noncompliance and the mixer deficiencies cannot be repaired immediately. When the mixer identification card is removed for noncompliance, make note of the deficiency or deficiencies found, and forward the card to the District Materials and Research Engineer who has Producer QC Plan acceptance authority.

Perform plastic concrete tests on the initial delivery from each plant of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure a technician is present and performing tests throughout the placement operation at each placement site. If a project has multiple concrete placements at the same time, identify the technicians in the QC Plan to ensure minimum sampling and testing frequencies are met. Ensure that the equipment used for delivery, placement and finishing meets the requirements of this Specification.

When a truck designated for QC testing arrives at the discharge site, a subsequent truck may also discharge once a representative sample has been collected from the QC truck and while awaiting the results of QC testing. Reject non-complying loads at the jobsite. Ensure that corrections are made on subsequent loads. Immediately cease concrete discharge of all trucks if the QC truck has failing test. Perform plastic properties tests of concrete on all trucks prior to the first corrected truck and the corrected truck. When more than one truck is discharging into a pump simultaneously, only the truck designated for QC testing may discharge into the pump to obtain a representative sample of concrete from the QC truck only.

Furnish sufficient concrete of each design mix as required by the Engineer for verification (VT) testing. When the Engineer's VT test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, located in Materials Manual Chapter 5, disposition of the concrete will be at the option of the Contractor.

On concrete placements consisting of only one load of concrete, perform initial sampling and testing in accordance with this Section. The acceptance sample and plastic properties tests may be taken from the initial portion of the load.

If any of the QC plastic properties tests fail, reject the remainder of that load, and any other loads that have begun discharging, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Following termination of a LOT, obtain samples from a new load, and perform plastic properties tests until the water to cementitious materials ratio, air content, temperature and slump comply with the Specification requirements. Initiate a new LOT once the testing indicates compliance with Specification requirements.

Suspend production when any five loads in two days of production of the same design mix are outside the specified tolerances. Increase the frequency of QC testing to one per load to bring the concrete within allowable tolerances. After production resumes, obtain the Engineer's approval before returning to the normal frequency of QC testing.

If concrete placement stops for more than 90 minutes, perform initial plastic properties testing on the next batch and continue the LOT. Cylinders cast for that LOT will represent the entire LOT.

When the Department performs Independent Verification (IV), the Contractor may perform the same tests on the concrete at the same time. The Department will compare results based on the Independent Assurance (IA) Checklist tolerances.

346-9 Acceptance Sampling and Testing.

346-9.1 General: Perform plastic properties tests in accordance with 346-8 and cast a set of three QC cylinders, for all structural concrete incorporated into the project. Take these acceptance samples randomly as determined by a random number generator acceptable to the Department. The Department will independently perform VT plastic properties tests and cast a set of VT cylinders. The VT cylinders will be the same size cylinder selected by the Contractor, from a separate sample from the same load of concrete as the Contractor's QC sample.

For each set of QC cylinders verified by the Department, cast two additional cylinders from the same sample, and identify them as the quality control resolution (QR) test cylinders. The Department will also cast two additional verification resolution (VR) test cylinders from each VT sample. All cylinders will be clearly identified as outlined in the Sample/LOT Numbering System instructions located on the State Materials Office website. Deliver the QC samples, including the QR cylinders to the final curing facility in accordance with ASTM C31. Concurrently, the Department will deliver the VT samples, including the VR cylinders, to their final curing facility.

Test the QC laboratory cured samples for compressive strength at the age of 28 days, in a laboratory meeting and maintaining at all times the qualification requirements listed in Section 105.

Ensure the QC testing laboratory input the compressive strength test results into the Department's Materials Acceptance and Certification (MAC) system within 24 hours after testing. Notify the Engineer when results cannot be inputted into MAC.

The Department will compare the VT sample compressive strength test results with the corresponding QC sample test results.

346-9.2 Sampling Frequency: As a minimum, sample and test concrete of each mix design for water to cementitious materials ratio, air content, temperature, slump and compressive strength once per LOT as defined by Table 346-9. The Engineer will randomly verify one of every four consecutive LOTs of each mix design based on a random number generator. The Department may perform Independent Verification (IV) testing to verify compliance with specification requirements. All QC activities, calculations, and inspections will be randomly confirmed by the Department.

Table 346-9
Sampling Frequency

Class Concrete [(1)]	LOT Size
I (Seal)	Each seal placement
I (Pavement)	According to Section 350
II, II (Bridge Deck), III, IV, V, VI, VII	50 cubic yards, or one day's production, whichever is less
IV (Drilled Shaft)	50 cubic yards, or one day's production, whichever is less [(2)]

Table 346-9 Sampling Frequency	
Class Concrete [1]	LOT Size
I (Seal)	Each seal placement
(1) For any class of concrete used for roadway concrete barrier, the lot size is defined as 100 cubic yards, or one day's production, whichever is less. (2) Start a new LOT when there is a gap of more than two hours between the end of one drilled shaft placement and the beginning of the next drilled shaft placement.	

346-9.2.1 Reduced Frequency for Acceptance Tests: Except for Class I (Pavement), the LOT size may represent 100 cubic yards when produced with the same mix design at the same concrete production facility for the same prime Contractor and subcontractor on a given Contract. As an exception, the requirements for the precast/prestressed production facility will only include the same mix design at the same concrete production facility. The reduced testing frequency of Class I (Pavement) is described in the Section 350.

Submit strength test results indicating that the two following criteria are met:

1. The average of the acceptance compressive strengths is equal to or greater than the specified minimum compressive strength (f′c) plus 2.33 standard deviations minus:

   a. 500 psi, if f′c is 5,000 psi or less.

   b. 0.10 f′c, if f′c is greater than 5,000 psi.

2. Every average of three consecutive strength test equals or exceeds the f′c plus 1.34 standard deviations.

Base calculations on a minimum of ten consecutive strength test results for a Class IV or higher; or a minimum of five consecutive strength results for a Class III or lower.

The average of the consecutive compressive strength test results, based on the class of concrete, can be established using historical data from a previous Department project. The tests from the previous Department project must be within the last calendar year or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from a laboratory meeting the requirements of Section 105. Obtain Department approval before beginning reduced frequency LOTs.

If at any time a strength test is not verified or the average strength of the previous ten or five consecutive samples based on the class of concrete from the same mix design and the same production facility does not conform to the above conditions, return to the frequency represented by the LOT as defined in Table 346-9. Notify the Engineer that the initial frequency is reinstated. In order to reinitiate reduced frequency, submit a new set of strength test results.

346-9.3 Strength Test Definition: The strength test of a LOT is defined as the average compressive strength tests of at least two companion cylinders cast from the same sample of concrete and tested at the same age.

346-9.4 Acceptance of Concrete: The Engineer will accept the concrete of a given LOT when the compressive strength test results are verified and meets the minimum specified compressive strength in Table 346-3. Ensure that the hardened concrete strength test results are obtained in accordance with 346-9.3.

The process of concrete compressive strength verification and acceptance consists of the following steps:

1. Verification of QC and VT data.
2. Resolution of QC and VT data if needed.
3. Structural Adequacy determination.

Do not discard a cylinder strength test result based on low strength (strength below the specified minimum strength as per the provisions of this Section).

When one of the three QC cylinders from a LOT is lost, missing, damaged or destroyed, determination of compressive strength will be made by averaging the remaining two cylinders. If more than one QC cylinder from a LOT is lost, missing, damaged or destroyed, the Contractor will core the structure at no additional expense to the Department to determine the compressive strength. Prior to coring, obtain Engineer's approval for coring the structure and its proposed coring location. Acceptance of LOT may be based on VT data at the discretion of the Engineer.

For each QC and each QR cylinder that is lost, missing, damaged or destroyed, payment for that LOT will be reduced by $750.00 per 1,000 psi of the specified design strength [Example: loss of two Class IV (Drill Shaft) QC cylinders that has no VT data will require the element to be cored and a pay reduction will be assessed (4,000 psi / 1,000 psi) x $750 x 2 = $6,000]. This reduction will be in addition to any pay adjustment for low strength.

346-9.4.1 Small Quantities of Concrete: When a project has a total plan quantity of less than 50 cubic yards, that concrete will be accepted based on the satisfactory compressive strength of the QC cylinders. Submit certification to the Engineer that the concrete was batched and placed in accordance with the Contract Documents. Submit a QC Plan for the concrete placement operation in accordance with Section 105. The Engineer may perform IV testing as identified in 346-9 and evaluate the concrete in accordance with 346-9.7.

346-9.5 Verification: The results of properly conducted test by QC and VT laboratories on specimens prepared from the same sample of concrete are not to differ by more than 14%.

$$\text{Difference (\%)} = \text{ABS}\left(\frac{\text{QC}-\text{VT}}{\text{QC}}\right)100$$

Where:

Difference (%) is the absolute percentage difference between QC and VT average compressive strength.

The procedure consists of verifying if the QC and VT compressive strengths data meet the established comparison criteria:

1. When the difference between the average compressive strength of QC and the average compressive strength of VT is less than or equal to 14%, the QC test results are upheld and verified. The Engineer will accept at full pay only LOTs of concrete represented by plastic property results which meet the requirements of the approved mix design and strength test results which equal or exceed the respective specified minimum strength.
2. When the difference between the average compressive strength of QC and the average compressive strength of VT data exceeds 14%, the compressive strength results are not verified and the Engineer will initiate the resolution procedure.

Maintain the QR and VR cylinders for a minimum of 30 days following the testing date of the specified strength.

346-9.6 Resolution: The Engineer will perform the resolution process to identify the reliability of the compressive strength results when the difference between the average compressive strength of QC and the average compressive strength of VT data exceeds 14% as described in 346-9.5(2).

The Engineer will estimate the 28-day strengths (VR_{28} and QR_{28}) for the VR and QR cylinders using the following equation:

$$\text{Estimated 28-Day Compressive Strength (psi)} = \left(\frac{\text{Average Strength at (t) days}}{\text{-17.8} + 46.3[\ln (t)] - 3.3[\ln (t)]^2}\right) 100$$

Where:

(t) is the elapsed number of days from concrete placement to the resolution cylinders testing.

ln (t) is the natural logarithm of (t).

The Engineer will compare:

1. The VT sample results with the VR_{28} cylinders results.
2. The QC sample results with the QR_{28} cylinders results.

Comparison results must not be greater than 17.5%. Core samples of the hardened concrete may be required.

$$V_D\ (\%) = \text{ABS}\left(\frac{VT - VR_{28}}{VT}\right) 100$$

$$Q_D\ (\%) = \text{ABS}\left(\frac{QC - QR_{28}}{QC}\right) 100$$

Where:

V_D (%) is the absolute percentage difference between VT and VR_{28}.

Q_D (%) is the absolute percentage difference between QC and QR_{28}.

Perform the resolution with the concrete compressive strength data at 56 days in lieu of the 28 days when the acceptance of concrete is at 56 days.

The resolution procedure will use the above equations. The Engineer will determine through the resolution procedure whether the QC strength test results or the VT strength test are deemed to be the most accurate, LOTs will then be considered to be verified.

The Engineer will inform the QC and VT laboratories within three calendar days of the acceptance compressive strength test to transport their QR and VR cylinders to the resolution laboratory. The QC and VT laboratories will transport their own hold cylinders to the resolution testing laboratory within three calendar days after the Engineer notifies the Contractor that a resolution procedure is required. In addition, the Engineer will ensure that the QR and VR cylinders are tested within 14 calendar days of the acceptance strength tests.

The Engineer will determine the most accurate strength test result to represent the four or fewer consecutive LOTs as follows:

1. When both results meet the established comparison criteria, both are deemed accurate and the QC strength will represent the LOTs. The Department will pay for cost of the resolution testing.
2. When only the QC result is within the established comparison criteria, the QC strength is deemed as most accurate and will represent the LOTs. The Department will pay for the cost of the resolution testing.
3. When only the VT result is within the established comparison criteria, the VT strength is deemed as most accurate and will represent the LOTs. The Department will assess a $1,000 pay reduction for the cost of the Resolution Investigation.
4. When both results are outside the established comparison criteria, the Engineer, with input from the DMO, will determine if any Department IA evaluations are

required and which test results are most accurate. The Department will pay for the cost of the resolution testing.

When the Engineer cannot determine which strength test results are the most accurate, the concrete represented by the four consecutive LOTs will be evaluated based on the QC data.

The results of the resolution procedure will be forwarded to the Contractor within five working days after completion of the investigation.

346-9.7 Structural Adequacy: The Engineer will evaluate the structural adequacy for verified concrete that does not meet the minimum specified compressive strength of Table 346-3.

For structural adequacy, with standard molded and cured compressive strength cylinders, the compressive strength of concrete is satisfactory provided that the two following criteria are met:

1. The average compressive strength does not fall below the specified minimum compressive strength by more than:

a. 500 psi if the specified minimum compressive strength is equal to or less than 5,000 psi.

b. 10% of the specified minimum compressive strength if the specified minimum compressive strength is greater than 5,000 psi.

2. The average compressive strength with the previous two LOTs is equal to or exceeds the specified minimum compressive strength. This condition only applies if there are two or more previous LOTs to calculate the average.

The Engineer will consider the concrete for a given LOT as structurally adequate and coring will not be allowed when a concrete compressive strength test result falls below the specified minimum strength but has met the above conditions.

346-9.7.1 Lightweight concrete: The Engineer may require an Engineering Analysis Scope in accordance with 6-4 to establish structural and durability adequacy when the lightweight concrete plastic density (unit weight) is outside of the specified tolerances.

346-10 Investigation of Low Compressive Strength Concrete.

When a verified concrete compressive strength test result falls below the specified minimum strength, and does not meet the structural adequacy described in 346-9.7, perform one of the following options:

1. Submit an Engineering Analysis Scope in accordance with 6-4 to establish structural and durability adequacy. When the scope is approved by the Engineer, submit an Engineering Analysis Report (EAR) in accordance with 6-4 that includes a full structural analysis. If the results of the structural analysis indicate adequate strength to serve its intended purpose with adequate durability, and is approved by the Engineer, the Contractor may leave the concrete in place subject to the requirements of 346-11, otherwise, remove and replace the LOT of concrete in question at no additional expense to the Department.

2. At the Engineer's discretion, obtain drilled core samples as specified in this Section to determine the in-place strength of the LOT of concrete in question, at no additional expense to the Department. The Engineer will determine whether to allow coring of the in-place concrete or require an engineering analysis based on the compressive strength of the test cylinders.

346-10.1 Coring for Determination of Structural Adequacy: Core strength test results obtained from the structure will be accepted by both the Contractor and the Department as the in-place strength of the LOT of concrete in question. The core strength test results will be used in

lieu of the cylinder strength test results for determination of structural adequacy. The Department will calculate the strength value to be the average of the compressive strengths of the three individual cores. This will be accepted as the actual measured value.

Obtain and test the cores in accordance with ASTM C42.The Engineer will select the size and location of the drilled cores so that the structure is not impaired and does not sustain permanent damage after repairing the core holes. Obtain the Engineer's written approval before taking any concrete core sample. Notify the Engineer 48 hours prior to taking core samples.

Sample three undamaged cores taken from the same approximate location where the questionable concrete is represented by the low strength concrete test cylinders. Repair core holes after samples are taken with a product in compliance with Section 930 or 934 and meeting the approval of the Engineer. Report the test results to the Engineer within two calendar days of testing the core samples.

The Engineer, with input from the DMO, will consider the concrete as structurally adequate, in the area represented by core tests at the actual test age, if the average compressive strength of cores does not fall below the specified minimum compressive strength (f'c) by more than:

a. 500 psi when the f'c is equal to or less than 5,000 psi.
b. 10% of the f'c when the f'c is greater than 5,000 psi.

The Engineer may also require the Contractor to perform additional testing as necessary to determine structural adequacy of the concrete.

346-11 Pay Adjustments for Low Compressive Strength Concrete.

346-11.1 General: For any LOT of concrete failing to meet the f'c as defined in 346-3, 346-9, and satisfactorily meeting all other requirements of the Contract Documents, including structural adequacy, the Engineer will individually reduce the price of each low strength LOT in accordance with this Section.

346-11.2 Basis for Pay Adjustments: The Engineer will determine payment reductions based on the 28-day compressive strength, represented by either acceptance compressive strength or correlated cores strength test results based on the following criteria:

1. When the acceptance compressive strength test result falls below the specified minimum compressive strength, but no more than the limits established in 346-9.7 below the specified minimum strength, do not core hardened concrete for determining pay adjustments. Use the acceptance compressive strength test results.

2. When the acceptance compressive strength test result falls below the specified minimum compressive strength by more than the limits established in 346-9.7, the structure may be cored for determination of structural adequacy as directed by the Engineer. Use the result of the 28-day correlated core compressive strength or the acceptance compressive strength test, whichever is less.

A price adjustment will be applied to the certified invoice price the Contractor paid for the concrete or the precast product.

The Engineer will relate the strength at the actual test age to the 28-day strength for the design mix represented by the cores using appropriate strength time correlation equations.

In precast concrete operations, excluding prestressed concrete, ensure that the producer submits acceptable core sample test results to the Engineer. The producer may elect to use the products in accordance with this Section. Otherwise, replace the concrete in question at no additional cost to the Department. For prestressed concrete, core sample testing is not allowed

for pay adjustment. The results of the cylinder strength tests will be used to determine material acceptance and pay adjustment.

346-11.3 Calculating Pay Adjustments: The Engineer will determine payment reductions for low strength concrete accepted by the Department. The 28-day strength is represented by either cylinders or correlated cores strength test results in accordance with 346-11.2.

Reduction in Pay is equal to the reduction in percentage of concrete compressive strength below the specified minimum strength:

$$\text{Reduction in Pay (\%)} = \left(\frac{\text{f'c} - \text{28 day Strength}}{\text{f'c}}\right) 100$$

For the elements that payments are based on the per foot basis, the Engineer will adjust the price reduction from cubic yards basis to per foot basis, determine the total linear feet of the elements that are affected by low strength concrete samples and apply the adjusted price reduction accordingly.

Use the concrete compressive strength data at 56 days in lieu of the 28 days when the acceptance of concrete is at 56 days.

For 28-day Class I pavement concrete, if the 56-day strength meets or exceeds the 28-day strength requirement, no reduction in pay will be made. If the 56-day strength is less than the 28-day strength requirement, but is at least within 500 psi of the 28-day strength requirement, reduction in pay is equal to the reduction in percentage of concrete compressive strength below the specified minimum strength:

$$\text{Reduction in Pay (\%)} = \left(\frac{\text{f'c} - \text{56 day Strength}}{\text{f'c}}\right) 100$$

346-12 Pay Reduction for Plastic Properties.

A rejected load in accordance with 346-6.4 is defined as the entire quantity of concrete contained within a single ready-mix truck or other single delivery vehicle regardless of what percentage of the load was placed. If concrete fails a plastic properties test and is thereby a rejected load but its placement continues after completion of a plastic properties test having a failing result, payment for the concrete will be reduced.

The pay reduction for cast-in-place concrete will be twice the certified invoice price per cubic yard of the quantity of concrete in the rejected load.

The pay reduction for placing a rejected load of concrete into a precast product will be applied to that percentage of the precast product that is composed of the concrete in the rejected load. The percentage will be converted to a reduction factor which is a numerical value greater than zero but not greater than one. The precast product payment reduction will be twice the Contractor's billed price from the producer for the precast product multiplied by the reduction factor.

If the Engineer authorizes placement of the concrete, even though plastic properties require rejection, there will be no pay reduction based on plastic properties failures; however, any other pay reductions will apply.

SECTION 347
PORTLAND CEMENT CONCRETE - CLASS NS

347-1 Description.

The requirements of this Section are applicable to concrete designated as nonstructural portland cement concrete, (Class NS) hereinafter referred to as concrete. Use concrete composed of a mixture of portland or blended cement, aggregates, water; and where specified chemical admixtures, or supplementary cementitious materials. Deliver concrete to placement site in a freshly mixed, unhardened state. Ensure the concrete is placed and cured in a manner to ensure that the strength and durability of the concrete is maintained.

347-2 Materials.

347-2.1 General: Ensure all materials used in concrete are free from detrimental matter and deleterious reaction.

Meet the following requirements:

Portland Cement..... Section 921 or ASTM C150
Blended Cement..... Section 921 or ASTM C595
Coarse Aggregate*..... Section 901 or ASTM C33
Fine Aggregate*..... Section 902 or ASTM C33
Water..... Section 923 or ASTM C1602
Admixtures for Concrete*.....Section 924
.....or ASTM C494 and ASTM C260
Supplementary Cementitious Materials..Section 929
.....or ASTM C618 and ASTM C989

* Recycled Asphalt Pavement (RAP) may replace up to 20% of the total aggregate in the design mix. Use RAP from a Department approved stockpile.

347-3 Production, Mixing and Delivery.

347-3.1 Concrete Production Requirements: Obtain concrete from a plant that is currently on the Department's Nonstructural Concrete Production Facility Listing. Producers seeking inclusion on the list must contact the local District Materials Office for approval.

When Volumetric Mixers are used, deliver concrete in accordance with the Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau (VMMB) VMMB 100-01.

Substitution of structural concrete in lieu of non-structural concrete may be used if approved by the Engineer. If structural concrete is used in lieu of non-structural concrete, obtain the concrete from a production facility meeting the requirements of Section 346. Acceptance is based on the requirements of Section 347.

The Engineer may disqualify any concrete production facility for non-compliance with Specification requirements.

347-3.2 Delivery: The maximum allowable mixing, agitation, and placement time of concrete is 120 minutes.

347-3.3 Small Quantities of Concrete: With approval of the Engineer, small quantities of concrete, less than 3 cubic yards placed in one day and less than 0.5 cubic yards placed in a single placement may be accepted using a pre-bagged mixture.

347-4 Certification and Acceptance.

347-4.1 General: Furnish a delivery ticket with each batch of concrete before discharging concrete at the placement site. Ensure the delivery ticket includes material quantities incorporated into the batch, sources of materials, batch adjustments, batch size, time loaded, time discharged, and the allowable jobsite water addition.

Ensure the batcher responsible for producing the concrete signs the delivery ticket, certifying that the batch was produced in accordance with the Contract Documents.

Record water added at the jobsite. Sign the delivery ticket certifying that the concrete was placed in accordance with the Contract Documents.

Acceptance by the Department will be by certification on the delivery ticket signed by the batcher and the Contractor. Certify that the concrete meets a minimum compressive strength of 2,500 psi at 28 days. The Engineer may verify the strength of the concrete.

347-4.2 Remedial Action: Delineate, remove to the full depth and width, and replace, at no cost to the Department, concrete that has:

1. Any cracking greater than 1/4 inch in vertical displacement.

2. Any spalling or flaking off of the surface layer that exposes the rough, pitted aggregate surface in excess of 10 square inches.

3.Any intersecting cracks visible in the hardened concrete (regardless of size) in sidewalk, ditch pavement, slope pavement, traffic separator, or curb and gutter.

4. Any uncontrolled cracks that appear during the life of the Contract unacceptable to the Engineer.

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct Portland cement concrete pavement in one course, on a prepared subgrade or base. Use either the fixed-form or the slip-form method of construction. When reinforced cement concrete pavement is specified or required, use concrete reinforced with steel bars or welded wire reinforcement, in accordance with details shown in the Plans. The Engineer may require a demonstration of equipment and paving operations.

If any uncontrolled cracks appear during the life of the Contract, remove and replace the cracked concrete at no expense to the Department. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of the Engineer.

350-2 Materials.

Meet the following requirements except as modified herein:

Concrete .....Section 346
Grinding Concrete Pavement.....Section 352
Curing Materials* .....Section 925
Embedded Items.....Section 931
Joint Seal.....Section 932
*Use products listed on the Department's Approved Product List (APL).

Provide concrete with a minimum 28-day compressive strength of 3,000 psi and maximum water to cementitious materials ratio of 0.50.

For concrete pavement placed using the slip-form method of construction, utilize concrete with a target slump of 1.5 inches plus or minus 1 inch. For concrete pavement placed by hand in constructed forms, utilize concrete with a target slump of 3 inches plus or minus 1.5 inches. Air content testing for concrete pavement mixes is not required.

350-3 Equipment.

350-3.1 General: Ensure the equipment and tools used have the capability of handling materials and performing all parts of the work and meet the following requirements:

To be of such capacity that the paver operates continuously and at a constant rate of production, with starting and stopping held to a minimum.

When equipment operates on the side forms, use scraping devices to clean accumulations from the top of the forms and wheels.

The forms will be a rigid material and mortar tight. Ensure that the alignment and grade of all forms are in accordance with the contract documents, prior to the placing of concrete.

350-3.2 Slip-Form Paver: Use a self-propelled slip-form paving system consisting of a slip-form paver and if needed, a concrete spreader to distribute, strike-off, consolidate, and screed the freshly placed concrete in one complete pass to produce a dense and homogeneous pavement requiring minimal hand finishing. The slip-form paving machine must extrude concrete into a shape using attached molding components consisting of a profile pan and side forms. The slip-form paving machine must be equipped with the following components:

1. Automatic controls to regulate line and grade from either or both sides of the machine.

2. Vibrators to consolidate the concrete for the full width and depth of the course placed in a single pass and designed and constructed so no spreading or slumping of the concrete occurs.

3. A positive interlock system to stop all vibration and tamping elements when forward motion of the machine stops.

For finishing small areas of concrete pavement, the Contractor may use alternative finishing equipment if approved by the Engineer. This equipment must produce equivalent results including adequate consolidation by internal vibration and an acceptable finish.

350-3.3 Vibratory Equipment: Consolidate the concrete for the full width and depth of concrete in a single pass of an approved internal vibrator system. Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute (vpm). The Engineer may authorize lowering the minimum vibration frequency to 3,500 vpm for isolated sections of paving such as super elevations.

Do not operate vibrators in a manner to cause segregation, either a downward displacement of large aggregate particles or an accumulation of laitance on the surface of the concrete. Reduce the vibrator frequency when forward motion of the paver is decreasing.

Stop vibrators whenever forward motion of the paver is stopped.

For internal vibrators, set the depth of penetration at the paver screed pan or below while passing above any dowels and dowel baskets. Use an operating position locking device so that no part of the vibrating unit will be in contact with reinforcing steel or tie bars while paving.

Meet the manufacturer’s recommendations for the horizontal spacing of the vibrators or 16 inches from center to center of the vibrators, whichever is less.

Ensure that the longitudinal axis of the vibrator body is mounted approximately parallel to the direction of paving.

Use vibrators that meet or exceed the following specifications at the manufacturer's design frequency of 8,000 vpm:

1. Amplitude (peak to peak) 0.070 inches.

2. Centrifugal force 1,200 pounds.

350-3.4 Vibratory Monitoring Equipment: All projects with concrete paving over 15,000 square yards in area, or 1 mile in length, must use an electronic vibrator monitoring device displaying the operating frequency of each individual internal vibrator.

Use a monitoring device with a readout display visible to the paver operator and the Engineer while paving. Display all vibrator frequencies with manual or automatic sequencing among all individual vibrators. Record the clock time, station location, paver track speed, and operating frequency of individual vibrators. Provide an electronic record of the data to the Engineer daily for the first 3 days of paving and weekly thereafter. The Engineer may adjust the frequency submission if necessary.

If the electronic monitoring and recording devices fail to operate properly, immediately check the vibrators manually. If the vibrators are functioning properly, paving may continue. Correct the malfunction within 3 days.

350-3.5 Curing Compound Application Equipment: Use equipment for applying membrane curing compound that is self-propelled and capable of uniformly applying the curing

compound at the specified rate. Use mechanical spray equipment that continuously stirs the curing compound, by effective mechanical means. Thoroughly atomize the curing compound during the spraying operation so that the finished surface of the fresh concrete will not be marred. Cover the entire surface of the pavement and, with slip-form type paving, the vertical faces by a single pass of the machine. Only use spray nozzles that are equipped with appropriate wind guards to ensure uniform application.

Power-spray equipment may be used to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-4 Subgrade Preparation.

Complete the construction of the subgrade for a distance of at least 500 feet ahead of the paving operation. Maintain the finished subgrade in a smooth, compact condition. Restore any areas which are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

Uniformly moisten the subgrade surface ahead of the paving operations with no standing water.

350-5 Setting Forms.

For straight forms, use only steel forms intended for concrete pavement. For curved work, use forms approved by the Engineer.

Clean forms and apply a release agent in accordance with the manufacturer's recommendations before use.

Align and grade so that the forms rest firmly, throughout their entire length, upon the subgrade surface. Join forms neatly and tightly. Brace the form to resist the pressure of the placed concrete and equipment operating on them. Obtain the Engineer's approval of the alignment and grade of all forms before and immediately prior to the placing of concrete.

350-6 Protection from Weather.

Protect unhardened concrete from effects of inclement weather. Cease production and paving operations in rain. The following will apply during paving in cold and hot weather:

1. During the cold weather paving, do not mix or place concrete when the air temperature is below 40ºF. Protect the fresh concrete from freezing in accordance with Section 400 until the concrete reaches a minimum compressive strength of 1,500 psi.

2. During paving in hot weather, cool the aggregates and mixing water as necessary to maintain the concrete temperature at not more than 100ºF at time of placement with the protective covering.

350-7 Placement Widths.

The Contractor may construct the pavement either in lanes as determined by the longitudinal joints shown in the Plans, or for the full width of the pavement in one operation. Construct the pavement to the full width of the lane or slab in a single construction operation. When constructing pavement in separate lanes, do not deviate the junction line from the true line shown in the Plans by more than 1/2 inch at any point.

350-8 Delivery Certification.

Ensure that a printed delivery ticket is furnished with each batch of concrete before unloading at the placement site. Include the following information on the delivery ticket:

1. Mix design number.
2. Time all materials are introduced into mixer.
3. Cubic yards in this load.

At the end of each day's production provide a summary listing all the daily ticket numbers along with the materials and quantities incorporated into each load, water to cementitious materials ratio, and the signature of the plant operator attesting to the accuracy and conformance of each load delivered to the project.

350-9 Sampling and Testing Methods.

350-9.1 General: Meet the requirements of 346-8 and 346-9, with the exception of air content.

350-9.2 Sampling Frequency for Quality Control Tests: Sample and test concrete of each design mix for temperature and compressive strength tests once per LOT.

A LOT is defined as the concrete placement of 2,000 square yards or one day's production, whichever is less. The LOT must be of the same type of placement method, such as slip form or formwork methods. Partial LOTs of less than 500 square yards will be combined with the previous LOT for testing and acceptance purposes.

350-9.2.1 Reduced Frequency for Quality Control Tests: The LOT size for reduced testing frequency of Class I (Pavement) may represent a maximum production quantity of 4,000 square yards, provided that the submitted historical compressive strength test results meet the requirements as described below:

1. The average of the acceptance compressive strengths is equal to or greater than 2,500 psi plus 2.33 standard deviations.
2. Every average of three consecutive strength test equals or exceeds the 3,000 plus 1.34 standard deviations.

Base calculations on a minimum of five consecutive compressive strength results. The average of the consecutive compressive strength test results can be established using historical data from a previous Department project. The tests from the previous Department project must be within the last calendar year or may also be established by a succession of samples on the current project. Only one sample can be taken from each LOT. Test data must be from sample(s) tested by a laboratory meeting the requirements of Section 105. Obtain Department approval before beginning reduced frequency LOTs.

If at any time a compressive strength test is not verified or the average compressive strength of the previous five consecutive samples from the same mix design and the same production facility does not conform to the above conditions, return to the frequency represented by the LOT as defined in 350-9.2. Notify the Engineer that the initial frequency is reinstated. To reinitiate reduced frequency, submit a new set of strength test results.

350-9.2.2 Sampling Frequency for Verification: The Engineer will verify one of every four consecutive LOTs, randomly selected, for each mix design in accordance with 346-8.

The Engineer may perform additional independent verifications tests. All QC activities, calculations and inspections may be randomly confirmed by the Engineer. The Engineer may obtain additional samples for informational purposes.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 General Requirements: Immediately after placing the concrete, strike-off, consolidate, and finish it to produce a finished pavement in accordance with the cross-section,

width, and surface finish required by the Contract Documents. After screeding while the concrete is plastic, correct all flaws such as cavities, blemishes, marks, or scratches that will not be removed by grinding.

Provide a concrete surface true to grade, cross slope and superelevation, and free of irregularities. If the Engineer permits adding water to assist the finishing operations, apply water as a fog spray by means of approved spray equipment.

350-10.2 Hand Methods: Use hand methods in areas of narrow width or irregular dimensions, where operation of a slip-form paver is impracticable or when using fixed form paving.

350-10.2.1 Strike-off and Screeding: Use a portable screed of an approved design, constructed either of metal or of other suitable material shod with metal, to strike-off and screed the concrete. Use a screed that is sufficiently rigid to retain its shape and is at least 2 feet longer than the maximum width of the strip to be screeded.

350-10.2.2 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3 Work Bridges: Provide work bridges or other devices necessary for access to the pavement surface for the purpose of inspection, finishing, straightedging, and performing corrective work.

350-10.4 Cross Slope: Control the cross slope using a level with a minimum length of 4 feet or a digital measuring device approved by the Engineer. Make this level or measuring device available at the jobsite at all times during paving operations.

Measure the cross slope at a minimum frequency of one measurement every 100 feet. When the difference between the measured cross slope and the design cross slope exceeds plus or minus 0.2% for travel lanes (including auxiliary lanes) or plus or minus 0.5% for shoulders, make any necessary corrections immediately to bring the cross slope for subsequent paving into the acceptable tolerance.

Upon approval of the Engineer, the frequency of the cross-slope measurements may be reduced to one measurement every 200 feet during paving operations when the cross slope is consistently within the acceptable tolerance.

350-11 Final Finish.

350-11.1 Finishing: Use a burlap drag that consists of two layers of medium weight burlap with the trailing edge of the lower layer extending approximately 2 inches behind the upper layer. Support the burlap drag in a manner so that a length of at least 3 feet of burlap is in contact with the pavement.

Except in areas where using hand methods to construct the pavement, support the lead end of the burlap drag by a traveling bridge. Maintain the drag clean and free from encrusted mortar. Replace the burlap with new material as necessary.

Apply a broom or burlap finish to areas constructed using hand methods.

350-11.2 Edging: After applying the final finish, but before the concrete has become nonplastic, carefully round the edges to a 1/4 inch radius on each side of transverse expansion joints and construction joints and along any structure extending into the pavement. Produce a well-defined and continuous radius, and obtain a smooth, dense mortar finish. Completely remove all concrete from the top of the joint filler.

350-12 Curing.

350-12.1 General: After completing the finishing operations and as soon as the concrete has hardened sufficiently to not mar the surface, cure the entire surface and, when the slip-form

method is used, cover and cure the edges of the newly placed concrete. Do not leave freshly placed concrete exposed for more than 30 minutes without applying curing protection. Failure to provide sufficient curing materials to adequately cure the concrete in place in a timely manner may result in the suspension of paving operations.

Continuously cure the freshly placed concrete for a period of 72 hours, exclusive of any periods when the temperature of the surface of the concrete falls below 50ºF.

350-12.2 White-Pigmented Curing Compound: Uniformly apply a Type 2 white-pigmented curing compound meeting the requirements of Section 925 to the surfaces to be cured, including the edges of slip-form produced paving, in a single coat of continuous film, at the minimum rate of 1 gallon per 200 square feet.

During application, thoroughly mix the compound in accordance with the manufacturer's recommendation.

Do not apply curing compound during periods of rainfall. Do not apply curing compound to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, repair the damaged portions immediately with additional compound. If using forms, upon their removal, immediately coat the sides of the slabs exposed to provide a curing treatment equal to that provided for the surface.

350-12.3 Removal of Forms: Do not remove forms from freshly placed concrete for at least 12 hours after placement. Remove forms carefully so as to avoid damage to the pavement. After removing the forms, immediately cure the sides of the slab in the same manner as the surface of the pavement.

350-13 Joints.

350-13.1 General: Construct joints at the locations and in accordance with the details shown in Standard Plans, Indexes 350-001 and 370-001 and the Contract Documents.

350-13.2 Longitudinal Joints: Construct longitudinal construction joints in accordance with the details shown in the Plans. Construct longitudinal lane-tie joints within the limits of the pavement placed, in accordance with the details shown in the Plans by sawing a groove in the surface of the hardened concrete.

350-13.2.1 Tie Bars: Place deformed steel tie bars at the required depth, parallel to the finished surface, at right angles to the joint and at the uniform spacing required in the Plans. Place them in the plastic concrete using approved equipment, or rigidly support them on the subgrade by approved devices capable of preventing displacement prior to placing of the concrete. Do not paint or coat the bars with any material before placing them in the concrete.

Use Grade 40 reinforcing steel when placing tie bars along a longitudinal construction joint by inserting bars with a 90 degree bend in the edge of the plastic concrete. When the concrete hardens, straighten the bar and replace any bar broken while being straightened in an approved manner.

Do not insert steel tie-bars into the unsupported side of the freshly formed slab. The Contractor may place tie-bars into position prior to extrusion from the paver by insertion through a temporary support form placed against the form slab, or by other means approved by the Engineer. Use a method that results in placement of the tie-bars at the specified locations without damaging or disrupting the plastic concrete.

350-13.3 Transverse Joints:

350-13.3.1 Load-Transfer Devices: Provide dowel load-transfer devices in all transverse joints. Firmly hold dowel bars in a position parallel to the surface in the longitudinal direction of the pavement and the centerline of the slab depth, by approved steel supports and

spacers. Allow the dowels to be free to move in one slab as the concrete contracts and expands. Wait a minimum of 7 days before coating one-half of the dowel with a petroleum based lubricant grease to inhibit bonding to the concrete. Provide a cap for the free end of expansion joint dowels. Use dowel bars coated in accordance with 931-2.3.

Ensure that the bars are straight, round, smooth, and free from burrs or other deformations detrimental to the free movement of the bar in the concrete. Provide a cap for the free end of expansion joint dowels.

Position each dowel such that:

1. Fits final deviation from parallel to the surface of the pavement does not exceed 1/2 inch.

2. Final deviation from parallel to the longitudinal centerline of the pavement does not exceed 1/2 inch.

3. Final deviation from being centered on the joint does not exceed 2 inches, and at no point in its length does it deviate from the surface of the pavement as shown in the Plans in excess of 1 inch. Confirm the position of dowel bars by suitable means acceptable to the Engineer.

350-13.3.2 Transverse Construction Joints: Construct transverse construction joints at the end of all pours and at other locations where the paving operations are stopped for 30 minutes or longer. Do not place construction joints within 7 1/2 feet of any other transverse joint or within 7 1/2 feet of either end of a section of pavement. If sufficient concrete has not been placed to form a slab at least 7 1/2 feet long, remove the excess concrete, back to the last preceding joint. Form the joints in place, in a plane perpendicular to the profile and centerline of the pavement. Saw or form construction joints, in a manner similar to contraction joints, so that a groove will be formed for holding the joint sealing compound.

Check all joints with a straightedge before the concrete has become non-plastic. Make corrections as necessary if one side of the joint is higher than the other, or the entire joint is higher or lower than the adjacent slabs.

350-13.3.3 Transverse Contraction Joints: Construct transverse contraction joints at the interval in accordance with the Standard Plans, Index 350-001.

Ensure that the sawing equipment does not damage the pavement and saw the transverse contraction joints as soon as the pavement has hardened to the degree that tearing and raveling are not excessive and before uncontrolled shrinkage cracking begins.

Accomplish the joint sawing in two steps. Make the initial cut 1/8 inch wide by a depth at least 1/3 of the pavement thickness and as soon as possible but in no case longer than 24 hours after placing the concrete. Upon approval of the Engineer, the Contractor may extend initial saw cutting time to avoid raveling at joint due to sawing too soon or reduce initial saw cutting time to avoid slab cracking due to sawing too late. Make a second saw cut, to provide the joint dimensions indicated in the Plans, just prior to final grinding and sealing the joint.

Repair any uncontrolled cracks at no expense to the Department by removing and replacing the pavement across the full width of all affected lanes or shoulders and to the nearest transverse joint in each direction.

350-13.3.4 Transverse Expansion Joints: Form transverse expansion joints using preformed joint filler, and provide them with dowel load transfer, in accordance with the details shown on the Standard Plans, or in the Plans.

Form the joints during the placing of the concrete, by securely staking a metal bulkhead accurately in place at the joint location or by other methods which will securely brace and support the joint filler. Where using approved devices to keep the expansion joint filler and dowels securely in place, the Engineer will not require a bulkhead. For concrete pavement using the Special Select soil base option, protect all transverse expansion joints at the bottom and side edges by a sheet metal strip as specified in 931-2.1 and as shown in the Contract Documents.

Cut the filler to the crown and shape of the slab cross-section and extend it to the subgrade. After installation, ensure that the top is not less than 1 inch, and not more than 1.25 inches, below the finished surface. Furnish the joint filler in lengths not less than the lane widths being poured, except that the Engineer will not require lengths greater than 12 feet. Where more than one section is allowed and used in a joint, securely lace or clip the sections together.

Place the filler normal to the pavement surface. Stake the assembly into position in such a way as to hold the assembly securely in position throughout construction. Ensure that the assembly is true to the line prescribed, subject to a tolerance of 1/4 inch in the width of the slab. Obtain the Engineer's approval of the assembly and its installation before placing any concrete against it. Obtain the Engineer's approval of the cross-section and length of the stakes.

When laying the pavement in partial width slabs, place transverse joints in the succeeding slab in line with the like joints in the first slab. In the case of widening existing pavement, place transverse joints in line with like joints in the existing pavement or as otherwise shown in the Plans.

350-13.4 Expansion Joints Around Structures at Manholes, Meter Boxes and other Projections: Form expansion joints by placing premolded expansion joint material around all structures and features projecting through, into or against the pavement. Ensure that such joints are 3/4 inch in width.

350-13.4.1 Bridge Approach Expansion Joints: Construct in accordance with Standard Plans, Index 370-001.

350-13.5 Cleaning Joints and Cracks:

350-13.5.1 Cleaning Joints in New Pavement:

350-13.5.1.1 Sawed Joints: Immediately after the final saw cut, completely remove the resulting slurry from the joint and the immediate area by flushing with a pressure washer and by using other tools as necessary.

1. After flushing, blow out the joints with compressed air.
2. Patch all spalled edges with an epoxy compound.
3. Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-13.5.1.2 Non-Sawed Joints: Thoroughly clean joints which require sealing of all foreign material for the full depth of the seal installation.

With the exception of slurry removal due to sawing, meet the cleaning requirements as specified for sawed joints.

350-13.5.2 Cleaning Joints in Existing Pavement: Remove all existing joint-sealing material and foreign material for the full depth of the new joint seal by sawing, wire brushing, sandblasting, or other methods approved by the Engineer.

Remove any existing sealant or parting strip material below the tape or backer rod bond breaker and replace it with additional bond breaker. When conditions require removal and replacement with additional bond breaker below the new joint seal, obtain the Engineer's approval of the type of bond breaker and its installation procedure. Perform cleaning by any method or combination of methods, as detailed in the Plans.

Flush the joint with a pressurized jet of water, and use other tools as necessary, to remove loose remnants and debris.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face.

Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-13.5.3 Cleaning Random Cracks in Existing Pavement: Do not begin cleaning random cracks in existing pavement until all other concrete pavement repairs have progressed to the point where those operations will not adversely affect the installation of the new seal.

Cut the random cracks to be repaired and sealed into grooved joints to the depth and width detailed in the Plans. Clean the joints in accordance with 350-13.5.2.

350-13.6 Sealing Joints and Cracks: Clean joints in accordance with 350-13.5 prior to final grinding and sealing.

When using silicone and non-silicone sealants in the transverse and longitudinal joints, respectively, use the silicone sealants first to prevent contamination at the intersection of the joint faces. Remove non-silicone sealant 1 foot in each direction from the transverse joints and replace it with silicone sealant.

350-13.6.1 Hot-Poured Type Sealant: When the Plans require hot poured sealant for specific joints, fill the joint thoroughly, without trapping air, ensuring the sealant is recessed 1/4 inch below the pavement surface Control the pouring rate to avoid spilling of sealant onto the adjacent pavement surface. If any spilling of sealant occurs, immediately remove and clean the entire surplus amount from the pavement surface. Place the poured material when the ambient air temperature is 50ºF or greater.

Use an indirect heating or double boiler type heating kettle that uses oil as a heat transfer medium, for hot poured sealer. Use a heating kettle that has a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.

350-13.6.2 Low Modulus Silicone Sealant: Use low modulus silicone sealant of either Type A non-sag (non-self-leveling), or Type B and/or Type C (self-leveling silicone sealant). Install and tool the sealant as necessary until firm contact is achieved and appropriately formed with the joint faces as specified.

Provide the required depth of recess above the sealant surface and below the pavement surface. Install the silicone sealant at ambient air temperatures above 40ºF.

350-14 Surface Requirements.

Produce, by grinding in accordance with Section 352, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture.

350-15 Thickness Determinations.

350-15.1 General: After completing the concrete pavement, including any corrective work to meet ride requirement, determine the thickness by core boring or non-destructive testing. The Engineer will select the locations for testing and make the determination of thickness. Sample locations will be taken at various offsets from the centerline such that each test represents an area not exceeding 2,500 square yards. Provide traffic control, non-destructive equipment, coring equipment, and operator to obtain the samples.

350-15.1.1 Core Borings: Drill cores from the pavement and measure thickness in accordance with ASTM C174 to determine the actual thickness. Replace the portions of the pavement removed by the borings at no expense to the Department.

350-15.1.2 Non-destructive Testing: Measure the thickness of the pavement in accordance with ASTM C1383 using the impact-echo method. The initial thickness measurement will be validated by having a core boring taken at that the same location in accordance with 350-15.1.1. If the results from the impact-echo test vary by plus or minus 0.15 inches from the core boring, then the non-destructive test method cannot be used on the pavement. In such case, the core boring will be used for acceptance of that LOT of concrete. The Engineer has the option to verify the accuracy of the results at any time.

350-15.2 Method of Calculating Average Thickness: The Engineer will determine the average thickness of the pavement by using the following method of calculation:

1. Areas of pavement which are left in place, but for which no payment will be made, will not be taken into account.
2. The specified thickness plus 1/2 inch will be considered in the calculation when the thickness of the pavement is more than 1/2 inch greater than the specified thickness.
3. The average thickness for the entire job will be calculated as a unit.

350-16 Deficient Thickness.

350-16.1 General: The Department will not pay for any pavement which is more than 1/2 inch less than the specified thickness. When the pavement contains no longitudinal construction joint, the Department will not pay for the area of such pavement that is the product of the full width of the strip placed as a unit times the sum of the distances each way from the short core or cores to the cores on each side which show measurements within the tolerance limits. When the pavement contains longitudinal construction joints, for the width, the Department will use the width between longitudinal construction joint and the edge of pavement.

350-16.2 Deficient Pavement Requiring Removal: The Engineer will evaluate areas of pavement found deficient in thickness by more than 1/2 inch and if, in his judgment, the deficiency is enough to seriously impair the anticipated service life of the pavement, remove such areas and replace them with concrete of the thickness shown in the Plans. The Department will not pay for the area of pavement removed or for the materials or labor involved in its removal. When removing a section of pavement, remove the full length between transverse joints and the full lane width. Grind replaced sections in accordance with 350-14.

350-16.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the pavement may be left in place, at no compensation.

350-16.4 Additional Borings: If the number of cores taken is not sufficient to indicate the thickness of the pavement, additional boring locations may be requested, with prior approval from the Engineer at no cost to the Department.

350-17 Pay Reductions for Low Compressive Strength Concrete.

Payment reductions for low compressive strength concrete will be assessed in accordance with Section 346. The payment reductions of 346-12 do not apply.

350-18 Opening Pavement to Traffic.

Construct an earth berm along longitudinal free edges of the pavement within 36 hours, when newly placed concrete pavement is constructed on a granular base of an erodible material. Build the berm to the full height of the pavement and at least 18 inches wide. Sufficiently compact the berm to prevent underwash of the pavement. Maintain the berm until the final shoulders are complete.

Keep the pavement closed to traffic, including construction operations until one of the following has been met:

1. Fourteen calendar days after placement of the concrete.
2. Test cylinders, made in accordance with ASTM C31 and tested in accordance with ASTM C39, indicate a compressive strength of at least 2,000 psi (cure these test cylinders in a manner identical to the corresponding section of pavement).
3. Provide a strength-maturity relationship curve as outlined by FM 3-C1074 for opening to traffic determined during design mix verification. Use the maturity method specified in this Section to:

    a. Determine if the concrete has achieved 2,000 psi and can be opened to traffic.

    b. Verify the strength of the last slab of each day's placement.

Fabricate three test cylinders for strength and maturity curve correlation testing. The compressive strength cylinders and maturity curve correlation testing will be performed at the first day of production or at the discretion of the Engineer.

350-19 Method of Acceptance.

Acceptance will be based on compressive strength of cylinders at placement in accordance with Section 346 and pavement thickness in accordance with 350-15.

350-20 Method of Measurement.

350-20.1 Concrete Pavement: The quantities to be paid for will be the plan quantity, in square yards, of plain cement concrete pavement and of reinforced cement concrete pavement, omitting any areas not allowed for payment under the provisions of 350-16.3 and adjusted for average thickness as provided herein.

For purposes of payment, the average thickness of pavement will determine the final pay quantities for this pavement as follows:

The area of pavement represented by the difference between the calculated average thickness and the specified thickness will be converted into equivalent square yards of specified thickness pavement, and the quantity thereby obtained will be added to, or deducted from, the quantity of pavement to be paid for, subject to the limitation that the maximum average of over-thickness permitted in the adjustment of the quantity of pavement to be paid for will be 1/2 inch.

Where the Plans call for cement concrete pavement that is to be covered with asphalt concrete surface course, payment will be made for the total thickness of the combination as plain cement concrete pavement. In such cases, price and payment will also include all costs of the asphalt concrete surface course constructed in accordance with Section 334.

Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-20.2 Joints and Cracks: For cleaning and sealing joints in new or existing concrete pavement, the quantity to be paid will be the length in feet, as determined by field measurement along the joints. Payment for the joints between concrete pavement and curb will be made under Section 520.

For cleaning and sealing random cracks in existing concrete pavement, the quantity to be paid will be the length in feet, as determined by field measurement along the cracks.

350-20.3 Bridge Approach Expansion Joint: The quantity to be paid for will be plan quantity, in feet of bridge approach expansion joint installed in accordance with Standard Plans, Index 370-001, calculated across the pavement at right angles to the centerline of the roadway pavement, completed and accepted.

350-21 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including any preparation of the subgrade not included in the work to be paid for under another Contract item; all transverse and longitudinal joint construction, including tie-bars and dowel bars; the furnishing of test specimens; repair of core holes; and all incidentals necessary to complete the work.

Payment will be made under:

Item No. 350- 3-	Plain Cement Concrete Pavement - per square yard.
Item No. 350- 4-	Reinforced Cement Concrete Pavement - per square yard.
Item No. 350- 5-	Cleaning and Sealing Joints - per foot.
Item No. 350- 6-	Cleaning and Sealing Random Cracks - per foot.
Item No. 350- 30-	Cement Concrete Pavement for Roundabout Apron - per square yard.

SECTION 352
GRINDING CONCRETE PAVEMENT

352-1 Description.

Grind existing concrete pavement in the areas designated on the Plans.

Grind new concrete pavement the full width of the travel lanes. Do not grind shoulders or roundabout aprons unless indicated in the Plans or required to promote drainage.

352-2 Equipment.

Provide a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement with diamond-impregnated grinding blades. Provide, operate, and maintain in working condition all necessary equipment to ensure performance of the work in the allotted time. Use equipment of the size, shape, and dimensions that does not restrict the movement of traffic in areas outside the designated limits of construction. The equipment will be of a size that can cut or plane at least 3 feet wide or as approved by the Engineer. Use equipment that is capable of grinding specified surfaces without causing spalls at cracks, joints, or other locations. The equipment will be capable of removing any slurry or residue resulting from the grinding operation.

352-3 Construction Methods.

Schedule and proceed with the construction operation in a manner that produces a uniform finished surface. Grind in a manner that eliminates joint or crack faults while providing positive lateral drainage by maintaining a constant cross-slope between grinding extremities in each lane. Grind transition, auxiliary or ramp lane as required from the mainline edge to provide positive drainage and an acceptable riding surface.

Grind parallel to the centerline until the pavement surfaces of adjacent sides of transverse joints and cracks are in the same plane. Grind the concrete pavement to eliminate the faulting at joints and cracks, maintain the overall smoothness within the limits specified, and texture over the majority of the pavement surface. Take all necessary precautions to minimize the number of minor depressions in the first place and only resolve to grind such areas if necessary. Continue grinding if accumulated total areas of minor depressions exceed 30% of the total area of a 0.1 mile section or if directed by the Engineer. Maintain the cross slope of the pavement as shown in the Plans.

Establish and obtain the Engineer’s approval for a means to continuously remove grinding residue.

Remove solid residue from pavement surfaces before traffic action or wind blows such residue. Do not allow residue to flow across lanes or shoulders used by public traffic or into gutters or other drainage facilities. Do not allow the discharge of any residue runoff into adjacent rivers, streams, lakes, ponds, or other bodies of water.

352-4 Final Surface Finish.

After the curing period, use a grinding process that produces a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge with a corduroy type appearance. Provide a surface finish with the peaks of the ridges approximately 1/32 inch higher than the bottoms of the grooves and with approximately 60 evenly spaced grooves per foot.

Grind to produce areas of uniform and neat surface appearance, beginning and ending at lines perpendicular to the pavement centerline.

352-5 Acceptance Testing for Surface Tolerance.

Test the pavement surface for smoothness with a 10 foot long straightedge, a 10 foot long rolling straightedge, or a California Type Profilograph while the Engineer observes the operations as described below. For pavement surfaces not meeting the smoothness requirements, provide corrective work and retesting to ensure conformity approved by the Engineer.

1. Testing with a 10 foot straightedge: Use this straightedge for longitudinal profiling, parallel to centerline, within 15 feet of a bridge approach or existing pavement which is being joined. Use it for all transverse profiling of cross slopes, approaches, and as otherwise directed with respect to (2) or (3) below.

Furnish and operate a 10 foot straightedge. When portland cement concrete pavement abuts bridge approaches or pavement not under this Contract, ensure that the longitudinal slope deviations of the finished pavement do not exceed 1/8 inch in 10 foot length.

Produce transverse slope deviations of the finished pavement that do not exceed 1/8 inch with the straightedge laid in a direction perpendicular to the centerline.

2. Testing with a 10 foot rolling straightedge: Use this straightedge for longitudinal profiling of short pavement sections up to 250 feet long, including mainline and non-mainline sections on tangent sections and on horizontal curves with a centerline radius of curve less than 1,000 feet and the pavement within the superelevation transition of such curves, turn lanes, ramps, tapers, and other non-mainline pavements as directed.

Furnish and operate the straightedge. Provide and operate a 10 foot rolling straightedge of a design acceptable to the Engineer, able to accurately measure surface irregularities exceeding 1/8 inch in a 10 foot effective length of the straightedge.

When tested with a straightedge, ensure that the finished pavement profile provides a uniform surface with no deviation greater than 1/8 inch in a 10 foot length. Perform the profiling in lines parallel to the centerline, at not more than 4 foot transversal spacing, and extending across the transverse joints.

The Contractor may confine checking through traffic lanes with the straightedge to joints and obvious irregularities as directed.

3. Testing With A California Type Profilograph:

a. General: Use the profilograph on all longitudinal profiling of mainline full width pavement lanes longer than 250 feet and as otherwise directed.

The following terms are defined:

1. Profilograph: A longitudinal profile testing apparatus used to measure a pavement's surface profile deviations.

2. Profile Trace or Profilogram: A surface profile record generated along the individual wheel paths using a profilograph. Such a record is analyzed to determine the rate of roughness (or smoothness) and to identify changes in the longitudinal pavement surface elevation that exceed a specified threshold along the pavement length traversed by the profilograph.

3. Profile Index (PI): A profile measurement is a series of numbers representing elevation relative to a specified reference. A Profile Index (PI) is a summary value calculated from these numbers above and below a blanking band over a specified length of pavement.

4. Blanking Band: A band of 0.2 inch uniform height with its longitudinal center positioned optimally between the highs and the lows of the profilogram depicting at least 100 ft of pavement.

b. Equipment: Furnish, calibrate, and operate an electronic California Type Profilograph device in accordance with FM 5-558.

c. Surface Test: Produce a riding surface meeting the requirements of FM 5-558 and having a Profile Index meeting the requirements herein. Start and terminate the profile 15 feet from each bridge approach or existing pavement, which is being joined.

Take at least two pavement profile traces with bump option turned on. Locate the position of the profiles in the traffic wheel paths. Take the profiles in the direction of the traffic and parallel to and approximately 3 feet from the outside edges of each traffic lane. The Contractor may take additional profiles to define the limits of an out-of-tolerance surface variation.

Upon completion of each day's testing, submit the profilograms to the Engineer for review to determine the pavement section in compliance with these requirements. The Engineer will retain those profilograms meeting these requirements. The Engineer will return profilograms with deficiencies to the Contractor for use to correct section deficiencies. The Engineer will retain the corrected profilograms, along with the deficient profilograms, for comparison purposes of the circumstances between the two profilograms.

Ensure that pavement tested meets the Profile Index requirements and is applicable to the profilogram for each profile trace:

1. Ensure that pavement on tangent alignment and horizontal curves having a centerline radius of curve 2,000 feet or more has a Profile Index of 5 inches per mile or less.

2. Ensure that pavement on horizontal curves having a centerline radius of curve 1,000 feet or more but less than 2,000 feet and pavement within the superelevation transition of such curves has a Profile Index of 7 inches per mile or less.

3. Ensure that the pavement riding surfaces have all deviations in excess of 0.3 inch in 25 feet removed.

The Engineer will evaluate the pavement in 0.1 mile consecutive sections. Grind all areas represented by individual points having deviations in excess of 0.3 inch in 25 feet or less pavement length, until such points do not exceed 0.3 inch.

After removing all individual deviations in excess of 0.3 inch in 25 feet, perform additional grinding as necessary to reduce the Profile Index to the specified requirements.

Surface smoothness tests with a California Type Profilograph on bridges are specified in 400-15. Ensure that the pavement within 15 feet of a bridge approach (or existing pavement which is being joined) complies with the testing requirements of a 10 foot straightedge.

Visually inspect transverse joints and random cracks to ensure that the adjacent surfaces are in the same plane. Where misalignment of the planes of the surfaces on adjacent sides of the joints or cracks is in excess of 1/16 inch, grind the pavement until the surfaces are flush.

352-6 Surface Corrections.

After the curing period, test the surface for pavement surface smoothness in accordance with 352-5. Plainly mark all variations from the required tolerances. Where pavement surfaces

do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet, but not in excess of 0.3 inch in 25 feet, by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the Plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved. Replace any area of concrete pavement with concrete that meets the requirements of Sections 353.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete. If the grinding operation removes more than a total length of 100 consecutive feet of the grooves, then re-groove the entire width of the pavement for the deficient area.

352-7 Method of Measurement.

The quantity to be paid for will be the plan quantity, in square yards, completed and accepted.

352-8 Basis of Payment.

Price and payment will be full compensation for all work and materials specified in this Section, including furnishing all labor, materials, tools, equipment, testing, and incidentals and for doing all work involved in grinding existing or new concrete pavement, removing residue, and cleaning the pavement, including necessary disposal of residue, and furnishing any water or air used in cleaning the pavement.

Pay adjustments based on the surface smoothness will be made in accordance with Table 352-1.

Table 352-1
Profile Index Pay Factors

Average Profile Index (inches/mile) per 0.1 mile Section		
Curvature Radius ≥2,000 ft	1,000 ft ≤ Curvature Radius < 2,000 ft	Pay Factor
PI ≤ 2	PI ≤ 4	1.05
2 < PI ≤ 5	4 < PI ≤7	1.00
PI > 5	PI > 7	Corrective work required

The Pay Factor will be based on the initial measured average Profile Index, prior to any corrective work. The Pay Factor will be applied to the bid price for Grinding Concrete Pavement.

The Pay Adjustment will be computed by multiplying the Pay Factor times the unit bid price for grinding concrete pavement times the plan surface area of grinding concrete pavement. The Pay Adjustment will apply to the total area of the 0.1 mile section for the lane width represented by the profilograms for the average Profile Index.

Payment will be made under:

Item No. 352- 70- Grinding Concrete Pavement - per square yard.

SECTION 353
CONCRETE PAVEMENT SLAB REPLACEMENT

353-1 Description.

Replace the existing defective area of concrete pavement with portland cement concrete free of any uncontrolled cracks. Repair the damaged area of adjacent slabs, caused by slab removal at no cost to the Department. When using the maturity method, submit a strength-maturity relationship curve as determined by FM 3-C 1074 for opening to traffic during design mix verification.

353-2 Materials.

Meet the following requirements:

Portland Cement Concrete* .....Section 346
Curing Materials .....Section 925
Epoxy Compounds.....Section 926
Dowel Bar Assembly** .....Section 931
Post-Installed Anchor Systems for Structural
Applications in Concrete Elements.....Section 937
Accelerating Admixtures .....ASTM C494, Type C and E

*For concrete pavement slab replacement, the use of supplementary cementitious materials is optional.

**Concrete pavement containing only dowel bars will be considered non-reinforced concrete.

353-3 Composition of Concrete.

353-3.1 Mixture Proportions: Designate the actual proportions to be used to produce a concrete with a minimum 28 day compressive strength of 3,000 psi.

Prior to producing concrete, submit the design mix for approval on a form acceptable to the Department. Provide a mix design that will produce a concrete with a minimum compressive strength of 1,600 psi, designated for opening to traffic, at the time period specified in the Contract Documents. Perform the plastic property tests in accordance with Section 346 prior to the addition of the accelerator. Use mixes approved by the Department and obtain concrete from a plant that is currently on the Department's Production Facility listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.

Make necessary adjustment to the concrete mix-water to account for the amount of water in the accelerating admixture solution.

353-3.2 Delivery Certification: Submit a delivery ticket in accordance with Section 346.

353-3.3 Demonstration Slab: Prior to batching production concrete, demonstrate the ability to furnish replacement slabs by constructing a demonstration slab at the project site. Demonstrate production techniques for slab removal, dowel installation, concrete placement, finishing, slab curing, sample preparation and curing, and proper timing of joint sawing. Demonstrate the ability to achieve the required compressive strengths. Demonstrate proficiency to the Engineer the ability to determine when the concrete has achieved a compressive strength of 1,600 psi by testing concrete cylinders or by using the maturity-strength curve. Use cylinders to verify the concrete compressive strength at 28 days. Schedule construction of the demonstration slab at the time specified in the Contract Documents. If the Engineer determines

that elements of the demonstration slab fail to meet requirements of the Contract Documents, propose adjustments to the construction processes and/or materials for the Engineer's approval.

The demonstration slab may be used in the final work with the approval of the Engineer. No slab replacements will be constructed until the demonstration slab is approved. The Engineer may require additional demonstration slabs until a demonstration slab conforms to the Contract Documents.

353-4 Batching and Mixing Concrete.

Obtain concrete that meets the requirements of Section 346 with the following additional requirements:

Add all the concrete ingredients, excluding the accelerator to the truck mixer at the plant.

Add the accelerator to the load at the job site and record the amount on the delivery ticket. Mix the concrete for 30 additional revolutions at mixing speed after the accelerator is added to the mixer.

Incorporate the accelerator into the concrete design mix in accordance with the recommendations of the admixture manufacturer. Do not exceed the manufacturer's written recommendations for the dosage rate of the accelerating admixture.

353-5 Test Requirements.

353-5.1 General: Perform concrete sampling and testing in accordance with Section 346, with the addition of density measurement testing is required. Perform the plastic property tests prior to the addition of the accelerator. Concrete strength determination can be done using test cylinders or by using the maturity method. If test cylinders are used, prepare after the addition of accelerator.

353-5.2 Verification of Maturity Curve Data: Develop a new maturity curve if any of the plastic properties or the density results exceed the tolerances specified in Table 353-1, for the initial sampling.

Table 353-1
Slump and Density Tolerances Prior to Accelerator Addition

Slump Tolerance	± 1.5 inches
Density Tolerance	± 3.0 lb/ft^3

Use either the maturity method in FM 3-C1074 or concrete cylinder testing to determine if the concrete has achieved 1,600 psi and can be opened to traffic. Use the maturity value or concrete cylinder test results to verify the strength of the last slab of each day's placement. Additional maturity meters or concrete cylinder testing may be used to open other locations to traffic prior to the last slab of each day, as needed, provided each location has achieved the minimum strength.

353-5.3 Cylinder Fabrication and Testing: If cylinders will be used for opening to traffic strength determination, fabricate three test cylinders for opening to traffic strength and three cylinders for 28 day strength after all materials, including the accelerator, are added. If the maturity method will be used for opening to traffic strength, fabricate three test cylinders for maturity curve correlation testing and three for 28 day strength.

The compressive strength cylinders and maturity curve correlation testing will be performed at the beginning of each production day, when the mix design is changed to another

mix design, at the discretion of the Engineer for each remaining placement week, when a new maturity curve is required, or until terminated by the Engineer.

353-6 Concrete Slab Acceptance and Testing.

Reject any Concrete not meeting the plastic property requirements of Section 346. Concrete pavement slab replacement mix designs are exempt from the requirements for concreting in hot weather. Reject concrete pavement slab replacement mix designs exceeding 100°F. Acceptance will be based on achieving a 1,600 psi compressive strength prior to opening the slab to traffic, and a 28 day compressive strength of 3,000 psi. Determine opening to traffic strength using the maturity method or concrete cylinder testing, and determine 28 day strength using concrete cylinder testing.

Perform Quality Control (QC) tests for temperature, slump, and density, and prepare compressive strength cylinders once per LOT. A LOT is defined as one day's production.

The Engineer will evaluate the particular circumstances in each instance where a strength deficiency occurs. Strength deficiencies will be addressed in accordance with Section 346.

Lost quality control cylinders and payment reductions for low strength concrete will be addressed in accordance with Section 346.

Controlled cracks are cracks designed to occur at specific locations based on the pavement design. All other cracks in the pavement are uncontrolled cracks. Repair uncontrolled cracked slabs, which occur during the life of the contract, by removing and replacing the pavement across the full width of all affected lanes or shoulders and to the nearest transverse joint in each direction. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of, the Engineer.

353-7 Placing, Striking Off, Consolidating and Finishing Concrete.

The requirements of Section 350 are applicable to this Section.

Perform straightedging while the concrete is still in plastic state after floating is completed and the excess water removed. Furnish and operate a 10 foot straightedge meeting the requirements of Section 350. Hold the straightedge in successive positions parallel to the road centerline, in contact with the surface, testing until the replacement slab is straight edged from one side to the other. Advance along the road in successive stages of not more than one-half the length of the straightedge. Fill any depressions immediately with freshly mixed concrete, consolidate, strike-off, and refinish. Cut down and refinish any high areas. Continue straightedge testing and surface correction until the entire surface conforms to the required grade and cross slope. Ensure that transverse slope deviations of the finished pavement do not exceed 1/8 inch with the straightedge laid in a direction perpendicular to the centerline. When Portland cement concrete pavement abuts bridge approaches or pavement not under this Contract, ensure that the longitudinal slope deviations of the finished pavement do not exceed 1/8 inch in 10 foot length. Produce a uniform, gritty textured final finish longitudinally along the pavement by dragging a broom or seamless strip of damp burlap, having at least 3 feet in contact with the pavement.

If the Engineer identifies a surface irregularity determined to be objectionable, straightedge with a 10 foot long straightedge and address all deficiencies in excess of 1/8 inch by grinding in accordance Section 352.

When required in the Contract Documents, produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture by grinding in accordance with Section 352.

353-8 Curing.

Cure the slab as specified in Section 350, except for time and temperature restrictions. Use a Type I (with dye) or Type ID (clear with dye) curing compound and apply within 1/2 hour after completing the finishing operations. After the curing compound has been applied, cover the surface and exposed edges with two layers of white burlap-polyethylene curing blanket conforming to Section 925 or insulating blankets approved by the Engineer. Continue curing the slab until the concrete achieves the required 1,600 psi compressive strength.

353-9 Joints.

353-9.1 General: Construct transverse joints as specified in Section 350 and as shown in the Standard Plans, except that dowels bars are installed per this Section. Tie bars will not be placed along the longitudinal joints unless shown in the Contract Documents. Apply a bond breaker to all vertical faces of the adjacent slabs. Submit the proposed bond breaker and manufacturer's technical data to the Engineer for approval.

Clean and seal joints in accordance with Section 350.

353-9.2 Dowel Bars: Provide dowel bars in accordance with the details shown in the Contract Documents.

353-9.2.1 Dowel Bars at Transverse Joint Between two Replacement Slabs: Follow the requirements of 350-12 when providing dowel bars at a transverse joint between two freshly placed replacement slabs.

353-9.2.2 Dowel Bars at Transverse Joints Between Existing and Replacement Slabs: Follow the requirements of Section 350, except drill holes and install dowel bars into the sawed face or end of the existing slab. Develop load transfer between existing and freshly placed replacement slab. The dowels shall be free to move inside the replacement slab and epoxy-bonded into the existing slab.

353-9.2.3 Dowel Bar Installation: Install dowel bars in accordance with Section 416 except as modified herein. Position each dowel such that its final deviation from parallel to the surface of the pavement and parallel to the longitudinal centerline of the pavement does not exceed 1/2 inch. Position each dowel such that its final deviation from centered on the joint does not exceed 2 inches. Position each dowel such that at no point in its length does it deviate from the surface of the pavement as shown in the Plans in excess of 1 inch. Confirm the position of dowel bars by means acceptable to the Engineer, which may include non-destructive testing methods.

Use epoxy compounds in accordance with Section 937. Dispense the epoxy from a cartridge or from metered equipment that indicates the amount of each component material being dispensed.

Inject epoxy into the hole after cleaning and prior to dowel insertion. Start injection at the back of the hole to force the epoxy to move forward during dowel insertion. Twist the dowel a minimum of one full turn during the insertion to ensure that the epoxy surrounds the dowel. The injection process and viscosity of the epoxy shall be adequate to ensure that the space between the surface of the dowel and the inside of the hole is filled with epoxy.

Do not allow the epoxy to escape from the front of the hole after inserting the dowel in the hole. Use a 1/8 inch thick nylon or plastic grout retention disk to hold epoxy in the hole during dowel insertion.

353-10 Protection and Opening to Traffic.

353-10.1 General: The requirements of Section 350 apply to this Section. Keep the placed slabs closed to traffic until the 1,600 psi compressive strength requirement is achieved. Submit documentation to the Engineer indicating that the required strength was achieved prior to opening to traffic. If documentation is not provided, the concrete will not be accepted. The Engineer may allow opening to traffic should the maturity equipment fail to provide a reading. Opening to traffic due to equipment failure does not constitute acceptance of the concrete.

Protect the pavement from all traffic, including construction vehicles, until the required strength has been obtained. The protective measures shall be arranged so as not to interfere with traffic lanes being utilized for required maintenance of traffic.

353-10.2 Maturity Method Testing: Use a maturity curve to estimate the strength of the concrete for opening to traffic for each day of production. Embed temperature sensors at mid-depth in the slab, at 6 inches from the leading edge of the transverse joint and at 6 inches from the longitudinal joint or at locations designated by the Engineer.

Develop a strength-maturity relationship curve using the Arrhenius maturity function with an activation energy of 33,500 J/mol as outlined in FM 3-C1074, in a laboratory with personnel qualified to perform the method. Compressive strength tests, as specified in FM 3-C1074, will be performed to produce a six point curve with points before and after the anticipated time for opening to traffic. Submit the mix design supporting data and the maturity curve to the Engineer for his approval.

Any changes of a material source or proportion in the concrete mixture will require a new maturity curve.

353-11 Method of Measurement.

The pay quantity for concrete pavement slab replacement, calculated using field-measured horizontal dimensions and thickness of the removed slab, will be the volume, in cubic yards, of calculated concrete volume placed and accepted.

The pay quantity for cleaning and sealing joints will be in accordance with Section 350.

353-12 Basis of Payment.

Price and payment for concrete pavement slab replacement, will be full compensation for all work specified in this Section and shall include demonstration slab construction, all joint construction, including tie bars and dowels, furnishing of test specimens, and all necessary incidentals.

Price and payment for cleaning and sealing joints will be made in accordance with Section 350.

Payment will be made under:

Item No. 353- 70- Concrete Pavement Slab Replacement - per cubic yard.

SECTION 355
VALUE ADDED PORTLAND
CEMENT CONCRETE PAVEMENT

355-1 Description.

Construct Value Added Portland Cement Concrete Pavement (Concrete Pavement), subject to a five year warranty period after final acceptance of the Contract in accordance with 5-11. This Section applies only to new pavements, including added lanes.

Submit each mix design to the Engineer at least 14 days prior to any paving work.

Perform all the associated work specified in this Section including continued responsibility for performing all remedial work associated with pavement distresses exceeding threshold values determined in accordance with this Section and as to which notice was provided to the Contractor.

The work specified in this Section will not be paid for directly, but will be considered as incidental to other Contract items.

355-2 Materials and Construction Requirements.

Meet the requirements of the following:

Portland Cement Concrete .....Section 346
Cement Concrete Pavement.....Section 350
Grinding Concrete Pavement.....Section 352

355-3 Statewide Disputes Review Board.

The Statewide Disputes Review Board in effect for this Contract will resolve any and all disputes that may arise involving administration and enforcement of this Specification. The Contractor and the Department acknowledge that use of the Statewide Disputes Review Board is required, and the determinations of the Statewide Disputes Review Board for disputes arising out of this Specification will be binding on both the Contractor and the Department, with no right of appeal by either party.

Meet the requirements of 8-3.

355-4 Pavement Evaluation and Remedial Work.

355-4.1 General: The Department's Pavement Condition Survey Program along with observations by the Engineer will be used as the basis for determining the extent and the magnitude of the pavement distresses occurring on the project. In the event the level of distress exceeds any of the threshold values defined below, remedial work as described in 355-5 by the Contractor will be required.

The Department will monitor the pavement for distresses and may require remedial action at any time. The Department may conduct a Pavement Condition Survey of the value added pavement following the final acceptance of the project, and at intermediate times throughout the warranty period with findings provided when considered by the Department to be the obligation of the Contractor.

The final survey, if determined by the Engineer to be necessary, will be conducted before the end of the warranty period with results provided to the Contractor for those conditions exceeding contract threshold values requiring remedial action that the Department believes to be an obligation of the Contractor. The Department will be responsible for all costs associated with the surveys.

If the survey findings, intermediate or final, are to be disputed by the Contractor, written notification must be submitted to the Engineer within 30 calendar days of the date of receipt of the information from the Department.

During the warranty period, the Contractor may monitor the pavement using nondestructive methods and may participate with the Department in the Pavement Condition Surveys upon request. Do not conduct any coring, milling or other destructive methods without prior approval by the Engineer.

355-4.2 Distress Indicators: The Department will use Ride, Spalling and Cracking, as distress indicators in accordance with the Rigid Pavement Condition Survey Handbook to evaluate the Concrete Pavement. Ride Number (RN) will be established by Laser Profiler in accordance with FM 5-549. For ride evaluation purposes, the project will be subdivided into LOTs of 0.1 mile per lane and partial LOTs which are segments that are less than 0.1 mile. For the purposes of threshold values and remedial work, partial LOTs and LOTs will be treated as LOTs. **355-4.3 Threshold Values and Remedial Work:** Threshold values and associated remedial work for the Concrete Pavement are specified in Table 355-1.

Table 355-1
Concrete Pavement Threshold Values and Remedial Work

Type of Distress	Threshold Values	Remedial Work
Ride	Ride Number < 3. 50	Grind all deficient LOTs and partial LOTs in accordance with Section 352.
Spalling in the wheel path	Four areas in any Lane Mile exceeding 1 inch in width and exceeding 6 inches in length OR any single area exceeding 3 inches in width.	Full depth slab replacement for a minimum of 6 feet in length and the full width of the slab in accordance with Section 353.
Spalling outside the wheel path	Four areas in any Lane Mile exceeding 1-1/2 inches in width and 12 inches in length OR any single area exceeding 3 inches in width and 12 inches in length.	Full depth slab replacement for a minimum of 6 feet in length and the full width of the slab in accordance with Section 353.
Cracking	Four Cracks in any Lane Mile with width exceeding 1/8 inch OR any Crack exceeding 3/16 inch.	Full depth slab replacement for a minimum of 6 feet in length and the full width of the slab in accordance with Section 353.
Shattered Slab	Cracking patterns that divide the slab into three or more segments	Full slab replacement in accordance with Section 353.

355-5 Remedial Work.

Perform all necessary remedial work described in this Section at no cost to the Department. Should an impasse develop in any regard as to the need for remedial work or the extent required, the Statewide Disputes Review Board will render a final decision by majority vote.

Remedial work will not be required if any one of the following conditions is found to apply:

1. Determination that the pavement thickness design as provided by the Department is deficient. The Department will make available a copy of the original pavement thickness design package and design traffic report to the Contractor upon request. The Contractor will be responsible for performing all remedial work associated with the pavement distress if the pavement design is provided by the Contractor.

2. Determination that the Accumulated ESALs (Number of 18 Kip Equivalent Single Axle Loads in the design lane) have increased by 25% or more than the Accumulated ESALs used by the Department for design purposes for the warranty period for the pavement design life. In calculating ESALs, the Average Annual Daily Traffic (AADT) will be obtained from the Department's traffic count data and the T24 (Percent Heavy Trucks during a 24 hour period) will be obtained from the Department's traffic classification survey data.

3. Determination that the deficiency was due to the failure of the existing underlying layers that were not part of the Contract work.

4. Determination that the deficiency was the responsibility of a third party or its actions, unless the third party was performing work included in the Contract.

If a measured distress value indicates remedial action is required per Table 355-1, begin remedial work within 45 calendar days of notification by the Department or a ruling of the Statewide Disputes Review Board. The Statewide Disputes Review Board will determine the allowable duration for the completion of the remedial work, but not to exceed 6 months.

If remedial action is necessary and forensic information is required, it is the responsibility of the Contractor to determine the source of the distress. The Contractor will not be responsible for damages to the pavement as a result of any forensic activities conducted at the discretion of the Engineer.

As applicable to distress criteria for ride, when two LOTs requiring remedial action or a partial LOT and a LOT are not separated by three or more LOTs not requiring remedial action, the remedial work shall be required for the total length of all such contiguous LOTs and partial LOTs, including the intermediate LOTs not requiring remedial action.

The Contractor has the first option to perform all remedial work, as determined by the Department. If, in the opinion of the Engineer, the problem poses an immediate danger to the traveling public and the Contractor cannot provide temporary mitigation for the defect within 4 hours of written notification and restore the pavement to its original design condition within 72 hours of written notification, the Engineer has the authority to have the remedial work performed by other forces. Temporary mitigation includes the use of traffic control systems such as barricades, drums, or other approved devices to secure the area including lane closures if necessary, and constructing temporary repairs making it safe for the roadway user until the defect can be restored to its original design condition. The Contractor is responsible for all incurred costs of the work performed by other forces should the problem (remedial work) be determined to be the responsibility of the Contractor. Remedial work performed by other forces does not alter any of the requirements, responsibilities or obligations of the Contractor.

Complete all remedial work to the satisfaction of the Engineer. Any disputes regarding the adequacy of the remedial work will be resolved by the Statewide Disputes Review Board. Approval of remedial work does not relieve the Contractor from continuing responsibility under the provisions of this Specification.

Notify the Engineer in writing prior to beginning any remedial work. Meet the requirements of the Specifications when performing any remedial work. Perform all signing and traffic control in accordance with the Standard Plans. Provide maintenance of traffic during remedial work at no additional cost to the Department. Lane closure restrictions listed in the original Contract will apply to remedial work. Written requests to obtain permission for lane closures for either forensic investigation or remedial work must be made to the Engineer 48 hours in advance of any lane closures. Do not perform any lane closures until written permission is given by the Engineer.

If remedial work necessitates a corrective action to the pavement markings, adjacent lanes, or roadway shoulders, perform these corrective actions using similar products at no cost to the Department.

355-6 Failure to Perform.

Failure to timely submit any dispute to the Statewide Disputes Review Board, failure to satisfactorily perform any remedial work, or failure to compensate the Department for any remedial work performed by the Department and determined to be the Contractor's responsibility in accordance with this Specification, the Department will suspend, revoke or deny the Contractor's certificate of qualification under the terms of Section 337.16(d)(2), Florida Statutes, for a minimum of 6 months or until the remedial work has been satisfactorily performed (or full and complete payment for remedial work performed by others made to the Department), whichever is longer. Should the Contractor choose to challenge the Department's notification of intent for suspension, revocation or denial of qualification and the Department's action is upheld, the Contractor will have its qualification suspended for an additional minimum of 6 months.

The remedial work is not an obligation of the Contractor's bond required by Section 337.18, Florida Statutes.

SECTION 370
BRIDGE APPROACH EXPANSION JOINTS

370-1 Description.

For concrete pavement using the asphalt base option, construct expansion joints in accordance with Standard Plans, Index 350-001. For concrete pavement using the special select soil base option, construct special expansion joints near the bridge approach slabs that consist of a section of reinforced concrete subslab supporting the roadway concrete pavement in accordance with the details shown in Standard Plans, Index 370-001 and the Contract Documents.

370-2 Materials.

Bar Reinforcement: Use bar reinforcing steel meeting the requirements of 931-1.1.

Concrete: For the expansion joint subslab, use concrete meeting the requirements of Section 347.

Galvanized Sheet Metal: Use galvanized sheet metal meeting the requirements shown in the Plans.

Seal: Use compression seals in accordance with Section 932 and Standard Plans, Index 370-001.

370-3 Construction Methods.

Construct the expansion joints in accordance with the applicable requirements of Sections 346, 347, 350, 415 and Standard Plans, Indexes 350-001 and 370-001.

370-4 Method of Measurement.

The quantity to be paid for will be plan quantity, in feet, calculated across the pavement at right angles to the centerline of the roadway pavement, completed and accepted.

370-5 Basis of Payment.

Price and payment will be full compensation for all work and materials specified in this Section or required for the expansion joint, including concrete subslab, sheet metal strip, reinforcing steel, compression seal and all additional excavation required.

Payment will be made under:

Item No. 370- 1- Bridge Approach Expansion Joint - per foot.

SECTION 400
CONCRETE STRUCTURES

400-1 Description.

Construct concrete structures and other concrete members, with the exception of pavement and incidental concrete construction (which are specified in other Sections).

Refer to Section 450 for prestressed construction requirements additional to the requirements of this Section.

For precast concrete structures meet the requirements of Section 450 for inserts and lifting devices, handling, storage, shipping, and erection.

Obtain incidental precast products from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.

400-2 Materials.

Meet the following requirements:

Concrete ..... Sections 346 and 347
Penetrant Sealer .....Section 413
High Molecular Weight Methacrylate (HMWM)**
..... Section 413
Reinforcing for Concrete .....Section 415
Water.....Section 923
Curing Materials*,** .....Section 925
Epoxy Bonding Compounds** .....Section 926
Post Installed Anchor Systems**.....Section 937
Joint Materials**.....Section 932
Bearing Pads .....Section 932
Non-Shrink Grout** .....Section 934
Class 5 Applied Finish Coatings**.....Section 975
Galvanizing Compound** .....Section 562
Dowel Bar Assembly** .....Section 931
Filter Fabric**.....Section 985

*The Engineer will allow clean sand and sawdust for certain curing, when and as specified.

**Use products listed on the Department's Approved Product List (APL).

400-3 Depth of Footing.

Refer to Section 455, "D. SPREAD FOOTINGS".

400-4 Falsework.

400-4.1 Plans: At the Engineer's request, submit detailed plans for falsework or centering to the Department. The Contractor is responsible for results obtained by using these plans.

400-4.2 Design and Erection: Design and construct all falsework to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Use

screw jacks or hardwood wedges to take up any settlement in the framework, either before or during the placing of concrete. If any weakness develops and the centering shows undue settlement or distortion, stop the work, remove any affected concrete, and strengthen the falsework before resuming work. Support falsework which cannot be founded on a satisfactory footing on piling. Space, drive, and remove the piling in an approved manner.

400-4.3 Camber: Provide camber to correct for settlement and deflection of falsework. Give bridges permanent camber only when shown in the Plans.

400-4.4 Bridge Deck Overhang Falsework for Steel I-Girders: Locate the lower contact point of bridge deck overhang falsework supporting screed rails within 6 inches above the bottom flange. If the lower contact point of the overhang falsework bears more than 6 inches above the bottom flange and/or if the deck overhang is 4 feet or greater, submit shop drawings and calculations to the Engineer in accordance with Section 5 and Chapter 11 of the Structures Design Guidelines (SDG). The deck overhang is measured from the centerline of the girder supporting the overhang falsework to the outside edge of the concrete deck.

400-5 Forms.

400-5.1 General: Provide forms, either of wood or metal, that are as follows: externally secured and braced where feasible; substantial and unyielding; of adequate strength to contain the concrete without bulging between supports and without apparent deviation from the neat lines, contours, and shapes shown in the Plans. Design forms to withstand the additional forces of vibration without apparent deviation from the desired shape or position. Assemble forms to be mortar-tight. If using lumber forms, construct them of dressed wood of uniform thickness. Use form liners on wooden forms where Class 3 surface finish is specified. Construct assembled forms to render a concrete surface of smooth, uniform finish. Make provisions to remove forms without injury to concrete surfaces. Remove blocks and bracing with the forms, and do not leave any portion of the forms in the concrete. Use the same form system for a type of work throughout.

400-5.2 Inspection and Approval: Do not place concrete in a form until the form has been inspected and approved. Although the Engineer inspects and approves the forms, the Contractor is responsible for obtaining satisfactory concrete surfaces, free from warping, bulging, or other objectionable defects. Pay special attention to the ties and bracing. Where the forms appear to be insufficiently braced or unsatisfactorily built, stop and correct defects to the satisfaction of the Engineer.

400-5.3 Non-metallic Form Materials:

400-5.3.1 Lumber: For all surfaces, use lumber that is not less than 3/4 inch in thickness, dressed, and free of knot holes, loose knots, cracks, splits, warps, and other defects. Proportion the spacing of studs, joists, and wales to exclude warps and bulges and to produce true and accurate concrete surfaces. Only use structurally sound lumber.

400-5.3.2 Form Liners: Use form liners of durable, abrasion resistant materials that are unaffected by water. Use liners with a hard surface texture capable of rendering concrete surfaces of a smooth, uniform texture, without grain marks, patterns, or blemishes. Use form liner material of sufficient thickness to eliminate the reflection of irregularities, undesirable patterns, and marks from the forms to the surfaces. Replace liners as necessary to produce a consistent concrete surface texture. Use form liners in large sheets and with true, tight-fitted joints which are logically located. Obtain the Engineer's approval of the layout of sheets. Do not use liners which have been patched. Use liner material of the same stock throughout.

400-5.3.3 Plywood: The Contractor may use plywood of not less than 5/8 inch in thickness manufactured with waterproof glue or protected with an approved impervious coating. Do not use pieces with bulged plies or raveled, untrue edges.

400-5.4 Special Requirements:

400-5.4.1 Re-entrant Angles: Use chamfered forms for exterior concrete corners and filleted forms for interior concrete corners. Use chamfers and fillets that are 3/4 by 3/4 inch and are mill-dressed on all sides to uniform dimensions. The Contractor may use plastic or metal chamfers and fillets provided they perform satisfactorily in producing uniform, smooth concrete corner surfaces without honeycomb.

400-5.4.2 Handrails, Concrete Barriers, Traffic Railings, and Parapets: Construct in accordance with Section 521.

400-5.4.3 End-bent Caps: Do not place forms for end-bent caps until the embankment has been constructed to within 12 inches of the bottom of the cap. Place a mass of embankment that is sufficient to produce the subsidence, displacement, and settlement which may result from the construction of the total embankment.

400-5.4.4 Footings: Where footing concrete can be placed in dry excavation, the Contractor may omit cribs, cofferdams, and forms, subject to compliance with the following limitations and conditions:

1. Use this procedure only in locations not exposed to view from traveled roadways.
2. Obtain required elevations shown in the Plans.
3. Obtain neat line dimensions shown in the Plans.
4. Fill the entire excavation with concrete to the required elevation of the top of the footing.
5. The Engineer will determine the volume of footing concrete to be paid for from the neat line dimensions shown in the Plans.

400-5.5 Form Alignment, Bracing, and Ties: Construct forms in such manner that they may be adequately secured for alignment, shape, and grade. Use bracing systems, ties, and anchorages that are substantial and sufficient to ensure against apparent deviation from shape, alignment, and grade. Do not drive nails into existing concrete. Do not use bracing systems, ties, and anchorages which unnecessarily deface or mark, or have an injurious or undesirable effect on surfaces that will be a part of the finished surface.

If metal ties and anchorages are to remain in the concrete, construct them so as to permit the removal of metal to at least 1 inch beneath the finished surface of concrete. Use accessories for metal ties and anchorages that allow the removal of metal to the prescribed depth while leaving the smallest possible repairable cavity.

When using wire ties, cut or bend them back from the finished surface of the concrete a minimum of 1 inch. Do not use internal ties of wire when forming surfaces that are exposed to view.

400-5.6 Preparation and Cleaning: Meet the following requirements for the condition of forms at the time of beginning concrete casting:

1. Treat all forms with an approved form-release agent before placing concrete. Do not use material which adheres to or discolors the concrete.
2. Clean forms of all concrete laitance from previous use and all dirt, sawdust, shavings, loose wire ties and other debris.
3. Close and secure all inspection and cleanout holes.

400-5.7 Stay-In-Place Metal Forms:

400-5.7.1 General: Utilization of stay-in-place metal forms is permitted in lieu of removable forms to form concrete bridge decks between beams and between the webs of individual box girders when designated in the Plans. Stay-in-place metal forms may be of the cellular, non-cellular or non-cellular with top cover sheet type. The flutes of non-cellular stay-in-place metal forms may be filled with polystyrene foam or concrete. When polystyrene foam is used to fill the forms, fill form flutes completely; do not allow any portion of the polystyrene foam to extend beyond the limits of the flutes. Ensure that the polystyrene foam remains in its required position within flutes during the entire concrete placement process. Do not use reinforcing supports or other accessories in such a manner as to cause damage to the polystyrene foam. Replace all damaged polystyrene foam to the satisfaction of the Engineer.

Apply polymer sheeting to stay-in-place metal forms in accordance with the requirements in the following table. Apply polymer sheeting to all faces and edges (including sheared edges) of support angles used on bridges with Moderately and Extremely Aggressive Superstructure Environmental Classifications (as shown in the Plans). No polymer sheeting is required for beam attachment straps or clips partially embedded in concrete, and for support angles used on bridges with a Slightly Aggressive Superstructure Environmental Classification. Use polymer sheeting materials and application methods as described herein.

Table 400-1
Polymer Sheeting Usage Requirements

Form Type		Superstructure Environmental Classification (as shown in Plans)		
		Slightly Aggressive	Moderately Aggressive	Extremely Aggressive
Non-cellular form with concrete filled flutes		No polymer sheeting required	Polymer sheeting required on bottom side[2]	Polymer sheeting required on bottom side[2]
Non-cellular form with polystyrene foam filled flutes		Polymer sheeting required on top side[1]	Polymer sheeting required on both sides[1,2]	Polymer sheeting required on both sides[1,2]
Non-cellular form with Top Cover Sheet	Top Cover Sheet	Polymer sheeting required on bottom side	Polymer sheeting required on bottom side	Polymer sheeting required on bottom side
	Non-cellular form	Polymer sheeting required on top side	Polymer sheeting required on both sides[2]	Polymer sheeting required on both sides[2]
Cellular form		No polymer sheeting allowed or required	Cellular form not permitted	Cellular form not permitted

1 Polymer sheeting not required on top side of form when foam filled flutes are used only at interior supports on continuous decks and the remainder of the flutes are concrete filled.
2 Polymer sheeting not required on bottom side of form located within box girders and U-beams.

Prior to using stay-in-place metal forms, submit detailed plans for approval of the forming system, including method of support and attachment and method of protecting the supporting structural steel components from welding effects. Submit design calculations for the forming system, which have been signed and sealed by the Specialty Engineer. Detail stay-in-place metal forms such that they in no way infringe upon the concrete

outline of the slab shown on the Plans. Use stay-in-place metal forms that provide and maintain the dimensions and configuration of the original slab in regards to thickness and slope.

Do not weld stay-in-place metal form supports and connections to the structural steel components. Do not connect polymer coated angles or other hardware that support polymer coated metal forms to the beam attachment straps or clips by welding. Electrical grounding to steel reinforcing or fiber reinforced polymer (FRP) reinforcing is prohibited.

Protect structural steel components from damage by using a shield to guard against weld splatter, weld overrun, arc strikes, or other damaging effects of the welding process. Upon completion of welding, rest the metal form support flush on the supporting steel component. Should any weld spatter, weld overrun, arc strike, or other effects of the welding process be evident or occur to the structural steel component, immediately stop in-place welding of the metal form supports for the remainder of the work. In this event, weld all metal form supports off of the structure and erect the forms after prefabrication, or use an alternate approved method of attaching the form supports. Remove improper weldment, repair the supporting steel component for any improper welding. Perform all required verification and testing at no expense to the Department and to the satisfaction of the Engineer.

Do not use stay-in-place metal forms until the forming system has been approved by the Engineer. The Contractor is responsible for the performance of the stay-in-place forms.

Structures designed, detailed, and dimensioned for the use of removable forms: Where stay-in-place metal forms are permitted, the Contractor is responsible and shall obtain the approval of the Engineer for any changes in design, etc. to accommodate the use of stay-in-place forms. The Engineer will compute pay quantities of the various components of the structure which are paid on a cubic yard basis from the design dimensions shown in the Plans with no allowance for changes in deflection or dimensions necessary to accommodate the stay-in-place forms or concrete to fill the form flutes. The Engineer will limit pay quantities of other Contract items that the Contractor increases to accommodate the use of stay-in-place forms to the quantity required for the original plan design.

Submit all changes in design details of bridge structural members that support stay-in-place forms, showing all revisions necessary to enable the supporting components to withstand any additional weight of the forms and the weight of any extra concrete that may be required to fill the forms. Include with the design calculations a comparative analysis of the stresses in the supporting components as detailed on the Plans and as modified to support the forms. Use the identical method of analysis in each case, and do not allow the stresses in the modified components to exceed those of the component as detailed in the Plans. Include with the design the adjusted cambers for any changes in deflection over those shown on the original Plans. Modify the beams to provide additional strength to compensate for the added dead loads imposed by the use of stay-in-place forms. Obtain the additional strength by adding strands to the pre-stressed beams or by adding steel material to increase the section modulus of steel girders. Substantiate the added strength by the comparative calculations. Do not use stay-in-place forms until the forming system and all necessary design revisions of supporting members have been approved by the Engineer.

Structures designed, detailed, and dimensioned for the use of stay-in-place metal forms:

Prior to using stay-in-place metal forms, submit detailed plans for approval of the forming system (including method of support and attachment) together with

design calculations. Include an analysis of the actual unit weight of the proposed forming system over the projected plan area of the metal forms. If the weight thus calculated exceeds the weight allowance for stay-in-place metal forms and concrete required to fill the forms shown on the Plans, then modify the supporting components to support the excess weight as specified by the Contractor's Specialty Engineer.

For all structures utilizing structural steel supporting components, paint the vertical sides of the top flange prior to installation of the stay-in-place metal forms in accordance with Section 560.

For non-polymer sheeting form surfaces, use zinc paint coating in accordance with Section 562 to all accessories cut from galvanized sheets, which are not embedded in concrete.

400-5.7.2 Design: Meet the following criteria for the design of stay-in-place bridge deck forms:

1. The maximum self weight of the stay in place metal forms, plus the weight of the concrete or expanded polystyrene required to fill the form flutes (where used), shall not exceed 20 psf.

2. Design the forms on the basis of dead load of form, reinforcement, and plastic concrete plus 50 pounds per square foot for construction loads. Use a unit working stress in the steel sheet of not more than 0.725 of the specified minimum yield strength of the material furnished, but not to exceed 36,000 psi.

3. Do not allow deflection under the weight of the forms, reinforcement, and plastic concrete to exceed 1/180 of the form span or 1/2 inch, whichever is less, for form spans of 10 feet or less, or 1/240 of the form span or 3/4 inch, whichever is less, for form spans greater than 10 feet. In all cases, do not use a total loading (psf) that is less than 20 plus the product of the deck thickness measured in inches times 12.5.

4. Use a design span of the form equal to the clear span of the form plus 2 inches. Measure the span parallel to the form flutes.

5. Compute physical design properties in accordance with requirements of the AISI Specifications for the Design of Cold Formed Steel Structural Members, latest published edition.

6. For all reinforcement, maintain the design concrete cover required by the Plans.

7. Maintain the plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck.

8. Do not consider the permanent bridge deck form as lateral bracing for compression flanges of supporting structural members.

9. Do not use permanent steel bridge deck forms in panels where longitudinal deck construction joints are located between stringers.

10. Secure forms to the supporting members by means other than welding directly to the member.

400-5.7.3 Materials:

400-5.7.3.1 Metal Forms: Fabricate stay-in-place metal forms and supports from steel meeting the requirements of ASTM A653 having a coating designation G165. Do not use form materials that are less than 0.03 inch uncoated thickness.

400-5.7.3.2 Polymer Sheeting: Use polymer sheeting comprised of at least 85% ethylene acrylic acid copolymer capable of being applied to both G165 and G210 steel

sheet as described in ASTM A742. Ensure that the polymer sheeting has a nominal thickness of 12 mils as manufactured and a minimum thickness of 10 mils after lamination to the steel sheet. Ensure that the polymer sheeting remains free of holes, tears and discontinuities and sufficiently flexible to withstand the forming process without any detrimental effects to bond, durability or performance. Ensure that the polymer sheeting is UV stabilized and contains antioxidants.

Ensure that the as-manufactured polymer sheeting (prior to application) has an Oxidative Induction Time (OIT) of 60 to 75 minutes at 170°C in air when tested according to ASTM D3895. Perform additional OIT tests on samples taken from the finished product (polymer sheeting applied to forms) resulting in a minimum OIT according to ASTM D3895 of 32 minutes at 170°C in air. Ensure that the polymer sheeting adheres to galvanized metal sufficient to prevent undercutting at penetrations made through the polymer sheeting or metal forms to the satisfaction of the Engineer. Ensure that edges subjected to shear cutting are coated by the form manufacturer with two coats of a compatible liquid coating repair material before delivery to the site. Ensure that steel used to produce polymer laminated metal forms is appropriately cleaned and prepared per NCCA (National Coil Coating Association) standard continuous coil coating practices. Ensure that pretreatment for use in conjunction with the manufacturer's polymer sheeting material is approved as compatible by the polymer sheeting manufacturer. Apply pretreatment in accordance with the polymer sheeting manufacturer's procedures. Apply polymer sheeting in accordance with the manufacturer's recommendations and procedures. Ensure that all steel has the polymer sheeting applied prior to fabrication of the stay-in-place forms and accessories.

Ensure that the screws to be used in the fastening of the stay-in-place laminated metal forms have a corrosion resistant cladding that will not have an adverse effect to the system due to the contact of dissimilar metals.

400-5.7.3.3 Certification: Submit a written certification from the manufacturer stating the product meets the requirements of this specification along with the delivery of the coated forms to the jobsite. Ensure that the certification conforms to the requirements of Section 6. Ensure that the manufacturer has a quality control program conforming to ISO 9001 2000 standards.

400-5.7.3.4 Polystyrene Foam: Use polystyrene foam comprised of expanded polystyrene manufactured from virgin resin of sufficient density to support the weight of concrete without deformation. Extrude the polystyrene foam to match the geometry of the flutes and provide a snug fit. Use polystyrene foam that has a density of not less than 0.8 pounds per cubic foot. Use polystyrene foam that has water absorption of less than 2.6% when tested according to ASTM C272. Submit a written certification from the manufacturer stating the product meets the requirements of this Specification along with the delivery of the product.

400-5.7.4 Construction: Install all forms in accordance with approved fabrication and erection plans.

Do not rest form sheets directly on the top of the stringer of floor beam flanges. Fasten sheets securely to form supports, and maintain a minimum bearing length of 1 inch at each end for metal forms. Place form supports in direct contact with the flange of the stringer or floor beam. Make all attachments for coated metal forms by bolts, clips, screws, or other approved means.

400-5.7.4.1 Form Galvanizing Repairs: For any permanent exposed steel where the galvanized coating has been damaged, thoroughly clean, wire brush, and paint it with

two coats of galvanizing compound in accordance with Section 562 to the satisfaction of the Engineer. Do not touch up minor heat discoloration in areas of welds.

400-5.7.4.2 Polymer Sheeting Repairs: Inspect and identify areas for damage to the polymer sheeting and repair with liquid polymer coating similar and compatible with respect to durability, adhesion and appearance in accordance with ASTM A762, as furnished by the stay-in-place form manufacturer. Ensure that the inspection includes checking the polymer sheeting for cuts, tears, cracking, surface pits, peeling, dirt, grease, oil, stains, rust or bare areas. Reject any panels that show coating blistering, peeling or cracking. Repair all polymer sheeting damage according to the following:

1. Surface Preparation: Ensure that all surfaces to be repaired are clean and free of any deleterious substances. Remove all traces of dirt, soil, oil deposits, greases, and other surface contaminates in accordance with the polymer sheeting and coating manufacturer's written specifications prior to touch-up and recoating.

2. Application Procedures: Ensure that the liquid polymer repair coating is applied to a clean dry surface and in accordance with the manufacturer's written specifications. Apply the repair coating using a suitable paintbrush or other means acceptable to the Engineer. Apply a first coat of product to the surface at 2-4 mils in thickness. Let the first coat air dry. Apply a second coat to form a complete layer and increase the thickness, immediately after verifying the first coat is dry to the touch (15 - 25 minutes depending on the local air drying temperature and atmospheric conditions). Apply the second coat at the same coating thickness as the first at 2-4 mils. Ensure that the total dry film thickness of the two coats is not less than 6 mils. Apply additional coats in this same manner until desired coating thickness is achieved.

400-5.7.5 Placing of Concrete: Vibrate concrete to avoid honeycomb and voids, especially at construction joints, expansion joints, valleys and ends of form sheets. Use approved pouring sequences. Do not use calcium chloride or any other admixture containing chloride salts in the concrete.

400-5.7.6 Inspection: The Engineer will observe the Contractor's method of construction during all phases of the construction of the bridge deck slab, including the installation of the metal form system; location and fastening of the reinforcement; composition of concrete items; mixing procedures, concrete placement, and vibration; and finishing of the bridge deck. Should the Engineer determine that the procedures used during the placement of the concrete warrant inspection of the underside of the deck, remove at least one section of the metal forms in each span for this purpose. Do this as soon after placing the concrete as practicable in order to provide visual evidence that the concrete mix and the procedures are obtaining the desired results. Remove an additional section in any span if the Engineer determines that there has been any change in the concrete mix or in the procedures warranting additional inspection.

If, in the Engineer's judgment, inspection is needed to check for defects in the bottom of the deck or to verify soundness, sound the metal forms with a hammer as directed by the Engineer after the deck concrete has been in place a minimum of two days. If sounding discloses areas of doubtful soundness to the Engineer, remove the metal forms from such areas for visual inspection after the concrete has attained adequate strength. Remove metal bridge deck forms at no expense to the Department.

At locations where sections of the metal forms have been removed, the Engineer will not require the Contractor to replace the metal forms. Repair the adjacent metal forms and supports to present a neat appearance and to ensure their satisfactory retention and

where they are polymer sheeted, coat all exposed surfaces of stay-in-place metal form system elements that are not coated or are damaged with a field applied liquid polymer coating as specified in 400-5.7.4.2. As soon as the form is removed, the Engineer will examine the concrete surfaces for cavities, honeycombing, and other defects. If irregularities are found, and the Engineer determines that these irregularities do not justify rejection of the work, repair the concrete as directed, and provide a General Surface Finish in accordance with 400-15. If the Engineer determines that the concrete where the form is removed is unsatisfactory, remove additional metal forms as necessary to inspect and repair the slab, and modify the method of construction as required to obtain satisfactory concrete in the slab. Remove and replace all unsatisfactory concrete as directed, at no expense to the Department.

If the method of construction and the results of the inspections as outlined above indicate that sound concrete has been obtained throughout the slabs, the amount of sounding and form removal may be reduced when approved by the Engineer.

Corrosion of assembly screws will not be considered a structural or aesthetic problem and is considered acceptable.

Provide the facilities for the safe and convenient conduct of the inspection procedures.

400-5.8 Stay-In-Place Concrete Forms:

400-5.8.1 General: Permanent stay-in-place precast reinforced concrete forms may be used in lieu of removable forms to form concrete bridge deck slabs subject to the conditions contained herein. Precast reinforced concrete stay-in-place forms are not permitted to construct a composite concrete deck. Do not use precast prestressed concrete stay-in-place forms to form any permanent bridge decks.

When detailed Plans for structures are dimensioned for the use of removable forms, provide additional slab thickness, elevation changes, changes in design, etc. to accommodate the use of stay-in-place forms, subject to the Engineer's approval. The Engineer will compute pay quantities of the various component members of the structure which are paid on a cubic yard basis from the design dimensions shown in the Plans with no allowance for changes in deflection and changes in dimensions necessary to accommodate the stay-in-place forms. The Engineer will limit pay quantities of other Contract items which are increased to accommodate the use of stay-in-place forms to the quantity required for the original plan design.

Prior to using stay-in-place forms, submit for approval detailed plans of the forming system and design calculations. Indicate on the plans the form panel sizes, placing patterns, type of mastic or felt bearing material and type and method of caulking between panels. Also, submit appropriate changes in design details of structural members supporting stay-in-place forms showing any revisions necessary to enable the supporting components to withstand the additional weight of the forms and perform equally as contemplated in the Plans. All calculations and details submitted shall be sealed by the Contractor's Engineer of Record. Modify the beams to provide additional strength to compensate for the added dead loads imposed by the use of stay-in-place forms. Obtain this strength by adding additional strands to prestressed girders or increasing the section modulus for steel girders. Do not use stay-in-place forms until the forming system and any necessary design revisions of supporting structural members have been approved by the Engineer. The Department is not responsible for the performance of the stay-in-place forms by its approval.

400-5.8.2 Materials: Construct permanent concrete forms of precast reinforced concrete with a Class 3 Surface Finish. As a minimum, use the same class of concrete and

28-day minimum compressive strength as being used to construct the bridge deck. Use welded steel wire reinforcement meeting the requirements of Section 931.

400-5.8.3 Design: Use the following criteria for the design of permanent bridge deck forms:

1. Design the forms on the basis of deadload of form, reinforcement, and plastic concrete plus an unfactored live load of 50 psf for construction loads. Meet the AASHTO design requirements for service loads and ultimate loads as applicable.

2. Deflection under the weight of the forms, reinforcement, and the plastic concrete shall not exceed 1/180 of the form span or 1/2 inch, whichever is less. In all cases, do not use a loading that is less than 120 psf total.

3. Use a design span of the form equal to the clear span of the form between supports. Measure the span of concrete forms parallel to the centerline of the form panels.

4. Compute physical design properties of concrete forms in accordance with current AASHTO design procedures.

5. Ensure that all reinforcement contained in the cast-in-place concrete has the minimum cover shown in the Plans or not less than one inch, whichever is greater. Measure the minimum cover normal to the plane of the bottom of the cast-in-place concrete. For stay-in-place concrete forms with other than plane surfaces in contact with the cast-in-place concrete, such as regularly spaced geometrical shapes projecting above the plane of the bottom of the cast-in-place concrete, meet the following special requirements:

a. Space geometrical shapes projecting above the bottom plane of the cast-in-place concrete used to provide support for reinforcement no closer than 3 feet apart and of sufficient height to maintain the required concrete cover on the bottom mat of reinforcing bars.

b. Construct all other geometrical shapes projecting above the plane of the bottom of the cast-in-place concrete to provide a minimum vertical clearance of 3/4 inch between the closest surface of the projections and the secondary longitudinal reinforcing bars in the deck slab.

c. Do not allow a minimum horizontal distance from the surface of any transverse reinforcing bars to surfaces of the stay-in-place form of less than 1 1/2 inches.

For all reinforcement for the stay-in-place form panels, provide a minimum of 1 inch concrete cover except that, for construction in a salt or other corrosive environment, provide a minimum of 1 1/2 inches concrete cover.

6. Maintain the plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck. Measure the minimum cover of the bottom mat of reinforcement normal to the top of the precast concrete form panel.

7. Do not consider the permanent bridge deck form as lateral bracing for compression flanges of supporting structural members.

8. Do not use permanent concrete bridge deck forms in panels where longitudinal deck construction joints are located between stringers.

9. Do not allow the maximum weight of the concrete form to exceed 40 pounds per square foot of form surface.

400-5.8.4 Construction: Install all forms in accordance with approved fabrication and erection plans.

For concrete forms, provide a minimum bearing length of at least 1 1/2 inches but not exceeding 2 1/2 inches. Support concrete forms on the beams or girders by continuous layers of an approved mastic or felt bearing material that will provide a mortar tight uniform bearing. Use a mastic or felt bearing material that has a minimum width of 1 inch and a maximum width of 1 1/2 inches. Seal joints between concrete form panels with caulking, tape, or other approved method.

400-5.8.5 Placing of Concrete: Place the concrete in accordance with the requirements of 400-5.7.5. Immediately prior to placing the slab concrete, saturate concrete stay-in-place form panels with water.

400-5.8.6 Inspection: Inspect the concrete in accordance with the requirements of 400-5.7.6.

After the deck concrete has been in place for a minimum period of two days, inspect the forms for cracks and excessive form deflection, and test for soundness and bonding of the forms by sounding with a hammer as directed by the Engineer. Remove, for visual inspection, form panels found to be cracked that show evidence of leakage and form panels which have a deflection greater than adjacent panels by 1/2 inch or more which show signs of leakage. If sounding discloses areas of doubtful soundness to the Engineer, remove the form panels from such areas for visual inspection after the concrete has attained adequate strength. Remove permanent bridge deck form panels at no expense to the Department.

At locations where sections of the forms have been removed, the Engineer will not require the forms to be replaced. Repair the adjacent forms and supports to present a neat appearance and to ensure their satisfactory retention. As soon as the form is removed, the Engineer will examine the concrete surfaces for cavities, honeycombing, and other defects. If irregularities are found, and the Engineer determines that these irregularities do not justify rejection of the work, repair the concrete as directed and provide a General Surface Finish in accordance with 400-15. If the concrete where the form is removed is unsatisfactory, as determined by the Engineer, additional forms shall be removed as necessary to inspect and repair the slab, and modify the methods of construction as required to obtain satisfactory concrete in the slab. Remove and replace all unsatisfactory concrete as directed at no expense to the Department.

If the methods of construction and the results of the inspections as outlined above indicate that the Contractor has obtained sound concrete throughout the slabs, the Contractor may moderate the amount of sounding and form removal, when approved.

Provide all facilities for the safe and convenient conduct of the inspection procedures.

400-6 Underdrain and Weep Holes.

Provide weep holes in all abutments and retaining walls.

Provide a continuous underdrain for box culverts in accordance with Standard Plans, Index 400-289. Provide weep holes that are at least 3 inches in diameter and not more than 10 feet apart. Place the outlet ends of the weep holes just above the finish graded surface in front of abutments and retaining walls. Cover the inlet ends of all weep holes with galvanized wire mesh and a minimum of 2 cubic feet of clean, broken stone or gravel wrapped in Type D 3 filter fabric, to allow free drainage but prevent the fill from washing through.

400-7 Placing Concrete.

400-7.1Weather Restrictions:

400-7.1.1 Concreting in Cold Weather: Do not place concrete when the air temperature at placement is below 40ºF.

Meet the air temperature requirements for mixing and placing concrete in cold weather as specified in Section 346. During the curing period, if NOAA predicts the ambient temperature to fall below 35ºF for 12 hours or more or to fall below 30ºF for more than 4 hours, enclose the structure in such a way that the air temperature within the enclosure can be kept above 50ºF for a period of 3 days after placing the concrete or until the concrete reaches a minimum compressive strength of 1,500 psi.

Assume all risks connected with the placing and curing of concrete. Although the Engineer may give permission to place concrete, the Contractor is responsible for satisfactory results. If the placed concrete is determined to be unsatisfactory, remove, dispose of, and replace the concrete at no expense to the Department.

400-7.1.2 Concreting in Hot Weather: Meet the temperature requirements and special measures for mixing and placing concrete in hot weather as specified in Section 346.

Spray reinforcing bars and metal forms with cool fresh water just prior to placing the concrete in a method approved by the Engineer.

Assume all risks connected with the placing and curing of concrete. Although the Engineer may give permission to place concrete, the Contractor is responsible for satisfactory results. If the placed concrete is determined to be unsatisfactory, remove, dispose of, and replace the concrete at no expense to the Department.

400-7.1.3 Wind Velocity Restrictions: Do not place concrete for bridge decks if the forecast of average wind velocity at any time during the planned hours of concrete placement exceeds 15 mph. Obtain weather forecasts from the National Weather Service “Hourly Weather Graph” for the city closest to the project site.

400-7.2 Lighting Requirements: Provide adequate lighting for all concrete operations conducted at night. Obtain approval of the lighting system prior to starting the concrete operations.

400-7.3 Inspections before Placing Concrete: Do not place concrete until the depth and character of the foundation and the adequacy of the forms and falsework have been approved by the Engineer. Do not deposit any concrete until all reinforcement is in place and has been inspected and approved by the Engineer.

400-7.4 Exposure to Water: Do not expose concrete other than seal concrete in cofferdams to the action of water before final setting. Do not expose such concrete to the action of salt or brackish water for a period of seven days after placing the concrete. Protect the concrete during this period by keeping salt or brackish water pumped out of cofferdams.

400-7.5 General Requirements for Placing Concrete: Deposit concrete as nearly as possible in its final position. Do not deposit large quantities at one point and then run or work it along the forms. Take special care to fill each part of the forms, to work coarse aggregate back from the face, and to force concrete under and around reinforcing bars without displacing them.

Use a method and manner of placing concrete that avoids the possibility of segregation or separation of aggregates. If the Engineer determines that the quality of concrete as it reaches its final position is unsatisfactory, remove it and discontinue or adjust the method of placing until the Engineer determines that the quality of the concrete as placed is satisfactory.

Use metal or metal-lined open troughs, chutes, or other means of concrete conveyance which have no aluminum parts in contact with the concrete. As an exception, chutes made of aluminum for ready mixed concrete trucks, no longer than 20 feet, may be used. This

exception does not apply to any other means of concrete conveyance. Where steep slopes are required, use chutes that are equipped with baffles or are in short lengths that reverse the direction of movement. Where placing operations would involve dropping the concrete freely more than 5 feet, deposit it through pipes, troughs, or chutes of sheet metal or other approved material. Use troughs, chutes, or pipes with a combined length of more than 30 feet only with the Department's authorization. Keep all troughs, chutes, and pipes clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run or more often if necessary.

Place concrete against supporting material that is moist at the time of concrete placement. If additional water is required, uniformly apply it ahead of the concrete placement as directed by the Engineer. Do not place concrete on supporting material that is frozen. The Contractor may use a moisture barrier in lieu of controlling the foundation grade moisture when approved by the Engineer.

400-7.6 Placing Concrete by Belt Conveyor: Place concrete by means of a belt conveyor system with written Department authorization. Remove conveyor belt systems which produce unsatisfactory results before continuing operations. Take concrete samples for assurance testing at the discharge end of the belt conveyor system. Make available to the Engineer the necessary platform to provide a safe and suitable place for sampling and testing. Remove any concrete placed in an unsatisfactory manner at no expense to the Department before continuing operations.

Use conveyor belt systems that do not exceed a total length of 550 feet, measured from end to end of the total assembly. Arrange the belt assembly so that each section discharges into a vertical hopper arrangement to the next section. To keep segregation to a minimum, situate scrapers over the hopper of each section to remove mortar adhering to the belt and to deposit it into the hopper. Equip the discharge end of the conveyor belt system with a hopper and a chute or suitable deflectors to cause the concrete to drop vertically to the deposit area.

In order to avoid delays due to breakdowns, provide stand-by equipment with an alternate power source prior to the beginning of the placement.

After the beginning of the placement, direct the discharge from the belt conveyor so that the concrete always falls on freshly placed concrete.

400-7.7 Placing Concrete by Pumping: In general, use concrete pumping equipment that is suitable in kind and adequate in capacity for the work proposed. Use a pump discharge line that has a minimum diameter of 4 inches. Use a pump and discharge lines that are constructed so that no aluminum surfaces are in contact with the concrete being pumped. Operate the pump to produce a continuous stream of concrete, without air pockets. When using cement slurry or similar material to lubricate the discharge line when pumping begins, collect such material at the point of discharge. Dispose of the collected slurry in areas provided by the Contractor. Control the pump discharge locations so that the placement locations of the various LOTs of concrete represented by strength test cylinders can be identified in the event the test cylinders indicate deficient strength. When concrete is placed by pumping, take all test samples of concrete at the end of the discharge line, except in accordance with the provisions of Section 346.

400-7.8 Consolidation: Consolidate the concrete by continuous working with a suitable tool in an acceptable manner, or by vibrating as set forth in 400-7.11. When not using vibrators, thoroughly work and compact all thin-section work with a steel slicing rod. Spade all faces, and flush the mortar to the surface by continuously working with a concrete spading implement.

400-7.9 Obstructions: In cases where, because of obstructions, difficulty is encountered in puddling the concrete adjacent to the forms, bring the mortar content of the mix into contact with the interior surfaces by vibrating the forms. Produce the vibrations by striking the outside surfaces of the forms with wooden mallets or by other satisfactory means. In placing concrete around steel shapes place it only on one side of the shape until it flushes up over the bottom flange of the shape on the opposite side, after which place it on both sides to completion. After the concrete has taken its initial set, exercise care to avoid jarring the forms or placing any strain on the ends of projecting reinforcing bars.

400-7.10 Requirements for Successive Layers: Place concrete in continuous horizontal layers, approximately 20 inches thick. To avoid obtaining a plane of separation or a cold joint between layers, vibrate the concrete in accordance with 400-7.11.

400-7.11 Vibration of Concrete:

400-7.11.1 General: Consolidate all concrete except seal, steel pile jackets, and concrete for incidental construction by the use of mechanical vibrators.

Use minimal mechanical vibration of no more than 3 seconds per insertion for Self-Consolidating Concrete (SCC), when necessary to consolidate the concrete or to avoid obtaining a plane of separation or a cold joint between layers.

400-7.11.2 Vibrators: Provide adequate vibrators on the project that are approved by the Engineer before beginning concrete work. Generally, provide vibrators of the internal type. For thin sections, where the forms are especially designed to resist vibration, the Contractor may use external vibrators. Use a vibrator with a minimum frequency of 4,500 impulses per minute with sufficient intensity and duration to cause complete consolidation of the concrete without causing segregation of the materials. For vibrating thin, heavily reinforced sections, use heads of such size to secure proper vibration of the concrete without disturbance of either the reinforcing bars or the forms.

400-7.11.3 Number of Vibrators Required: Use a sufficient number of vibrators to secure the compaction of each batch before the next batch is delivered, without delaying the delivery. In order to avoid delays due to breakdowns, provide at least one stand-by vibrator, with an appropriate power source.

400-7.11.4 Method of Vibration: Use vibrators to consolidate properly placed concrete. Do not use them to move concrete about in the forms. Insert the vibrators in the surface of concrete at points spaced to ensure uniform vibration of the entire mass of the concrete. Insert the vibrator at points that are no further apart than the radius over which the vibrator is visibly effective. Allow the vibrator to sink into the concrete by its own weight, and allow it to penetrate into the underlying layer sufficiently so that the two layers are thoroughly consolidated together. After thoroughly consolidating the concrete, withdraw the vibrator slowly to avoid formation of holes.

400-7.11.5 Hand Spading: When necessary in order to secure well-filled forms, free from aggregate pockets, honeycomb, bubbles, etc., spade the concrete by hand, along the surfaces of the forms and in all corners, following the vibration.

400-7.12 Columns: Place concrete in columns in one continuous operation for each lift as shown in the Plans.

400-7.13 Slabs and Bridge Decks:

400-7.13.1 Bulkheads, Screed Rails, and Screeding Devices: Strike-off the concrete using an approved metal screed operating on rails or bulkheads. Use devices which do not contain aluminum parts. Prior to placing concrete, provide an approved screed capable of

striking-off and screeding the surface of the slab or deck to the required shape. Set all necessary bulkheads and screed rails to the required grade. Use bulkheads, screed rails, and screeding devices that permit vertical profile adjustment to the grade, satisfactory for providing straight transverse slopes, differing transverse slopes broken as shown in the Plans and/or transverse slopes with changing grade along the longitudinal length of slab or deck. Locate the screed rails so the entire placement surface can be screeded to grade without using intermediate screed rails, unless approved otherwise by the Engineer.

Use a screed consisting of a truss or heavy beams that will retain it's shape under all working conditions, and a set of rotating drums with a diameter sufficient to carry a 2 inch mortar roll in front of and parallel to the axis of the drums, while making an initial pass. Adjust the drums to prevent mortar buildup forming behind the trailing edges of the drums. For long bridges, as defined in 400-15.2.5.1, provide a device that automatically smoothes the concrete surface to an untextured finish and that is attached to, and is moved by, the rolling drum screed. As an alternate to the drum type screed, a mechanical screed with a metal strike-off may be used. Equip the mechanical screed with mechanical vibrators to provide continuous uniform vibration to the entire length unless otherwise authorized by the Engineer. Small and irregularly shaped areas that cannot be mechanically screeded may be screeded in a manner approved by the Engineer.

400-7.13.2 Screed Demonstration: Subsequent to the placement of all reinforcing bars and prior to placing any slab or deck concrete, demonstrate that the proposed equipment and methods can finish the concrete to the specified grades while maintaining the specified cover over the reinforcement. Provide the demonstration over the entire length and width of the spans to be placed.

400-7.13.3 Screeding Operations: Perform concrete placement and screeding as independently controlled mechanical operations. Ensure that the passing of the screed and forward movement of the screeding equipment are independent of the movement of concrete placement equipment.

Level the concrete in front of the screed as near to the finished grade as possible to prevent the screed from rising off the rail and forming uneven ridges behind the screed. Pass the screed over the slab or deck as many times as necessary to obtain a satisfactory surface and provide a concrete surface true to grade and crown, and free of irregularities.

Do not add water to the concrete surface to assist in finishing operations unless specifically authorized by the Engineer. If the Engineer permits the addition of water, apply only a fog mist, above the concrete surface, by means of approved power driven spray equipment.

For long bridges, as defined in 400-15.2.5.1, do not manually or mechanically float the concrete surface or apply a texture by broom or any other device to the concrete surface produced by the screeding process. Correct isolated surface irregularities in accordance with 400-15.2.5.3.

400-7.13.4 Placing Operations: Select an approved concrete design mix which ensures complete placement of all slab or deck concrete between construction joints before initial set begins in the plastic concrete. On placements of 50 yd^3 or less, the minimum placement rate is 20 cubic yards per hour. On placements of greater than 50 cubic yards, the minimum placement rate is 30 cubic yards per hour.

The Engineer will not permit slab or deck placements until an acceptable plan for meeting the minimum placement rate is approved.

400-7.13.5 Concrete Decks on Steel Spans: Where concrete decks are placed on steel spans, release the temporary supports under the bridge before placing any concrete.

400-7.13.6 Concrete Decks on T-Beams: For cast-in-place T-beam construction, cast the slabs and beams in one continuous operation. As an exception, where special shear anchorage or keys are provided for in the Plans or approved by the Engineer, the beams and slabs may be constructed in successive placements.

400-7.13.7 Diaphragms: Place concrete diaphragms at least 48 hours before the bridge deck slabs are placed unless otherwise indicated in the Plans.

400-7.13.8 Weather Protection: Provide an approved means of protecting unhardened concrete from rain. Position the protection system to shield the concrete from rain and running water. Provide a shield impervious to water over the slab or deck concrete, of sufficient size to protect all areas of slab or deck concrete subject to water damage, and include a means of intercepting and diverting water away from freshly placed concrete. Arrange the equipment so that the weather protection system can be erected over unhardened concrete. When there is a possibility of rain during concrete placement operations, place the weather protection system in stand-by readiness, capable of being deployed in a timely manner. Use the weather protection immediately when rain begins so that slab or deck concrete damage will not occur. Do not place concrete during rain.

Assume responsibility for damage to the slab or deck in the case of failure of the weather protection system.

400-7.14 Concrete Box Culverts: In general, place the base slab or footing of concrete box culverts, and allow them to set before constructing the remainder of the culvert. In this case, make suitable provision for longitudinal keys. Construct bottom slabs, footings, and apron walls as a monolith if practicable. Where transverse construction joints are necessary, place them at right angles to the culvert barrel, and make suitable provision for keys.

In the construction of box culverts having walls 6 feet or less in height, the sidewalls and top slab may be constructed as a monolith or may place the concrete in the walls and allow it to set before placing the top slab concrete.

Where the height of the box culvert walls exceed 6 feet, place the walls, and allow the concrete to set at least 12 hours before placing the top slab concrete. In such cases, form keys in the sidewalls.

When casting the walls and top slabs of box culverts as a monolith, ensure that any necessary construction joints are vertical. Design all construction joints with formed keys. Provide keys that are beveled as shown in the Plans or as directed, but do not allow the edge of the beveled material forming the key to be less than 1 1/2 inches from the edge of the concrete.

Construct each wingwall, if possible, as a monolith. Ensure that construction joints, where unavoidable, are horizontal and so located that no joints will be visible in the exposed face of the wing above the finished graded surface.

Precast box culvert sections may be used in lieu of cast-in-place box culvert construction provided the provisions in Section 410 are satisfied.

400-8 Seals.

400-8.1 General: Wherever practicable, dewater all foundation excavations, and deposit the concrete in the dry as defined in 455-15.2. Where conditions are encountered which render it impracticable to dewater the foundation before placing concrete, the Engineer may authorize the construction of a concrete foundation seal of the required size. Then, dewater the foundation, and place the balance of the concrete in the dry.

When required to place seal concrete, the Contractor is responsible for the satisfactory performance of the seal in providing a watertight excavation for placing structural concrete. The Department will provide and pay for the seal concrete as an aid to the construction of the structure. Repair seal concrete as necessary to perform its required function at no expense to the Department.

400-8.2 Method of Placing: Carefully place concrete deposited under water in the space in which it is to remain by means of a tremie, a closed-bottom dump bucket of not less than 1 cubic yard capacity, or other approved method. Do not disturb the concrete after depositing it. Deposit all seal concrete in one continuous placement. Do not place any concrete in running water, and ensure that all form work designed to retain concrete under water is watertight.

400-8.3 Use of Tremie: Use a tremie consisting of a tube having a minimum inside diameter of 10 inches, constructed in sections having water-tight joints. Do not allow any aluminum parts to have contact with the concrete. Ensure that the discharge end is entirely seated at all times, and keep the tremie tube full to the bottom of the hopper. When dumping a batch into the hopper, keep the tremie slightly raised (but not out of the concrete at the bottom) until the batch discharges to the bottom of the hopper. Stop the flow by lowering the tremie. Support the tremie such as to permit the free movement of the discharge end over the entire top surface of the work and to permit its being lowered rapidly when necessary to choke off or retard the flow. Provide a continuous, uninterrupted flow until completing the work. Exercise special care to maintain still water at the point of deposit.

400-8.4 Time of Beginning Pumping: Do not commence pumping to dewater a sealed cofferdam until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than 72 hours after placement of the concrete.

400-9 Construction Joints.

400-9.1 Location: Make construction joints only at locations shown in the Plans or in the placement schedule, unless otherwise approved in writing. If not detailed in the Plans or placement schedule, or in case of emergency, place construction joints as directed.

400-9.2 Provisions for Bond and Transmission of Shear: Use shear key reinforcement where necessary to transmit shear or to bond the two sections together.

400-9.3 Preparations of Surfaces: Before depositing new concrete on or against concrete which has hardened, re-tighten the forms. Roughen the surface of the hardened concrete in a manner that will not leave loosened particles, aggregate, or damaged concrete at the surface. Thoroughly clean the surface of foreign matter and laitance, and saturate it with water.

400-9.4 Placing Concrete: Continuously place concrete from joint to joint. Carefully finish the face edges of all joints which are exposed to view true to line and elevation.

400-9.5 Joints in Sea Water or Brackish Water: For concrete placed in sea water or brackish water, do not place any construction joints between points 2 feet below the mean low water elevation and 6 feet above the mean high water elevation.

400-9.6 Joints in Long Box Culverts: For long concrete box culverts, vertical construction joints may be placed at a spacing not less than 30 feet. When using transverse construction joints, ensure that longitudinal reinforcing is continuous through the joint and that the joint is vertical.

400-9.7 Crack Control Grooves in Concrete Bridge Decks: When the Plans require crack control grooves in the top surface of decks, either install a tooled “V” groove prior to initial concrete set or saw a groove using an early entry dry cut saw. When using an early entry dry cut saw, operate in accordance with the manufacturer’s recommendations. Commence

sawing as soon as the concrete has hardened enough to permit standing on the surface without leaving visible tracks or impressions and before uncontrolled concrete cracks occur.

400-10 Expansion Joints.

400-10.1 General: After meeting the smoothness criteria in 400-15, construct expansion joints to permit absolute freedom of movement. Carefully remove all loose or thin shells of mortar likely to cause a spall with movement at a joint from all expansion joints as soon as possible.

400-10.2 Sealed Joints: Fill expansion joints with a preformed joint filler. Cut the filler to conform to the cross-section of the structure, and furnish it in as few pieces as practicable, using only a single piece in each curb section. Do not use small pieces that would tend to come loose. Prepare joints to be sealed and apply the sealer in accordance with approved manufacturer's directions.

400-10.3 Joint System Installation: Install expansion joints before or after the deck planing required by 400-15.2.5.5 following the manufacturer's instructions. When installed after deck planing, install the edge rail assemblies in the blockouts on a profile tangent between the ends of the deck and/or approach slab to within a plus 0 and minus1/4 inch variation.

When installed before deck planing, install the edge rail assemblies 3/8 inch, plus or minus 1/16 inch, below the top surface of the deck or approach slab to compensate for concrete removal during planing.

400-11 Contact and Bearing Surfaces.

400-11.1 Separation of Surfaces: In general, separate all contact surfaces between superstructure and substructure or end walls and between adjacent superstructure sections by a layer of ASTM D6380 Class S, Type III organic felt. When an organic felt bond breaker is specified for other structures, use either one layer of ASTM D6380 Class S, Type III or two layers of ASTM D226 Type II organic felt.

400-11.2 Finishing of Bearing Surfaces: Construct bearings surfaces (areas) to the tolerances as specified herein and in the other parts of the Contract Documents. When using neoprene bearing pads, finish the concrete surface to a uniform 'rough' texture using a burlap drag, fine bristle broom or float. For metal or high load rotational bearings, fill minor depressions, 1/8 inch maximum, caused by finishing, bush hammering, or grinding with a low-viscosity epoxy meeting the requirements of 926-1, Type F-2, applied by the use of a squeegee. Bearing surfaces may be ground to final position with carborundum. Check all bearing surfaces with a metallic straightedge prior to setting bearings or neoprene pads.

400-11.2.1 Deviation from Specified Elevations for Steel Beam Superstructures: Construct to the elevation shown on the Plans plus or minus 0.01 feet and do not exceed a 0.01 feet difference between specified elevations of bearing areas of adjacent bearings measured between the centerlines of bearing areas.

400-11.2.2 Deviation from Specified Elevations for Concrete Beam Superstructures: Construct to the elevation shown on the Plans plus or minus 0.02 feet.

400-11.2.3 Projecting Irregularities: Projecting irregularities will not exceed 1/16 inch.

400-11.2.4 Variations in Flatness for Neoprene Pads: In any direction, the pad is to be flat to within 1/16 inch. Pads designated to be sloped are not to deviate from the theoretical slope by the same amount.

400-11.2.5 Variations in Flatness for Metal or High Load Rotational Bearings: Construct the bearing area to the tolerance indicated for the measured length along the orthogonal axes.

Bearing area length up to 30 inches long to plus or minus 1/16 inch.

Bearing area length over 30 inches up to 45 inches long to plus or minus 3/32 inch.

Bearing area length over 45 inches long to plus or minus 1/8 inch.

400-11.3 Bearing Pads: Use bearing pads for seating bridge shoes, ends of beams, and slabs of the types specified or required in the Plans.

Furnish and install neoprene pads as detailed in the Plans. Place neoprene pads, where specified or required, directly on concrete surfaces finished in accordance with the requirements of this Article. Ensure that pads, bearing areas of bridge seats, and metal bearing plates are thoroughly cleaned and free from oil, grease, and other foreign materials.

Exercise care in fabrication of related metal parts to avoid producing conditions detrimental to the performance of the pads, such as uneven bearing, excessive bulging, etc.

The Engineer will evaluate the degree of deformation and condition of bearing pads in the completed bridge on or before the final inspection required by 5-10 or when requested by the Contractor. As directed by the Engineer, correct horizontal bearing pad deformations that at the time of inspection exceed 50% of the bearing pad thickness or that the Engineer predicts will exceed 50% of the bearing pad thickness during future high or low temperature periods. Payment for this correction effort will be considered extra work in accordance with 4-3.

400-12 Anchor Bolts and Dowels.

Set anchor bolts and dowels as specified in Section 460.

Galvanize all anchor bolts as specified in Section 962.

400-13 Epoxy Bonding Compounds.

Where epoxy bonding compounds for bonding concrete are specified or required, apply the epoxy bonding materials only to clean, dry, structurally sound concrete surfaces. Provide surface preparation, application, and curing of epoxy bonding compound in strict accordance with the manufacturer's recommendations for each particular application.

400-14 Removal of Forms.

Use the table below as the criterion for minimum time or compressive strength required before removal of forms or supports.

When using the time period criterion, include in the time period all days except days in which the temperature falls below 40ºF.

Use the specified 28-day minimum compressive strength value as stated in 346-3.1 for each Class of Concrete utilized.

Table 400-2

Location of Concrete Placement	Minimum Time for Form Removal for any Strength Concrete*	Minimum (%) of 28-day Compressive Strength for Form Removal
(1) Deck slabs, top slabs of culverts and bottom of caps, forms under sidewalks, and safety curb overhangs extending more than 2 feet		

Table 400-2		
Location of Concrete Placement	Minimum Time for Form Removal for any Strength Concrete*	Minimum (%) of 28-day Compressive Strength for Form Removal
(a) Class II Bridge Deck	7 days**	75**
(b) Class II (Other than Bridge Deck)	7 days	75
(c) Class III	7 days	70
(d) Class IV	7 days	60
(e) Class V	7 days	50
(2) Walls, piers, columns, sides of beams and other vertical surfaces	24 hours***	50***
(3) Front face form of curbs	6 hours	70
* For mass concrete, remove forms in accordance with Section346. ** Reference 400-16.4 ***Do not place additional load on the section until 70% of the specified 28-day concrete strength is attained. Also, refer to 400-7.4.		

When using the percent of required strength, cast test cylinders for each mix for compressive strength determination, develop a curing concrete strength versus time curve (S/T Curve) or a strength-maturity curve. Either curve may be used in lieu of multiple test cylinders to determine when the percent of required strength has been met.

Prior to use, obtain the Engineer's approval of the S/T Curve and its supporting data. An approved testing laboratory may be used to provide this information with approval of the Engineer. Plot S/T Curves using at least three different elapsed times that begin once test cylinders are cast; however, one of the elapsed times must be prior to the Contractor's intended form removal. Each elapsed time plotted must have a corresponding compressive strength computed by averaging the compressive strength of two test cylinders.

Cure such test cylinders as nearly as practical in the same manner as the concrete in the corresponding structural component, and test them in accordance with ASTM C39 and ASTM C31. Perform cylinder casting, curing, and testing at no expense to the Department and under the observation of the Engineer. When the S/T Curve indicates a compressive strength equal to or greater than the percentage of specified strength shown in the table above for form removal, the Contractor may remove the forms. When the ambient air temperature falls 15ºF or more below the ambient air temperature that existed during development of a S/T Curve, use a S/T Curve that corresponds to the lower temperature and that is developed in accordance with this section.

Prior to using the strength-maturity method, obtain the Engineer's approval of the strength-maturity curve and its supporting data. Estimate the strength development of concrete using the strength-maturity method in accordance with ASTM C1074. An approved testing laboratory may be used to provide this information with approval of the Engineer. Develop the strength-maturity curves at no expense to the Department.

Do not remove forms at any time without the consent of the Engineer. Even when the Engineer provides consent to remove the forms, the Contractor is responsible for the work.

400-15 Finishing Concrete.

400-15.1 General Surface Finish (Required for All Surfaces): After placing and consolidating the concrete, strike-off all exposed surfaces to the lines and grades indicated in the

Plans in a manner that will leave a surface of uniform texture free of undesirable surface irregularities, cavities, and other defects. Cut back metal ties supporting reinforcement, conduit, and other appurtenances a minimum of 1 inch from finished surface. After removing excess mortar and concrete and while the concrete is still in a workable state, carefully tool all construction and expansion joints. Leave joint filler exposed for its full length with clean edges. Ensure that finished work in addition to that specified above is compatible and complementary to the class of surface finish required.

Remove all laitance, loose material, form oil and curing compound from exposed surfaces that do not require forming and from exposed surfaces requiring forming, after form removal. Remove fins and irregular projections flush with the surface. Clean, saturate with water, and fill all holes, tie cavities, honeycomb, chips and spalls. Prior to filling, prepare the surface to ensure that patching mortar will bond to the existing concrete. Exercise care during the roughening process to prevent excessive defacement and damage to the surface of the existing concrete. Use patching mortar blended from the mix ingredients of the existing concrete. Ensure the patching mortar closely matches the color of the existing concrete when fully cured. As an alternative, mortar consisting of the following materials may be used: 4 parts of ordinary gray portland cement, 1/2 part of white portland cement, 1 part of coal ash and 2 to 4 parts of sand. The blended mortar must closely match the color of the filled element once fully cured and the proportion of white portland cement may be adjusted to achieve as close a match as possible. Regardless of the type patching mortar used, provide a mortar surface closely resembling the existing surface.

Cure the newly placed mortar using a curing blanket or a Type I clear curing compound at a uniform coverage as recommended by the manufacturer, but not less than 0.06 gallon per square yard.

In the event unsatisfactory surfaces are obtained, repair these surfaces by methods approved by the Engineer or the affected concrete will be rejected. Repair any surface or remove rejected concrete at no expense to the Department.

400-15.2 Surface Finishes:

400-15.2.1 General: In addition to the general surface work specified for all exposed concrete surfaces, the Engineer may require one of the classes of surface finish listed below. For all such exposed surfaces, begin finish work for the applicable class specified, along with the general finish work, immediately after removal of the forms. In order to further ensure the required quality of the finish, remove forms no later than the minimum time specified for the forms to remain in place. Satisfactorily repair finished concrete surfaces which are subsequently disfigured or discolored at no expense to the Department.

Provide the required class of surface finish for the various items of structural concrete as shown in the Plans.

400-15.2.2 Class 1 Surface Finish: As soon as the pointing has sufficiently set, thoroughly saturate the exposed surfaces with water, and rub them with a medium coarse carborundum stone. Continue rubbing until the surface has been ground to a paste and remove all form marks, irregularities, and projections. In this process, do not introduce any additive material other than water. After the rubbing has produced a smooth surface of uniform color, allow the material which has been ground to a paste to reset under proper curing conditions. Subsequently, as a second operation, re-saturate the concrete surfaces with water, and thoroughly rub them with a fine carborundum stone. Continue this rubbing until the surface has a smooth, fine grain texture of uniform color.

The Contractor may substitute a Class 5 applied finish coating in accordance with 400-15.2.6 as an alternate surface finish on all areas where Class 1 surface finish is specified.

400-15.2.3 Class 2 Surface Finish: As soon as pointing has sufficiently set, thoroughly saturate the exposed concrete surfaces with water and rub them with a medium coarse carborundum stone. Continue rubbing until the surface has been ground to a paste and remove all form marks, irregularities, and projections. In this process, do not introduce any additive material other than water.

After rubbing has produced a smooth surface finish, of uniform color, carefully brush the material which has been ground to a paste to a uniform texture, and allow it to reset under proper curing conditions. Carefully protect these surfaces from disfigurement and discoloration during subsequent construction operations.

400-15.2.4 Class 3 Surface Finish: Where this surface finish is specified, use forms with a form liner. Where specified or required on the Plans, use No. 89 coarse aggregate for concrete.

After concrete has been placed in the forms and compacted, finish all exposed surfaces which are not contained by the forms to produce a surface texture as nearly equal to that produced by the form as practicable. Generally, finish unformed surfaces to a smooth, dense surface with a steel trowel.

Perform all work, including general surface finish work, in a manner that will preserve the same surface texture and color produced by the form liner. Pointed areas may be rubbed with a dry carborundum stone.

400-15.2.5 Class 4 Deck Finish:

400-15.2.5.1 General: Apply a Class 4 finish on bridge decks and concrete approach slabs. On Short Bridges (bridges having a length less than or equal to 100 feet), and on Miscellaneous Bridges (Pedestrian, Trail and Movable Spans) regardless of length, meet the finish and smoothness requirements of 400-15.2.5.2 and 400-15.2.5.4. On Long Bridges (bridges having a length greater than 100 feet) meet the finish and smoothness requirements of 400-15.2.5.3 and 400-15.2.5.5. When an existing bridge deck is widened, see the Plans for the finish and smoothness requirements of the existing bridge deck and its new widened section. After meeting the screeding requirements of 400-7.13 and curing requirements of 400-16 and the smoothness requirements, herein, groove the bridge deck and approach slabs.

Regardless of bridge length, finish decks with less than 2 1/2 inches of top cover in accordance with the requirements for Short Bridges.

400-15.2.5.2 Plastic Surface Finish for Short and Miscellaneous Bridges: After screeding is completed, check the surface of the plastic concrete with a 10 foot straightedge, positioning and half-lapping the straightedge parallel to the centerline to cover the entire surface. Immediately correct deficiencies of more than 1/8 inch, measured as an ordinate between the surface and the straightedge.

Finish the concrete surface to a uniform texture using a burlap drag, fine bristle broom or float. Finish the deck to a smooth surface having a sandy texture without blemishes, marks or scratches deeper than 1/16 inch.

400-15.2.5.3 Plastic Surface Finish for Long Bridges: Do not moisten, manually float or apply texture to the concrete surface after the screed, with attached smoothing device, has passed unless correction of isolated surface irregularities is warranted and this should

be done as soon as possible after screeding while the concrete is plastic. Correct all flaws such as cavities, blemishes, marks, or scratches that will not be removed by planing.

If the Engineer permits the addition of water when correcting flaws, apply moisture to the concrete surface only if required and only in the immediate vicinity of the isolated irregularity. Apply a quantity of moisture not greater than what is needed to facilitate correction of the irregularity and apply only a fog mist, above the concrete surface, by power driven spray equipment approved by the Engineer.

400-15.2.5.4 Smoothness Requirements for Short Bridges and Miscellaneous Bridges (including approach slabs): Perform a final straightedge check with a 10 foot straightedge, positioning and half-lapping the straightedge parallel to the centerline, approximately 5 feet apart to cover the entire surface. Correct all irregularities greater than 3/16 inch measured as an ordinate to the straightedge, by grinding. Perform grinding by the abrasive method using hand or power tools or by machine, to leave a smooth surface within a 1/8 inch tolerance.

400-15.2.5.5 Smoothness Evaluation and Concrete Surface Planing, Long Bridges (including approach slabs): Prior to planing, provide a smoothness evaluation of the completed bridge deck and exposed concrete surfaces of approach slabs by a computerized California-type profilograph in accordance with the criteria herein and FM 5-558. Furnish this evaluation through an independent provider approved by the Engineer, using equipment calibrated by the Engineer. All bridge deck and concrete approach slab surfaces within 2 feet of gutter lines are subject to this smoothness evaluation.

Prior to initial profilograph testing, complete work on the bridge deck and approach slabs. Thoroughly clean and clear the bridge deck and approach slab areas to be evaluated for smoothness of all obstructions and provide the smoothness evaluation. Ensure that no radio transmissions or other activities that might disrupt the automated profilograph equipment are allowed during the evaluation.

Average the Profile Index Value for the bridge deck, including the exposed concrete surfaces of the approach slabs, for the left and right wheel path of each lane. The maximum allowable Profile Index Value for acceptable smoothness is 10 inches per mile utilizing the 0.2 inch blanking band. Apply these criteria to a minimum of 100 feet of each lane. Additionally, correct individual bumps or depressions exceeding a cutoff height of 0.3 inch from a chord of 25 feet (see ASTM E1274) on the profilograph trace. Ensure that the surface meets a 1/4 inch in 10 feet straightedge check made transversely across the deck and approach slabs if determined necessary by the Engineer. Provide additional profilograph testing as necessary following longitudinal planing and any other actions taken to improve smoothness, until a profile meeting the acceptance criteria is obtained.

Regardless of whether expansion joints are installed before or after deck planing is complete, plane off the concrete deck surface to a minimum depth of 1/4 inch and also meet or exceed the profilograph smoothness criteria. Longitudinally plane the entire bridge deck and exposed concrete surfaces of the approach slabs using a self-propelled planing machine with gang mounted diamond saw cutting blades specifically designed for such work. Use the profilograph generated smoothness data, to establish the optimum planing machine settings. Plane the deck surface to within 2 feet of the gutter line so that there is a smooth transition, without vertical faces or sudden surface discontinuities, from the fully planed surface to the unplaned surface. Use a machine with a minimum wheel base length of 15 feet, constructed and operated in such manner that it does not cause strain or damage to deck or

approach slab surfaces, excessive ravels, aggregate fractures or spalling. The equipment shall be approved by the Engineer. Perform longitudinal planing parallel to the roadway centerline, and provide a consistent, textured surface. Clean the surface of all slurry/debris generated during this work concurrently with operation of the machine.

After the deck has been planed the minimum 1/4 inch, reevaluate the surface smoothness using the profilograph testing described above. Perform cycles of planing and profilograph retesting as necessary until the deck and exposed concrete surfaces of approach slabs are in compliance with the smoothness criteria but do not exceed the maximum concrete removal depth of 1/2 inch.

400-15.2.5.6 Grooving: After the concrete surface profile, as required by 400-15.2.5, has been accepted by the Engineer, and prior to opening the bridge to traffic, groove the bridge deck and approach slabs perpendicular to the centerline of the structure. Do not groove the deck surface of pedestrian or trail bridges unless otherwise shown in the Contract Documents. Cut grooves into the hardened concrete using a mechanical saw device which will leave grooves nominally 1/8 inch wide and 3/16 inch deep. Space the grooves apart in random spacing center of grooves in the following sequence: 3/4 inch, 1-1/8 inch, 5/8 inch, 1 inch, 5/8 inch, 1-1/8 inch, 3/4 inch in 6 inch repetitions across the width to be grooved in one pass of the mechanical saw device. One 6 inch sequence may be adjusted by 1/4 sequence increments to accommodate various cutting head widths provided the general pattern is carried out. The tolerance for the width of the grooves is plus 1/16 inch to minus 0 inch and the tolerance for the depth of grooves is plus or minus1/16 inch. The tolerance for the spacing of the grooves is plus or minus1/16 inch.

Cut grooves continuously across the deck or approach slab to within 18 inches of gutter lines at traffic railing, curb line and median divider. At skewed metal expansion joints in bridge deck surfaces, adjust groove cutting by using narrow width cutting heads so that all grooves of the bridge deck surface or approach slab surface end within 6 inches, measured normal to centerline of the joint, leaving no ungrooved surface adjacent to each side of the joint greater than 6 inches in width. Ensure that the minimum distance to the first groove, measured normal from the edge of the concrete joint or from the junction between the concrete and the metal leg of the armored joint angle, is 1 inch. Produce grooves that are continuous across construction joints or other joints in the concrete surface less than 1/2 inch wide. Apply the same procedure described above where the gutter lines at traffic railing, curb lines and median dividers are not parallel to the centerline of the bridge to maintain the 18 inches maximum dimension from the grooves to the gutter line. Cut grooves continuously across formed concrete joints.

400-15.2.6 Class 5 Applied Finish Coating:

400-15.2.6.1 General: Place an applied finish coating upon all concrete surfaces where the Plans indicate Class 5 applied finish coating. Apply the finish coating after completion of the general surface work specified for all exposed concrete surfaces.

400-15.2.6.2 Material: For the coating material, use a commercial product designed specifically for this purpose. Use only coating material that is manufactured by one manufacturer and delivered to the job site in sealed containers bearing the manufacturer's original labels. Submit the manufacturer's written instructions to the Engineer.

400-15.2.6.3 Surface Preparation: Prepare the surface prior to the application of an applied finish coating by providing a surface finish in accordance with the requirements of 400-15.1. The Engineer will not require surface voids that are 1/4 inch or less in

width and depth to be grouted prior to application of the finish coating. Fill surface void larger than 1/4 inch in width and depth an approved high strength, non metallic, non shrink grout meeting the requirements of Section 934, mixed and applied in accordance with the manufacturer's recommendations. Apply the grout by filling the surface voids using burlap pads, float sponges, or other acceptable methods. As soon as the grout has taken its initial set, brush the surface to remove all loose grout, leaving the surface smooth and free of any voids. Ensure that the surface to be coated is free from efflorescence, flaking coatings, curing compound, dirt, oil, and other substances deleterious to the applied finish coating. Prior to application of the finish coating onto precast or cast-in-place concrete surfaces, test the concrete surface at 30 foot intervals for the presence of curing compound using one or two drops of muriatic acid placed on the concrete surface. If curing compound is present, there will be no reaction between the acid and the concrete. If there is no reaction, remove the compound by pressure washing the concrete surfaces. Prepare the surfaces in accordance with the manufacturer's recommendations, and ensure that they are in a condition consistent with the manufacturer's requirements. Clean surfaces of existing structures in accordance with 400-19.

400-15.2.6.4 Application: Apply the finish coating utilizing a method recommended by the manufacturer. When applying the finish coating by spraying, supply heavy duty spray equipment capable of maintaining a constant pressure necessary for proper application. Mix and cure all coating materials in accordance with the manufacturer's written instructions. Apply the finished coating at a rate of 50, plus or minus 10 square feet per gallon.

400-15.2.6.5 Finished Product: Produce a texture of the completed finish coat that is generally similar to that of rubbed concrete. Ensure that the completed finished coating is tightly bonded to the structure and presents a uniform appearance and texture. If necessary, apply additional coats to produce the desired surface texture and uniformity.

Upon failure to adhere positively to the structure without chipping, flaking, or peeling, or to attain the desired surface appearance, remove coatings entirely from the structure, and reapply the finish coating after surface preparation until achieving the desired finished product. Do not allow the average thickness of the completed finish coating to exceed 1/8 inch.

400-15.2.6.6 Material Tests and Certification: Before any portion of any shipment of finish coating is applied on the project, submit to the Engineer a certificate from the manufacturer attesting that the commercial product furnished conforms to the same formula as that previously subjected to the tests specified in Section 975. In addition, submit the following product analysis, obtained from the manufacturer, for each batch of the material used:

1. Weight per gallon.
2. Consistency (Krebs Units).
3. Weight percent pigment.
4. Weight percent vehicle solids.
5. Infra-red spectra of vehicle solution.

400-15.2.7 Final Straightedging for Surfaces to Receive Asphalt Concrete Surface: Test the slab surfaces of poured-in-place decks which are to be surfaced with an asphalt concrete wearing course for trueness with a 10 foot straightedge, as specified above. As an exception, correct only irregularities of more than 1/4 inch measured as an ordinate (either above or below the general contour of the surface). The Engineer will not require belting or brooming of slabs that are to be surfaced with an asphalt concrete wearing course. For curing, meet the requirements specified for other deck slabs.

400-15.2.8 Finishing Bridge Sidewalks: Finish bridge sidewalks in accordance with the applicable requirements of Section 522.

400-16 Curing Concrete.

400-16.1 Internal curing: At the Contractor's option use internal curing in combination with one or more of the external curing methods listed in this Section. Use lightweight fine aggregates from Department-approved sources meeting the requirements of ASTM C1761.

400-16.2 External curing: Cure cast-in-place and precast (non-prestressed) concrete as required herein for a minimum duration of 72 hours. If forms are loosened or removed before the 72 hour curing period is complete, expand the curing to cover these surfaces by either coating with curing compound or extending the continuous moist cure area.

Until curing has begun, retain concrete surface moisture at all times by maintaining a surface moisture evaporation rate less than 0.1 pound per square foot per hour. Periodically, at the site of concrete placement prior to and during the operation, measure the ambient air temperature, relative humidity and wind velocity with industrial grade weather monitoring instruments to determine the on-site evaporation rate. If the evaporation is, or is likely to become 0.1 pound per square foot per hour or greater, employ measures to prevent moisture loss such as application of evaporation retarder, application of supplemental moisture by fogging or reduction of the concrete temperature during batching. Compute the evaporation rate by using the nomograph in the ACI manual of Concrete Practice Part 2, Section 308R Guide to Curing Concrete, or by using an evaporation rate calculator approved by the Engineer.

400-16.2.1 Methods: Except where other curing methods are specified, select from the following options the chosen method(s) for curing all concrete components.

1. Continuous Moisture: Place burlap on the surface and keep it continuously saturated for the curing period by means of soaker hoses or automatic sprinklers. Water flow may be metered to cycle repetitively for five minutes on and five minutes off during the 72 hour curing period. Do not apply moisture manually. If side forms are loosened or removed during the curing period, extend the burlap so as to completely shield the sides of the members.

2. Membrane Curing Compound: Apply a white Type 2 curing compound to all surfaces at a uniform coverage as recommended by the manufacturer but not less than 0.06 gallon per square yard. Allow surfaces covered by the membrane curing compound to remain undisturbed for the curing period. Recoat any cracks, checks or other defects in the membrane seal which are detected during the curing period within one hour. If side forms are loosened during the curing period, maintain surface moisture and remove the forms within one hour and immediately coat the formed surfaces with a membrane curing compound. Bottom surfaces shall be similarly coated after removal of or from the forms.

If curing compound is to be applied by spraying, use a compressor driven sprayer of sufficient size to provide uniform mist. Standby equipment is required in case of mechanical failure and hand held pump-up sprayers may be used only as standby equipment.

3. Curing Blankets: Curing blankets may be used for curing the top surfaces of members while the member side forms remain in place. Do not use curing blankets which have been torn or punctured. Securely fasten all edges to provide as tight a seal as practical. Should the system fail to maintain a moist condition on the concrete surface, discontinue use of the blankets and continue curing using another method. Keep curing blankets in place for the duration of the curing period.

4. Accelerated Cure:

a. General: Accelerated curing of the concrete can be achieved by use of either low pressure steam curing, radiant heat curing or continuous moisture and heat curing. If accelerated curing is completed before the 72 hour curing period has elapsed, continue curing for the remaining part of the 72 hour curing period in accordance with one of the curing methods listed above.

If accelerated curing is used, furnish temperature recording devices that will provide accurate, continuous and permanent records of the time and temperature relationship throughout the entire curing period. Provide one such recording thermometer for each 200 feet of placement length or part thereof. Initially calibrate recording thermometers and recalibrate at least annually.

The preheating period shall equal or exceed the time of initial set as determined by ASTM C403 and shall not be less than 4 hours. When the ambient air temperature is above 50ºF, allow the member to remain undisturbed in the ambient air for the preheating period. If the ambient air temperature is below 50ºF, apply heat during the preheating period to hold the air surrounding the member at a temperature of 50 to 90ºF.

To prevent moisture loss from exposed surfaces during the preheating period, enclose members as soon as possible after casting or keep the surfaces wet by fog mist or wet blankets. Use enclosures for heat curing that allow free circulation of heat about the member with a minimum moisture loss. The use of tarpaulins or similar flexible covers may be used provided they are kept in good repair and secured in such a manner to prevent the loss of heat and moisture. Use enclosures that cover the entire placement.

During the application or removal of the heat, do not allow the temperature rise or fall within the enclosure to exceed 40ºF per hour. Do not allow the curing temperature throughout the enclosure to exceed 160ºF. Maintain the curing temperature within a temperature range of 130 to 160ºF until the concrete has reached the required form removal strength for precast and cast-in-place components or the required release strength for prestressed concrete components.

b. Low-Pressure Steam: The steam used shall be in a saturated condition. Do not allow steam jets to impinge directly on the concrete, test cylinders, or forms. Cover control cylinders to prevent moisture loss and place them in a location where the temperature is representative of the average temperature of the enclosure.

c. Curing with Radiant Heat: Apply radiant heat by means of pipes circulating steam, hot oil or hot water, or by electric heating elements. Do not allow the heating elements to come in direct contact with the concrete or the forms. Distribute sources of heat in a manner that will prevent localized high temperatures above 160ºF. To prevent moisture loss during curing, keep the exposed surfaces wet by fog mist or wet blankets.

d. Continuous Moisture and Heat: This method consists of heating the enclosure in combination with the continuous moisture method described above.

In addition to the curing blankets, an auxiliary cover for retention of the heat will be required over the entire placement. Support this cover at a sufficient distance above the placement being cured to allow circulation of the heat.

400-16.3 Silica Fume Concrete: Cure silica fume concrete a minimum of 72 hours using continuous moisture cure. No substitution of alternative methods nor reduction in the time period is allowed. After completion of the 72 hour curing period, apply a membrane curing compound to all concrete surfaces. Apply curing compound according to 400-16.2.

400-16.4 Bridge Decks and Approach Slabs: Cure bridge decks and approach slabs for a duration of seven days. Apply a membrane curing compound to the top surface in accordance with 400-16.2 using a compressor driven sprayer. In general, apply curing compound when the surface is damp and after all pooled water has evaporated. For Short bridges, begin applying curing compound immediately after the initially placed concrete has been floated, straightedged, textured and a damp surface condition exists and continue applying compound as concrete placement progresses with as little interruption as possible until the entire top surface has been coated with compound. For Long bridges, begin applying curing compound to the initially placed concrete as soon as a damp surface condition exists and continue applying compound as concrete placement progresses with as little interruption as possible until the entire top surface has been coated with compound. For all bridges, the elapsed time between the initial placement of deck or approach slab concrete and the completed application of curing compound must not exceed 120 minutes. The 120 minute limit may be extended by the Engineer if project specific factors (cool temperatures, high humidity, retarding admixtures, etc.) prolong wet surface conditions.

Prior to the first deck or approach slab placement, submit to the Engineer the method that will be used to periodically measure the rate of application of curing compound in, gallons per square foot as the concrete placement progresses. Prior to the placement of each deck or approach slab, submit to the Engineer the anticipated quantity of curing compound in gallons along with the corresponding square feet of concrete to be covered to meet the coverage rate in 400-16.2. Compute the actual quantity of curing compound applied at the conclusion of each concrete placement and submit the quantity to the Engineer. Apply the curing compound from a work platform.

Place curing blankets on all exposed surfaces which are not formed as soon as possible with minimal effect on the surface texture. Place the curing blankets with sufficient overlapping seams to form an effective moisture seal. Before using curing blankets, mend tears, splits, or other damage that would make them unsuitable. Discard curing blankets that are not repairable. Wet all curing blankets immediately after satisfactorily placing them and maintain them in a saturated condition throughout the seven-day curing period. Supply sufficient quantity of water meeting the requirements of Section 923 at the job site for wetting the blankets.

Where a bridge deck or approach slab is to be subjected to walking, wheeling or other approved construction traffic within the seven-day curing period, protect the curing blankets and the concrete surface from damage by placing wooden sheeting, plywood or other approved protective material in the travel areas.

When the ends of the curing blankets are rolled back to permit screeding of adjacent concrete, keep the exposed surfaces wet throughout the period of exposure.

Bridge deck bottom and side forms may be removed after 72 hours upon compliance with 400-14. Approach slab side forms may be removed after 72 hours. Apply membrane curing compound to all surfaces stripped of forms within one hour of loosening. Apply curing compound according to 400-16.2.

400-16.5 Construction Joints: Cure construction joint areas using either the continuous moisture or curing blankets method.

400-16.6 Concrete Barriers, Traffic Railings, Parapets and End Post: Ensure concrete is cured in accordance with 400-16.2(2), except that a clear Type 1-D curing compound that must contain a fugitive dye may be used in lieu of Type 2. If Type 1-D is used, its removal per 400-15.1 during finishing is not required. When construction is by the slip form method, coat

all concrete surfaces with a curing compound that meets the requirements of 925-2, either within 30 minutes of extrusion or before the loss of water sheen, whichever occurs first. Ensure a curing compound coating period of not less than seven days after application. Prior to each concrete placement, submit to the Engineer the method that will be used to periodically measure the rate of application in gallons per square foot. Also, prior to each placement, submit to the Engineer the anticipated quantity of curing compound in gallons that will be used to meet the coverage rate specified in 400-16.2 along with the corresponding square footage of concrete barriers, traffic railings, parapets and end posts to be coated with that quantity. Measure the actual quantity of curing compound that is applied during each concrete placement and submit the quantity to the Engineer. Applied finish coatings that are flagged as permitted for use as a curing compound, may be used in lieu of a curing compound. If an applied finish coating is used in lieu of a curing compound, have a backup system that is in full compliance with 400-16.2(2) available at all times to ensure that an effective alternative system will be immediately available if the applied finish coating cannot be applied within 30 minutes of extrusion or before the loss of water sheen.

400-16.7 Removal of Membrane Curing Compounds: Provide the longest possible curing duration; however, remove curing compound on portions of members to be bonded to other concrete. Compounds may be removed by either sand or water blasting. Water blasting requires the use of water meeting the requirements of Section 923 and a minimum nozzle pressure of 2,900 psi.

400-17 Protection of Concrete.

400-17.1 Opening to Traffic: Do not open concrete bridge decks, approach slabs, or culverts to traffic for at least 14 days after concrete placement. During placement operations, concrete may be wheeled across previously placed slabs after they have set for 24 hours and plank runways are used to keep the loads over the beams.

400-17.2 Storing Materials on Bridge Slabs: Do not store heavy equipment or material, other than light forms or tools, on concrete bridge slabs or approach slabs until 14 days after they have been placed. Obtain approval from the Engineer prior to storing materials, tools or equipment on bridge decks at any time. Disperse any such loads to avoid overloading the structure.

400-17.3 Time of Placing Superstructure: Do not place the weight of the superstructure or beams on concrete substructure elements for at least 10 days after placement.

400-17.4 Alternate Procedure: As an alternative to the time delay periods set forth in 400-17.1 and 400-17.3, test cylinders may be prepared and tested by the Contractor in accordance with 346-5 and a determination made using one of the following methods:

1. When the cylinder test results indicate the minimum 28 day compressive strength shown in the Plans, concrete bridge decks, approach slabs, and culverts may be opened to traffic or the superstructure and beams may be placed on caps.
2. Submit signed and sealed calculations, prepared by a Specialty Engineer, demonstrating that the concrete caps can safely support the weight of the girders for the current concrete strength to the Engineer for approval.

In any event, comply with the curing provisions of 400-16.

400-18 Precast Planks, Slabs, and Girders.

400-18.1 General: Where so shown in the Contract Documents, the Contractor may construct concrete planks, slabs, girders, and other structural elements by precasting. In general,

use a method that consists of casting structural elements in a casting yard, curing as specified in 400-16, transporting them to the site of the work, installing them on previously prepared supports and, where so shown in the Plans, joining them with poured-in-place slabs or keys. Handle and install precast prestressed members as specified in Section 450.

400-18.2 Casting: Cast precast elements on unyielding beds or pallets. Use special care in casting the bearing surfaces on both the elements and their foundations in order that these surfaces shall coincide when installing the elements. Check bearing surfaces on casting beds with a level and a straightedge prior to the casting. Similarly check corresponding surfaces on the foundations during finishing operations.

400-18.3 Poured-in-Place Keys: Where precast elements are to be joined with poured-in-place keys, carefully align the elements prior to pouring the keys.

400-18.4 Surface Finish: Finish the surface as specified in 400 15, except that where precast slabs and poured-in-place keys form the riding surface, give the entire surface a broomed finish.

400-18.5 Moving, Placing, and Opening to Traffic: Reinforced precast members may be moved from casting beds, placed in the structure, and opened to traffic at the ages shown in the following table:

Handling from casting beds to storage areas ..... 7 days
Placing in structure ..... 14 days

Opening to traffic:

Precast elements..... 14 days
Cast-in-place slabs over precast girders..... 14 days
Cast-in-place keys joining precast slabs ..... 7 days

As an alternate procedure, in lieu of the time delay periods set forth above, test beams may be cast from representative concrete, and cure them identically with the concrete in the corresponding structural component. Test the test beams in accordance with ASTM C31 and ASTM C78. When the test results indicate a flexural strength of 550 psi, or more, any of the operations listed above may proceed without completing the corresponding time delay period.

400-18.6 Setting Prestressed Slabs: Before permitting construction equipment on the bridge to erect slab units, submit sketches showing axle loads and spacing and a description of the intended method of setting slab units to the Engineer for approval. Do not use axle loads, spacing, and methods of setting which produce stresses in the slab units greater than the allowable stress.

400-18.7 Protection of Precast Elements: The Contractor is responsible for the safety of precast elements during all stages of construction. The Engineer will reject any precast elements that become cracked, broken, seriously spalled, or structurally impaired. Remove rejected precast elements from the work at no expense to the Department.

400-18.8 Form Material: Form material used to form hollow cores may be left in place. Ensure that the form material is neutral with respect to the generating of products harmful to the physical and structural properties of the concrete. The Contractor is responsible for any detrimental effects resulting from the presence of the form material within the precast element.

400-19 Cleaning and Coating Concrete Surfaces of Existing Structures.

For the purposes of this article, an existing structure is one that was in service prior to the start of the project to which this specification applies. For existing structures, clean concrete surfaces that are designated in the Contract Documents as receiving Class 5 applied finish coating by pressure washing prior to the application of coating. Use pressure washing equipment

producing a minimum working pressure of 2,500 psi when measured at or near the nozzle. Do not damage or gouge uncoated concrete surfaces or previously coated concrete surfaces during cleaning operations. Remove all previously applied coating that is no longer adhering to the concrete or that is peeling, flaking or delaminating. Ensure that after the pressure wash cleaning and the removal of non-adherent coating, that the cleaned surfaces are free of efflorescence, grime, mold, mildew, oil or any other contaminants that might prevent proper adhesion of the new coating. After cleaning has been successfully completed, apply Class 5 Applied Finish Coating in accordance with 400-15.2.6 or as otherwise specified in the Plans.

400-20 Approach Slabs.

Construct approach slabs at the bridge ends in accordance with the applicable requirements of Section 350 using Class II (Bridge Deck) concrete. Place the reinforcement as specified in 350-7 and Section 415.

400-21 Disposition of Cracked Concrete.

400-21.1 General: The disposition of cracked concrete is described in this Article and applies to all cast-in-place concrete members, and once installed, to the precast and prestressed concrete members that are produced in accordance with 410, 450, 521, 534, 548 and 641.

400-21.2 Investigation, Documentation and Monitoring: The Engineer will inspect concrete surfaces as soon as surfaces are fully visible after casting, with the exception of surfaces of precast concrete products produced in offsite plants, between 7 and 31 days after the component has been burdened with full dead load, and a minimum of 7 days after the bridge has been opened to full unrestricted traffic. Additionally, for bridge decks that require planing, the Engineer will perform bridge deck crack measurements once the deck is free of all debris after planing is complete and before transverse grooves are cut. The Engineer will measure the width, length and depth of each crack and establish the precise location of the crack termination points relative to permanent reference points on the member. The Engineer will determine if coring of the concrete is necessary when an accurate measurement of crack depth cannot be determined by use of a mechanical probe. The Engineer will monitor and document the growth of individual cracks at an inspection interval determined by the Engineer to determine if cracks are active or dormant after initial inspection.

Provide the access, equipment and personnel needed for the Engineer to safely perform this work at no expense to the Department. Core cracks for use by the Engineer in locations and to depths specified by the Engineer. Additional compensation or time will not be granted for coring when the Engineer determines the cause of concrete cracking to be the responsibility of the Contractor.

400-21.3 Classification of Cracks: The Engineer will classify cracks as either nonstructural or structural. In general, nonstructural cracks are cracks 1/2 inch or less deep from the surface of the concrete; however, the Engineer may determine that a crack greater than 1/2 inch deep is nonstructural. In general, structural cracks are cracks that extend deeper than 1/2 inch. As an exception, all cracks in concrete bridge decks that are supported by beams or girders will be classified as nonstructural and repair will be in accordance with 400-21.5.1. However, if the Engineer determines that repair under 400-21.5.1 is unacceptable, repair in accordance with 400-21.5.2.

A crack that is fully or partially underwater at any time during its service life will be classified as a structural crack unless the Environment note on the General Notes sheet in the

Plans categorizes the substructure as slightly aggressive, in which case, the nonstructural crack criteria may apply as determined by the Engineer.

Review and comment on the Engineer's crack classification; however, the Engineer will make the final determination.

400-21.4 Nonstructural Cracking Significance: The Engineer will determine the Cracking Significance. The Cracking Significance will be determined on the basis of total crack surface area as a percentage of total concrete surface area. Cracking significance will be categorized as Isolated, Occasional, Moderate or Severe according to the criteria in Tables 400-3 and 400-4. Cracking Significance will be determined on a LOT by LOT basis. A LOT will typically be made up of not more than 100 square feet and not less than 25 square feet of concrete surface area for structures other than bridge decks or typically not more than 400 square feet or not less than 100 square feet for bridge decks. A LOT will not extend beyond a single Elevation Range as shown in Table 400-3 or 400-4.

Review and comment on the Engineer's determination of Cracking Significance; however, the Engineer will make the final determination.

400-21.5 Repair Method: Repair or remove and replace cracked concrete as directed by the Engineer. Additional compensation or time will not be granted for repair or removal and replacement of cracked concrete when the Engineer determines the cause to be the responsibility of the Contractor.

400-21.5.1 Nonstructural Cracks: Repair each crack using the method as determined by the Engineer for each LOT in accordance with Table 400-3 or 400-4. When further investigation is required to determine repair or rejection, submit an Engineering Analysis Scope in accordance with 6-4, signed and sealed by a Specialty Engineer, to determine the strength and durability of the proposed repair. Upon approval of the Engineering Analysis Report (EAR) and final determination of the Engineer, repair or remove and replace the cracked concrete in accordance with the EAR.

400-21.5.2 Structural Cracks: Submit an Engineering Analysis Scope in accordance with 6-4, signed and sealed by the Contractor's Engineer of Record, to determine the strength and durability of the proposed repair. Upon approval of the EAR and final determination of the Engineer, repair or remove and replace the cracked concrete in accordance with the approved EAR.

Table 400-3
DISPOSITION OF CRACKED CONCRETE OTHER THAN BRIDGE DECKS
[see separate Key of Abbreviations and Footnotes for Tables 400-3 and 400-4]

Elev. Range	Crack Width Range (inch) (2) x = crack width	Cracking Significance Range per LOT (1)											
		Isolated Less than 0.005%			Occasional 0.005% to<0.017%			Moderate 0.017% to<0.029%			Severe 0.029% or gtr.		
		Environment Category											
		SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
Elevation: 0 to 6 ft AMHW	x ≤ 0.004	NT	NT	PS (6)	NT	PS (6)	PS (6)	PS (6)	PS (6)				
	0.004< x ≤ 0.008	NT	PS (6)	EI (3)	PS (6)	EI (3)	EI (3)	PS (6)					
	0.008< x ≤ 0.012	NT	PS (6)	EI									
	0.012< x ≤ 0.016	PS (6)	Investigate to Determine Appropriate Repair (4, 5) or Rejection										
	0.016< x ≤ 0.020												
	0.020< x ≤ 0.024									Reject and Replace			
	0.024< x ≤ 0.028												
	x > 0.028												
Elev.: More Than 6 ft to 12 ft AMHW	Crack Width	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
	x ≤ 0.004	NT	NT	PS (6)	NT	PS (6)	PS (6)	PS (6)	PS (6)	PS (6)	PS (6)		
	0.004< x ≤ 0.008	NT	PS (6)	EI (3)	PS (6)	PS (6)	EI (3)	PS (6)	EI (3)				
	0.008< x ≤ 0.012	NT	PS (6)	EI	EI	EI							
	0.012< x ≤ 0.016	PS (6)	EI	EI	EI								
	0.016< x ≤ 0.020	EI											
	0.020< x ≤ 0.024		Investigate to Determine Appropriate Repair (4, 5) or Rejection							Reject and Replace			
	0.024< x ≤ 0.028												
	x > 0.028												
Elev.: Over Land or More Than	Crack Width	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
	x ≤ 0.004	NT	NT	NT	NT	PS (6)	PS (6)	PS (6)	PS (6)	PS (6)	PS (6)		
	0.004< x ≤ 0.008	NT	PS (6)	PS (6)	PS (6)	PS (6)	EI (3)	PS (6)	EI (3)	EI (3)	PS (6)		

	$0.008 < x \leq 0.012$	NT	PS [6]	EI	EI	EI	EI	EI	EI				
	$0.012 < x \leq 0.016$	PS [6]	EI	EI	EI	EI	EI						
	$0.016 < x \leq 0.020$	EI	EI	EI	EI								
	$0.020 < x \leq 0.024$	EI	Investigate to Determine Appropriate Repair [4, 5] or Rejection										
	$0.024 < x \leq 0.028$										Reject and Replace		
	$x > 0.028$												

Table 400-4
DISPOSITION OF CRACKED CONCRETE BRIDGE DECKS
[see separate Key of Abbreviations and Footnotes for Tables 400-3 and 400-4]

Elev. Range	Crack Width Range (inch) [2] x = crack width	Cracking Significance Range per LOT [1]											
		Isolated less than 0.005%			Occasional 0.005% to<0.017%			Moderate 0.017% to<0.029%			Severe 0.029% or gtr.		
		Environment Category											
		SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
Elevation: 12 feet or Less AMHW	x ≤ 0.004	NT	NT	NT	NT	NT	NT	NT	NT	NT			
	0.004< x ≤ 0.008	NT	NT	EI/M	NT	NT	EI/M	EI/M	EI/M	EI/M			
	0.008< x ≤ 0.012	NT	NT	EI/M	NT	EI/M	EI/M	EI/M	EI/M				
	0.012< x ≤ 0.016	NT	NT	EI/M	NT	EI/M							
	0.016< x ≤ 0.020	EI/M	EI/M	EI	EI								
	0.020< x ≤ 0.024	EI/M	EI	EI	Investigate to Determine Appropriate Repair [4, 5] or Rejection						Reject and Replace		
	0.024< x ≤ 0.028	EI/M	EI										
	x > 0.028												
Elevation: Over Land or More Than 12 feet AMHW	Crack Width	SA	MA	EA	SA	MA	EA	SA	MA	EA	SA	MA	EA
	x ≤ 0.004	NT	NT	NT	NT	NT	NT	NT	NT	NT			
	0.004< x ≤ 0.008	NT	NT	NT	NT	NT	EI/M	NT	EI/M	EI/M			
	0.008< x ≤ 0.012	NT	NT	EI/M	NT	NT	EI/M	EI/M	EI/M				
	0.012< x ≤ 0.016	NT	NT	EI/M	NT	EI/M							
	0.016< x ≤ 0.020	NT	EI/M	EI	EI/M	Investigate to Determine Appropriate Repair [4, 5] or Rejection							
	0.020< x ≤ 0.024	NT	EI/M	EI							Reject and Replace		
	0.024< x ≤ 0.028	NT	EI/M										
	x > 0.028												

Key of Abbreviations and Footnotes for Tables 400-3 and 400-4		
Type Abbreviation	Abbreviation	Definition
Repair Method	EI	Epoxy Injection
	M	Methacrylate
	NT	No Treatment Required
	PS	Penetrant Sealer
Environment Category	EA	Extremely Aggressive
	MA	Moderately Aggressive
	SA	Slightly Aggressive
Reference Elevation	AMHW	Above Mean High Water

Footnotes

(1) Cracking Significance Range is determined by computing the ratio of Total Cracked Surface Area (TCSA) to Total Surface Area (TSA) per LOT in percent [(TCSA/TSA) x 100] then by identifying the Cracking Significance Range in which that value falls. TCSA is the sum of the surface areas of the individual cracks in the LOT. The surface area of an individual crack is determined by taking width measurements of the crack at 3 representative locations and then computing their average which is then multiplied by the crack length.

(2) Crack Width Range is determined by computing the width of an individual crack as computed in (1) above and then identifying the range in which that individual crack width falls.

(3) When the Engineer determines that a crack in the 0.004 inch to 0.008 inch width range cannot be injected then for Table 400-3 use penetrant sealer unless the surface is horizontal, in which case, use methacrylate if the manufacturer's recommendations allow it to be used and if it can be applied effectively as determined by the Engineer.

(4) (a) Perform epoxy injection of cracks in accordance with Section 411. Seal cracks with penetrant sealer or methacrylate as per Section 413. (b) Use only methacrylate or penetrant sealer that is compatible, according to manufacturer's recommendations, with previously applied materials such as curing compound or paint or remove such materials prior to application.

(5) When possible, prior to final acceptance of the project, seal cracks only after it has been determined that no additional growth will occur.

(6) Methacrylate shall be used on horizontal surfaces in lieu of penetrant sealer if the manufacturer's recommendations allow it to be used and if it can be applied effectively as determined by the Engineer.

(7) Unless directed otherwise by the Engineer, repair cracks in bridge decks only after the grinding and grooving required by 400-15.2.5 is fully complete.

400-22 Method of Measurement.

400-22.1 General: The quantities of concrete to be paid for will be the volume, in cubic yards, of each of the various classes shown in the Plans, in place, completed and accepted. The quantity of precast anchor beams to be paid for will be the number in place and accepted. The quantity of bridge deck grooving to be paid for will be the area, in square yards of bridge deck and approach slab, completed and accepted. The quantity of bridge deck grooving and planing to be paid for will be the area, in square yards of bridge deck and approach slab, completed and accepted.

Except for precast anchor beams, for any item of work constructed under this Section and for which measurement for payment is not to be made by the volume of concrete, measurement and payment for such work will be as specified in the Section under which the work is specified in detail.

No separate payment will be made for obtaining the required concrete finish.

400-22.2 Calculation of Volume of Concrete:

400-22.2.1 Dimensions: The quantity will be computed by the plan dimensions of the concrete, within the neat lines shown in the Plans, except that no deduction will be made for weep holes, deck drains, or encroachment of inlets and pipes in box culverts, and no chamfers, scorings, fillets, or radii 1 1/2 in^2 or less in cross-sectional area will be taken into account.

400-22.2.2 Pay Quantity: The quantity to be paid for will be the original plan quantity, measured as provided in 400-22.2.1.

400-22.2.3 Items not Included in Measurement for Payment: No measurements or other allowances will be made for work or material for forms, falsework, cofferdams, pumping, bracing, expansion-joint material, etc. The volume of all materials embedded in the concrete, such as structural steel, pile heads, etc., except reinforcing bars or mesh, will be deducted when computing the volume of concrete to be paid for. For each foot of timber pile embedded, 0.8 cubic feet of concrete will be deducted. The cost of furnishing and placing dowel bars shall be included in the Contract unit price for the concrete.

400-22.2.4 Deck Girders and Beam Spans: In computing the volume of concrete in deck girders and beam spans, the thickness of the slab will be taken as the nominal thickness shown on the drawings and the width will be taken as the horizontal distance measured across the roadway. The volume of haunches over beams will be included in the volume to be paid for.

400-22.2.5 Stay-in-Place Metal Forms: When using stay-in-place metal forms to form the slab of deck girder and beam spans, the volume of concrete will be computed in accordance with the provisions of 400-22.2.4 except that the thickness of the slab over the projected plan area of the stay-in-place metal forms will be taken as the thickness shown on the drawings above the top surface of the forms. The concrete required to fill the form flutes will not be included in the volume of concrete thus computed.

400-22.3 Bridge Deck Grooving: The quantity to be paid for will be plan quantity in square yards, computed, using the area bound by the gutter lines (at traffic railings, curbs and median dividers) and the beginning and end of the bridge or the end of approach slabs, whichever is applicable, constructed, in place and accepted.

400-22.4 Bridge Deck Grooving and Planing: The quantity to be paid for will be plan quantity in square yards, computed, using the area bound by the gutter lines (at traffic railings, curbs and median dividers) and the beginning and end of the bridge or the end of approach slabs, whichever is applicable, constructed, in place and accepted.

400-22.5 Composite and Plain Neoprene Bearing Pads: The quantity to be paid for will be the original plan quantity, computed using the dimensions of the pads shown in the Plans.

400-22.6 Cleaning and Coating Concrete Surfaces: The quantity to be paid for will be the plan quantity in square feet for the areas shown in the Plans.

400-23 Basis of Payment.

400-23.1 Concrete:

400-23.1.1 General: Price and payment will be full compensation for each of the various classes of concrete shown in the Contract Documents.

400-23.1.2 Concrete Placed below Plan Depth: Authorized concrete placed in seal or footings 5 feet or less below the elevation of bottom of seal or footing as shown in the Plans will be paid for at the Contract price set forth in the Contract Documents under the pay items for substructure concrete.

Authorized concrete used in seal (or in the substructure where no seal is used) at a depth greater than 5 feet below the bottom of seal or footing as shown in the Plans will be paid for as Unforeseeable Work.

Such payment will be full compensation for the cofferdam construction, for excavation, and for all other expenses caused by the lowering of the footings.

400-23.1.3 Seal Concrete Required but Not Shown in Plans: When seal concrete is required as provided in 400-8 and there is no seal concrete shown in the Plans, it will be paid for as Unforeseeable Work.

400-23.2 Precast Anchor Beams: Price and payment will be full compensation for the beams, including all reinforcing and materials necessary to complete the beams in place and accepted.

No separate prices will be allowed for the various types of anchor beams.

400-23.3 Reinforcing: Reinforcing bars, wires and mesh will be measured and paid for as provided in Section 415, except that no separate payment will be made for the welded wire reinforcement used in concrete jackets on steel piles or reinforcement contained in traffic railings, concrete barriers, traffic separators or parapets. Where so indicated in the Plans, the Department will not separately pay for reinforcing used in incidental concrete work, but the cost of such reinforcement shall be included in the Contract unit price for the concrete.

400-23.4 Bridge Deck Grooving: Price and payment will be full compensation for all grooving, equipment, labor, and material required to complete the work in an acceptable manner.

400-23.5 Bridge Deck Planing: Price and payment will be full compensation for all planing, equipment, labor, and material required to complete the work in an acceptable manner.

400-23.6 Composite and Plain Neoprene Bearing Pads: Price and payment will be full compensation for all work and materials required to complete installation of the pads, including sampling and testing.

400-23.7 Cleaning and Coating Concrete Surfaces: Price and payment will be full compensation for all work and materials required. The cost of coating new concrete will not be paid for separately, but will be included in the cost of the item to which it is applied.

400-23.8 General: The above prices and payments will be full compensation for all work specified in this Section, including all forms, falsework, joints, weep holes, drains, pipes, conduits, bearing pads, setting anchor bolts and dowels, surface finish, and cleaning up, as shown in the Plans or as directed. Where the Plans call for water stops, include the cost of the water stops in the Contract unit price for the concrete.

Unless payment is provided under a separate item in the Contract Documents, the above prices and payments will also include all clearing and grubbing; removal of existing structures; excavation, as provided in Section 125; and expansion joint angles and bolts.

The Department will not change the rate of payment for the various classes of concrete in which steel or FRP may be used due to the addition or reduction of reinforcing.

The Department will not make an allowance for cofferdams, pumping, bracing, or other materials or equipment not becoming a part of the finished structure. The Department will not pay for concrete placed outside the neat lines as shown in the Plans.

When using stay-in-place metal forms to form bridge decks, the forms, concrete required to fill the form flutes, attachments, supports, shoring, accessories, and all miscellaneous items or work required to install the forms shall be included in the Contract unit price of the superstructure concrete.

400-23.9 Payment Items:

Payment will be made under:

Item No. 400- 0-	Class NS Concrete – per cubic yard.
Item No. 400- 1-	Class I Concrete (Seal) - per cubic yard.
Item No. 400- 2-	Class II Concrete - per cubic yard.
Item No. 400- 3-	Class III Concrete - per cubic yard.
Item No. 400- 4-	Class IV Concrete - per cubic yard.
Item No. 400- 6-	Precast Anchor Beams - each.
Item No. 400- 7-	Bridge Deck Grooving - per square yard.

Item No. 400- 8-	Class V Concrete - per cubic yard.
Item No. 400- 9-	Bridge Deck Planing - per square yard.
Item No. 400- 16-	Class VI Concrete - per cubic yard.
Item No. 400-143-	Cleaning and Coating Concrete Surfaces - per square foot.
Item No. 400-147-	Composite Neoprene Pads - per cubic foot.
Item No. 400-148-	Plain Neoprene Bearing Pads - per cubic foot.

SECTION 407
THREE-SIDED PRECAST CONCRETE CULVERT

407-1 Description.

Design and construct a three-sided precast concrete culvert for the three-sided concrete culvert structure shown in the Contract Documents. Three-sided precast concrete culverts are defined as monolithic arched segments, frame segments with vertical walls and either horizontal or arched top slabs, or three-sided proprietary precast concrete bridge systems.

Meet the requirements of 449-1.

407-2 Materials.

Ensure that the materials used for the construction of precast culverts have certification statements from each source, showing that they meet the applicable requirements of the following:

Portland Cement Concrete	Section 346
Reinforcing for Concrete	Section 415
Precast Concrete Drainage Products	Section 449
Riprap	Section 530
Coarse Aggregate*	Section 901
Fine Aggregate*	Section 902
Curing Materials	Section 925
Materials for Concrete Repair	Section 930
Non-Shrink Grout	Section 934
Geotextile Fabrics	Section 985
Mechanical Connection Steel*	Section 460
External Sealing Band Wrap	ASTM C877

*Use products listed on the Department's Approved Product List (APL).

**The gradation requirements of aggregates are not applicable when using dry-cast concrete.

407-3 Limitations on Use.

Do not use three-sided precast culverts in lieu of four-sided culverts described in Section 410, however they may be considered as a Cost Savings Initiative Proposal (CSIP) in accordance with Section 4. Provide the required Section 346 concrete class and concrete cover in accordance with the Structures Design Guideline for the environmental classification shown in the Plans for the culvert location. Do not use a three-sided precast culvert to extend the inlets of existing multi-cell culverts due to the potential for clogging with debris.

407-4 Materials Acceptance and Testing.

407-4.1 General: Meet concrete materials, testing, inspection, and acceptance requirements of Section 346, as modified herein:

Precast culverts are produced using certification-acceptance criteria; therefore, assume responsibility for performance of all quality control testing and inspections in accordance with Section 346.

Prepare, cure, and test the test cylinders in accordance with ASTM C31 and ASTM C39 test methods. Follow the alternative method of concrete compaction, in accordance with ASTM C497, if the consistency of concrete is too stiff for compaction by rodding or

internal vibrations. Expose shipping strength test cylinders to the same curing conditions as the precast concrete sections. The 28-day test cylinders shall be cured in accordance with Section 346.

Perform all concrete quality control testing and inspections in accordance with 346-9.2.

For training and other qualifications meet the requirements of Section 105. Test all QC samples for compressive strength in a laboratory meeting the requirements of Section 105.

407-4.2 Quality Assurance Inspection and Testing: The Engineer will perform periodic inspections, sampling, and testing to ensure of the quality and acceptability of the materials, methods, techniques, procedures and processes being utilized by the manufacturing facility in the fabrication of precast concrete culverts.

407-4.3 Special Requirements for Dry-Cast Concrete: Dry-cast concrete is defined as a very low slump concrete that requires continuous and intense vibration to compact the concrete, enabling immediate removal of the side forms without detrimental effects to the concrete when used in a dry-cast manufacturing process.

The target slump, air content ranges, and the plastic property tolerances in Section 346 are not applicable to dry-cast concrete.

Perform absorption tests on specimens from each LOT of dry-cast production in accordance with the test methods in ASTM C497. The absorption of each specimen must not exceed 9.0% of the dry mass for Test Method A procedure or 8.5% for Test Method B procedure. All specimens must be free of visible cracks and must represent the full thickness of the product. Test specimens after 28 days of standard curing or prior to the date of shipping if the precast concrete culvert sections are to be shipped before the completion of the 28-day curing period.

Core three specimens for Test Method B in accordance with ASTM C42 and meet the sampling location and size requirements of ASTM C497. Prepare or core a minimum of one specimen for Test Method A in accordance with the test cylinder requirements of ASTM C497. When the initial absorption specimen from a concrete culvert section fails to conform to the requirements of this Section, the absorption test may be made on another specimen from the same culvert section and the results of the retest may be substituted for the original test results for acceptance of the LOT. The manufacturer may test each concrete culvert section within a LOT and cull the culvert sections not meeting absorption requirements marking them as deficient with waterproof paint or other approved means. Deficient culvert sections must not be shipped to the project site. Reduce the frequency of absorption tests to one test every five LOTs when the results of five consecutive LOTs meet the specified limit.

407-5 Design Requirements.

Provide a design that complies with the requirements of the AASHTO LRFD Bridge Design Specifications and the Structures Design Guidelines. Perform a bridge load rating in accordance with the Structures Design Guidelines, for any design with a total span equal to or greater than 20 feet, when measured between the inside face of end supports, along the centerline of the roadway crossing. Submit design calculations, shop drawings and load rating for approval in accordance with Section 5. Ensure that the Contractor's Engineer of Record performs the design of the precast culvert and signs and seals the design plans, calculations and load rating. When the channel lining design is not provided in the Contract Documents or must be

redesigned, submit a hydraulic analysis and scour evaluation, signed and sealed, by the Contractor's Engineer of Record.

Line the channel between footings with either a 6 inch minimum thick cast-in-place reinforced concrete slab with a 30 inch minimum depth toe wall at the inlet and outlet end of the structure, or a blanket of revetment designed in accordance with the Department Drainage Manual. Use lining designed to withstand the hydraulic forces and extend the lining a minimum of 10 feet beyond the ends of the structure. A riprap rubble ditch lining with a minimum thickness of 18 inches will be permitted if the flow velocity corresponding to the Design Flood Scour Event does not exceed five feet per second. Filter fabric must be used in conjunction with any revetment in accordance with Section 985. Design and construct the connection between the revetment or concrete slab and the culvert footing, to prevent the migration of soil through the connection.

Ensure that the bottoms of spread footings are a minimum of 30 inches below the bottom of the channel lining.

407-6 Other Elements of a Precast Culvert System.

Extend reinforcing from precast sections to provide adequate splice lengths or utilize a mechanical rebar splicing system (steel reinforcing only) listed on the Department's Approved Product List (APL) for securing reinforcing dowels for cast-in-place headwalls and wingwalls. Precast headwalls, wingwalls and culvert footings are permitted. Precast culvert footings must span a minimum of three culvert units and provide shear connections between adjacent units with keyed joints or cast-in-place closure sections. Precast footings under wingwalls are not permitted.

Submit all connection details for precast elements to the Engineer for approval. All mechanical connections must be galvanized in accordance with 962-7 or Type 316 (UNS S31600) stainless steel, except in extremely aggressive environments only Type 316L (UNS 31603) stainless steel is permitted for welded connections and Type 316 stainless steel for non-welded shapes and fasteners.

Unless otherwise addressed in the Plans, bedding material and compaction requirements for wingwalls and toe walls shall be the same as required for the footing in 407-12, except that the granular material may be placed to the inside edge of the toe wall.

All requirements of Section 400 and Section 415 apply to the fabrication of cast-in-place elements.

407-7 Fabrication.

407-7.1 Casting: Cast precast elements in unyielding beds and forms. Ensure bearing surfaces in casting forms are level and straight, and vertical surfaces are plumb prior to casting. Ensure surfaces within the forms, against which concrete will be cast, are clean and free from rust and hardened residual concrete. Provide full concrete cover clearance to all form wires and other miscellaneous pieces of metal, except as permitted by Section 415. Bend all tie wires away from the form surface to provide maximum concrete cover. Provide inserts and lifting devices in accordance with 450-9.2.1.

407-7.2 Surface Finish: Finish the precast elements in accordance with 400-15.1.

407-7.3 Curing: Perform the curing by any method prescribed in Sections 400 and 450, or by any other Department approved alternative curing method included in the manufacturer's QC Plan, or combinations thereof that have provided satisfactory results.

407-7.4 Fabrication Tolerances:

407-7.4.1 Internal Dimensions: Ensure the internal dimensions do not vary more than one percent or two inches, whichever is less, from the design dimensions, with a maximum of 3/4 inches. The haunch dimensions shall not vary more than 3/4 inches from the design dimensions.

407-7.4.2 Slab and Wall Thickness: Ensure the slab and wall thicknesses are not less than that shown in the design Plans or approved shop drawings by more than five percent or 1/2 inches, whichever is greater. A thickness more than that required in the design will not be a cause for rejection.

407-7.4.3 Length of Opposite Surfaces: Ensure the variations in laying lengths of two opposite surfaces of the culvert segments are not more than 3/4 inch, except where beveled ends for laying curves, or skewed ends are specified by the Engineer.

407-7.4.4 Length of Section: Ensure the underrun in length of segments is not more than 1/8 inch per foot of length with a maximum of 1/2 inch in any culvert segment. The total underrun in length of the in-place precast culvert must not be less than 3 inches from the design length.

407-7.4.5 Tongue and Groove Joints or Ends: Ensure the planes formed by the ends of precast culvert sections do not vary perpendicular from the joint axis by more than 3/8 inches for internal spans or heights less than 15 feet, or more than 1/2 inches for internal spans or heights of 15 feet or greater.

407-7.4.6 Position of Reinforcement: Meet the requirements of 415-5.10.2 for the maximum variation in the position of slab steel. Meet the requirements of 415-5.8.2 for the maximum variation of the wall steel, except that the concrete cover must not be less than 1/4 inches nor more than 1/2 inches from the design dimensions.

407-7.4.7 Area of Reinforcement: Provide the area of reinforcement as indicated in the Plans or approved shop drawings as a minimum. If welded wire reinforcement is utilized in lieu of mild steel reinforcement, the provisions of 415-6 shall apply. Reinforcing steel areas greater than specified in the shop drawings will be acceptable when the reinforcing spacing is equal or less than specified in the shop drawings. Substitution of mild steel or welded wire reinforcement for fiber reinforced polymer (FRP) reinforcing, or vice versa, is not permitted.

407-7.5 Removal of Forms: Remove forms after the concrete has attained the minimum compressive strength requirements in the Producer QC Plan, but not less than 2500 psi. Products manufactured with dry-cast concrete, are exempt from this requirement.

407-7.6 Lifting and Removal from Casting Area: Handle all products, including those manufactured by the dry-cast process, upon the concrete attaining sufficient compressive strength as determined by the manufacturer and included as part of the Producer QC Plan, but not less than 2500 psi. Limit the flexural stresses from handling to three times the square root of the specified 28-day strength.

407-8 Joints.

Produce precast units with keyways at the adjoining surfaces or with butt joints between adjacent units. In the keyways, use a non-shrink grout listed on the APL. Design and construct the adjoining surfaces so that when placed together, they make a continuous line of units with a smooth interior free of appreciable irregularities within the permissible variations given in Section 11 of ASTM C1504. Seal all joints between precast units with a bituminous seal or low modulus silicone sealant listed on the APL, and provide an external sealing band in accordance with ASTM C877 along the outside of the joint. Determine the minimum width of sealing bands by substituting the larger of the clear rise or span of the precast concrete box section, for the

equivalent pipe diameter in ASTM C877 Tables 1 and 2. Install external sealing band wrap in accordance with the manufacturer's instructions. Cover the external sealing band with a strip of filter fabric adhered to the precast unit. Ensure that the filter fabric strip is a minimum of 24 inches wide and meets the requirements of Section 985. Obtain the Engineer's approval of the adhesive used. Exercise care during backfilling to prevent damage to the filter fabric.

Construct headwalls, wingwalls, and other special features in place or as detailed on the shop drawings. Leave sufficient steel exposed or utilize a mechanical rebar splicing system listed on the APL, in end units for connection of headwalls, wingwalls and other cast-in-place sections.

407-9 Handling, Storage, and Shipping.

Handle, store, and ship precast culverts in a manner that prevents chipping, cracks, fractures, and excessive bending stress. Do not ship precast culverts to the project site prior to the completion of the 72-hour curing period and attainment of the required 28-day compressive strength.

The manufacturer is permitted to verify the shipping strength test, before 28 days, by testing compressive strength cylinders that are cured under conditions similar to the product or by testing temperature match cured cylinders. The manufacturer may use the maturity method, ASTM C1074, pulse velocity method in accordance with ASTM C597, or any other approved nondestructive test method to estimate the strength of concrete for determining form removal and handling strengths or before verification of shipping strength by test cylinders.

Curing temperature and cycle must be monitored on a minimum of one precast culvert curing cell from each day of production when nondestructive test methods or temperature match cured cylinders are used to determine concrete strengths.

The shipping strength test is the average compressive strength of two test cylinders. Do not ship any products until the QC Manager's stamp is affixed to the product.

407-10 Repairs and Rejection.

Evaluate cracks, spalls and other deficiencies in accordance with 450-12, except that cracks will be classified in accordance with 400-21. Classify fractures and cracks passing through the wall or slab, except for a single end crack that does not exceed the depth of the joint, as structural cracks. Repair nonstructural cracks in accordance with 400-21 (substructure requirements), and all other deficiencies in accordance with 450-13 or the plant's approved repair methods that are included as part of the Producer QC Plan. Ensure that the original performance and durability of the repaired precast culverts are maintained.

Use materials for concrete repair that will meet or exceed the strength requirement of the class of concrete used. Materials meeting the requirements of Section 930 may be substituted for non-shrink grout when required by 450-13. Precast culvert elements are subject to rejection if they fail to conform to any of the specification requirements after repair or when damaged ends would prevent making a satisfactory joint.

407-11 Marking.

Clearly mark indelibly the following information on the interior of each precast unit by indention, water proof paint, or other approved method as described in the producer QC Plan: three sided structure span, rise, maximum and minimum design earth cover, skew angle, date of manufacture, serial number, project number, and name or trademark of manufacturer.

407-12 Construction Requirements.

Prior to constructing the footing, prepare the bearing soil in accordance with Section 455 for spread footings. If a precast concrete footing is used, prepare a 4-inch-thick layer of compacted granular bedding material to a minimum width of 12 inches outside the footing width and meet the density requirements of 125-9.2. Provide bedding material in accordance with Standard Plans, Index 120-001 select material, with not more than 15% fines passing the No. 200 U.S. Standard sieve, or other granular material approved by the Engineer.

Accomplish all footing construction in dry or dewatered excavations, as defined in 455-29. When coarse aggregate is approved for use as an alternate bedding or foundation backfill material, fully wrap the coarse aggregate with a layer of Type D-4 geotextile filter fabric, as specified in Section 985. At each end of any concrete slab channel lining, substitute the coarse aggregate with select material within four feet of toe walls.

Form a 3 inches deep key in the top surface of the footing 4 inches wider than the wall thickness. Ensure that footings reach a compressive strength of 3,000 psi before placing precast units.

Place the units as shown in the shop drawings. Carefully set the structure to the true line and grade. Set the units in a bed of mortar placed in the keyway in the top of the footing. Fill the keyway with mortar, and float the mortar flush with the top of the footing or use shims between the footer and culvert during setting, then inject non-shrink grout under the culvert walls. Seal blockouts and holes provided for lifting or joint restraint by using an epoxy mortar or non-shrink grout in accordance with Sections 926 or 934.

Carefully place backfill against the filter fabric and joint seal to avoid damage to the material. Use mechanical tampers or approved compacting equipment to compact all backfill and embankment immediately adjacent to each side of the structure. Place the backfill within 4 feet of each side of the structure in lifts of 8 inches or less (loose depth). Do not operate heavy compaction equipment within 4 feet of the structure. Ensure that the backfill elevation differential between both sides of the structure does not exceed 24 inches. Backfill behind wingwalls in accordance with Section 125. Carry backfill in front of wingwalls to the finished grade surface shown in the Plans.

407-13 Shop Drawings.

Submit details of all precast culvert elements and modifications to cast-in-place elements for approval to the Engineer prior to manufacturing in accordance with 5-1.4. These shop drawings must include the proposed layout, full reinforcing details, lifting devices, a note describing the casting method for the precast culverts and full details of any modifications to cast-in-place elements and any connections. All details must be submitted as a complete package including modifications to cast-in-place elements.

407-14 Method of Measurement.

The quantity to be paid for will be the plan quantity at the price bid for the sum of the items shown in the Contract Documents. The length of precast culvert is measured along the centerline of the structure, from the outside face of the headwalls at each end. No increase in length will be permitted for multiple barrel precast culvert installations or extension of precast culverts ends to avoid skewed end conditions.

407-15 Basis of Payment.

Price and payment will be full compensation for all work and materials specified in this Section necessary to complete the structure, including dewatering, excavation, channel excavation, channel lining, backfilling, footings, headwalls, wingwalls, toe walls and other miscellaneous items.

Payment will be made under:

Item No. 407- 1- Precast Three-Sided Culvert - per foot.

SECTION 410
PRECAST CONCRETE BOX CULVERT

410-1 Description.

Provide precast four-sided concrete box culverts as an alternative to the structure shown in the Contract Documents. Only monolithic segments, or two-piece segments with three-sided bottom sections and a simple support top slab section, are permitted. Two-piece segments are limited to installations with a minimum of two feet fill height above the top slab.

Construct headwalls, wingwalls and other special features using cast-in-place concrete. Precast wingwalls, cut-off walls or headwalls are not permitted unless otherwise noted in the Contract Documents.

Meet the requirements in 449-1.

410-2 Materials.

Ensure that the materials used for the construction of precast box culverts have certification statements from each source, showing that they meet the applicable requirements of the following:

Portland Cement Concrete	Section 346
Reinforcing for Concrete	Section 415
Precast Concrete Drainage Products	Section 449
Wire for Site Cage Machines	Section 931
Coarse Aggregate*	Section 901
Fine Aggregate*	Section 902
Curing Materials for Concrete	Section 925
Materials For Concrete Repair**	Section 930
Non-Shrink Grout**	Section 934
Liner Repair Systems	Section 948
Joint Materials	ASTM C443, ASTM C877 or ASTM C990
Geotextile Fabrics	Section 985

* The gradation requirements of aggregates are not applicable when using dry-cast concrete.

** Use products listed on the Department's Approved Product List (APL).

410-3 Materials Acceptance and Testing of Precast Box Culverts.

410-3.1 General: Meet the requirements of Section 346, except as modified herein:

Prepare, cure, and test the test cylinders in accordance with ASTM C31 and ASTM C39 test methods. Follow the alternative method of compaction, in accordance with ASTM C497, if the consistency of concrete is too stiff for compaction by rodding or internal vibrations. Expose shipping strength test cylinders to the same curing conditions as the precast concrete box sections.

Perform all concrete quality control testing and inspections in accordance with 346-9.2.

For training and other qualifications meet the requirements of Section 105. Test all QC samples for compressive strength in a laboratory meeting the requirements of Section 105.

410-3.2 Quality Assurance Inspection and Testing: The Engineer will perform periodic inspections, sampling, and testing to ensure of the quality and acceptability of the materials, methods, techniques, procedures and processes being utilized by the manufacturing facility in the fabrication of precast concrete box culverts.

410-3.3 Special Requirements for Dry-Cast Concrete: Dry-cast concrete is defined as a very low slump concrete that requires continuous and intense vibration to compact the concrete, enabling immediate removal of the side forms without detrimental effects to the concrete when used in a dry-cast manufacturing process.

The target slump, air content ranges, and the plastic property tolerances of Section 346 are not applicable to dry-cast concrete.

Perform absorption tests on specimens from each LOT of dry-cast production in accordance with the test methods in ASTM C497. The absorption of each specimen must not exceed 9.0 percent of the dry mass for Test Method A procedure or 8.5 percent for Test Method B procedure. All specimens must be free of visible cracks and must represent the full thickness of the product. Test specimens after 28 days of standard curing, or prior to the date of shipping if the precast box sections are to be shipped before the completion of the 28 day curing period.

Core three specimens for Test Method B in accordance with ASTM C42 and meet the sampling location and size requirements of ASTM C497. Prepare or core a minimum of one specimen for Test Method A in accordance with the test cylinder requirements of ASTM C497. When the initial absorption specimen from a concrete box section fails to conform to this Specification, the absorption test may be made on another specimen from the same box section and the results of the retest may be substituted for the original test results for acceptance of the LOT. The manufacturer may test each box section within a LOT and cull the box sections not meeting absorption requirements marking them as deficient with waterproof paint or other approved means. Deficient box sections must not be shipped to the project site. Reduce the frequency of absorption tests to one test every five LOTs when the results of five consecutive LOTs meet the specified limit.

410-4 Design of Precast Concrete Box Sections.

410-4.1 General: In lieu of a cast-in-place concrete box section or if specified in the Contract Documents, provide precast box culverts in accordance with Standard Plans, Index 400-291 and the following:

Segment lengths must be between 4 feet and 16 feet. Short-side wall lengths for end segments of skewed culverts, may be less than 4 feet when approved by the Engineer.

Provide tongue and groove joints at the ends of segments. For two-piece box culvert segments, provide keyed joints for the top slab-to-wall connection to prevent lateral displacement at the top of the walls, and double-sided tongue and groove joints in the bottom slab to minimize differential settlement between segments. Alternate methods to prevent differential settlement may be used when included in the Contract Documents or approved by the Engineer. Concrete cover at the joints may be reduced from the nominal cover shown in the Contract Documents, in accordance with the Standard Plans, but not less than 1 inch clear to the ends or inside mating surfaces of the joints or 1-1/2 inches clear to the outside surface of the joint for slightly and moderately aggressive environments, or 2 inches clear to the outside surface for extremely aggressive environments.

Meet one of the following design options:

410-4.1.1 Equivalent to Cast-In-Place Designs: Provide precast box segments identical to the plan details, including reinforcing steel grade or FRP reinforcing type, sizes and spacings, concrete cover, concrete class, and slab and wall dimensions. Reinforcing bar sizes and spacings may be reduced provided the equivalent area of reinforcing is provided in each layer. Haunch dimensions may be increased with the approval of the Engineer, but not greater than 8 inches for box culverts with internal spans less than 6 feet, or 12 inches for box culverts with larger internal spans.

410-4.1.2 Standard Precast Designs: Provide precast box segments in accordance with Standard Plans, Index 400-292 with the same hydraulic opening, fill height and reinforcing bar cover as shown in the Plans, for the most critical design loading combination. Perform a bridge load rating in accordance with the Structures Design Guidelines, for any multiple barrel culverts with a total span equal to or greater than 20 feet, when measured between the inside face of end supports, along the centerline of the roadway crossing.

410-4.1.3 Modified or Special Designs: Submit Modified Designs which differ from the standard precast designs in 410-4.1.2 with modifications to the wall and slab thickness haunch dimensions, or the use of FRP reinforcing. Submit Special Designs for sizes, elements and loads other than those referenced in 410-4.1.2. Redesign box culverts using the same AASHTO design specification, live load, hydraulic opening, fill height, minimum concrete class and concrete cover as shown in the Contract Documents. Special Designs will be required for all two-piece concrete box culvert segments. Provide a minimum member thickness not less than 75% of the thickness of the corresponding member of an equivalent Standard Plans, Index 400-292 box culvert, but not less than 7 inches for culverts with 2 inch concrete cover or 8 inches for 3 inch concrete cover. Perform a bridge load rating in accordance with the Structures Design Guidelines, for any redesign with a total span equal to or greater than 20 feet, when measure between the inside face of end supports, along the centerline of the roadway crossing.

410-4.2 Design Submittals: Submit shop drawings for all design options in accordance with 410-12. Submit design calculations, revised plans and load rating when required for approval in accordance with Section 5 for Modified or Special Designs. Ensure that a Specialty Engineer performs the design for Modified Designs of the box culvert and signs and seals the calculations.

Ensure that the Contractor's Engineer of Record performs any bridge load rating and the design for any Special Designs and signs and seals the revised plans, calculations and load rating.

410-5 Other Elements of a Precast Box Culvert System.

Extend reinforcing from precast sections to provide adequate splice lengths or utilize a mechanical rebar splicing system (steel reinforcing only) listed on the Department's Approved Product List (APL) for securing reinforcing dowels for headwalls, toe walls and wingwalls.

Cast all elements of the headwalls and wingwalls (footing and stem) in-place, unless otherwise noted in the Contract Documents. Cast all cut-off or toe walls for precast box end segments in-place only. Extend the depth of cut-off or toe walls an additional 6 inches with the limits of the bedding material. Bedding material and compaction requirements for wingwalls are the same as required for precast box sections, except that the granular material may be placed to the inside edge of the toe wall, unless otherwise specified in the Contract Documents. Bedding material is not required for cast-in-place wingwall footings.

All requirements of Section 400 and Section 415 apply to the fabrication of these elements. Backfill the locations behind the walls in accordance with the requirements of Section 125.

410-6 Fabrication.

410-6.1 Casting: Cast precast elements in unyielding beds and forms. Ensure bearing surfaces in casting forms are level and straight, and vertical surfaces are plumb prior to casting. Ensure surfaces within the forms against which concrete will be cast, are clean and free from rust and hardened residual concrete. Provide full concrete cover clearance to all form wires and other miscellaneous pieces of metal, except as permitted by Section 415. Bend all tie wires away from the form surface to provide maximum concrete cover. Provide inserts and lifting devices in accordance with 450-9.2.1.

410-6.2 Surface Finish: Finish the precast elements in accordance with 400-15.1.

410-6.3 Curing: Perform the curing by any method prescribed in Sections 400 and 450, or by any other Department approved alternate curing method included in the approved Producer QC Plan, or combinations thereof that have provided satisfactory results.

410-6.4 Fabrication Tolerances:

410-6.4.1 Internal Dimensions: Ensure the internal dimensions do not vary more than 1% from the design dimensions, with a maximum of 3/4 inch. Ensure the haunch dimensions do not vary more than 1/4 inch from the design dimensions.

410-6.4.2 Slab and Wall Thickness: Ensure the slab and wall thickness are not less than that shown in the Plans or approved shop drawings by more than 5 percent or 3/16 inch, whichever is greater. A thickness more than that required in the design will not be a cause for rejection although payment will be for plan quantity only.

410-6.4.3 Length of Opposite Surfaces: Ensure the variations in laying lengths of two opposite surfaces of the box section are not more than 1/8 inch per foot of clear span, with a maximum of 5/8 inches for precast boxes with a clear span of up to 7 feet and a maximum of 3/4 inches for boxes with a clear span greater than 7 feet. The exception to this is when beveled ends, for the purpose of laying curves, or skewed ends are specified by the Engineer.

410-6.4.4 Length of Section: Ensure the under run in length of sections is not more than 1/8 inch per foot of length with a maximum of 1/2 inches in any box section.

410-6.4.5 Tongue and Groove Joints or Ends: Ensure the planes formed by the ends of box sections do not vary perpendicular from the joint axis by more than the following:

1. Profiled Rubber Gasket Joints (ASTM C1677): 1/8 inch per foot of internal span with a maximum 5/8 inches for internal spans or heights less than or equal to 7 feet, and a maximum of 3/4 inches for internal spans greater than 7 feet.
2. Preformed Flexible Joints (ASTM C990): 1/4 inches for internal spans or heights less than 5 feet, or more than 3/8 inches for internal spans or heights of 5 feet or greater.

410-6.4.6 Position of Reinforcement: Meet the requirements of 415-5.10.2 for the maximum variation in the position of slab reinforcing. Meet the requirements of 415-5.8.2 for the maximum variation of wall reinforcing, except that the concrete cover must not be less than 1/4 inches nor more than 1/2 inches from the design dimensions.

410-6.4.7 Area of Reinforcement: Provide the area of reinforcement as indicated in the Plans or approved shop drawings as a minimum. If welded wire reinforcement is utilized in lieu of mild steel reinforcement, the provisions of 415-6 apply.

410-6.5 Removal of Forms: Remove forms after the concrete has attained the minimum compressive strength requirements included as part of the Producer QC Plan, but not less than the following:

Table 410-1	
Vertically cast walls and slabs for four-sided sections	1,000 psi
Three-sided box culvert bottom section	2,500 psi
Horizontally cast self-supporting slabs or walls	2,500 psi

Products manufactured with dry-cast concrete, are exempt from these requirements.

410-6.6 Lifting and Removal From Casting Area: Handle all products, including those manufactured with dry-cast concrete, after the concrete attains sufficient compressive strength as determined by the manufacturer but not less than the following, unless otherwise approved in the Producer QC Plan:

Table 410-2	
Vertically cast and stored elements (walls and slabs)	1,000 psi
Form/pallet supported elements (walls or slabs)	1,000 psi
Self-supporting four-sided sections	1,000 psi
Self-supporting horizontal slabs or three-sided sections	2,500 psi

Limit the flexural tension stresses from handling to a maximum allowable stress of three times the square root of the concrete compressive strength in psi, prior to the concrete attaining the required 28-day strength.

410-7 Handling, Storage, and Shipping.

Handle, store, and ship precast box culverts in a manner that prevents chipping, cracks, fractures, and excessive bending stress. Do not ship precast box culverts before the concrete attains the required 28-day strength.

The manufacturer is permitted to verify the shipping strength test, before 28 days, by testing compressive strength cylinders that are cured under the conditions similar to the product or by testing temperature match cured cylinders. The manufacturer may use the maturity method, ASTM C 1074, pulse velocity method in accordance with ASTM C 597, or any other approved nondestructive test method to estimate the strength of concrete for determining form removal and handling strengths or before verification of shipping strength by test cylinders.

Curing temperature and cycle must be monitored on a minimum of one box culvert curing cell from each day of production when nondestructive test methods or temperature match cured cylinders are used to determine concrete strengths.

The shipping strength test is the average compressive strength of two test cylinders. Do not ship any products until the QC Manager's stamp is affixed to the product.

410-8 Repairs and Rejection.

Evaluate cracks, spalls and other deficiencies in accordance with 450-12. Classify fractures and cracks passing through the wall or slab, except for a single end crack with a length that does not exceed the depth of the joint, as major cracks. Walls and slab areas outside the

middle half of the internal span will be considered non-critical locations for the purpose of evaluating cracks. Repair cracks and all other deficiencies in accordance with 450-13 or the plant's approved repair methods that are included as part of the Producer QC Plan. Ensure that the original performance and durability of the repaired box culverts are maintained.

Use materials for concrete repair that will meet or exceed the strength requirement of the class of concrete used. Materials meeting the requirements of Section 930 may be substituted for non-shrink grout when required by 450-13. Precast box culvert elements are subject to rejection if they fail to conform to any of the Specification requirements after repair or when damaged ends would prevent making a satisfactory joint.

410-9 Marking.

Ensure each section of Precast Box Culvert has permanently and clear marking on an inside face by indentation, waterproof paint, or as specified in the Producer QC Plan, showing the manufacture date, serial number, project number, and manufacturer's name or symbol. The top of the box culvert must also be clearly indicated with waterproof paint or as specified in the Producer QC Plan.

410-10 Trench, Foundation, Laying, and Backfill.

410-10.1 General: Meet the requirements of Section 125 and/or Section 121, for trench excavation, foundation construction, laying and backfilling and the following:

Lay all precast box culvert sections on a dry, slightly yielding foundation, to ensure uniform bearing across the full width of the bottom slab. Provide dewatering devices, if applicable, in accordance with 455-29, capable of maintaining a stable and surface-dry trench bottom. Construct any temporary sheet piling used in cofferdams, retaining walls and to incorporate the Contractor's specific means and methods, in accordance with 125-3.

410-10.2 Bedding: Provide bedding that consists of a minimum 6 inch depth of select material, with not more than 15% fines passing the No. 200 U.S. Standard sieve, in accordance with Standard Plans, Index 120-001 or other granular material approved by the Engineer. Place bedding in maximum 6 inch compacted layers below the culvert to a minimum width of 12 inches outside the exterior walls of the culvert and meet the density requirements of 125-9.2. When coarse aggregate is approved for use as an alternate bedding material, wrap the bottom and sides of the coarse aggregate with a layer of Type D-4 geotextile filter fabric as specified in Section 985, and substituted the coarse aggregate with select material within 4 feet of the cut-off or toe walls at each end of the precast box culvert. Obtain the Engineer's approval before using flowable fill for bedding material. Provide other special bedding material, when required by the Contract Documents.

Set grade forms 12 inches outside each exterior wall of the box culvert. Uniformly compact this material and then grade off using the forms. Set the grade forms approximately 1/8 inches to 1/4 inches above the theoretical grade line to allow for soil compression. Adjust this distance to yield the proper grade, but do not use in lieu of the proper compaction of the granular bedding material. Remove the forms after placing the precast box culvert section.

410-10.3 Placement of Precast Box Culvert Sections: Obtain the Engineer's approval of the method of controlling line and grade during culvert installation. Use a method that allows rapid checking of the previously laid sections. Maintain line and grade on sections previously set. The Engineer will consider sections which do not retain the plan line within 0.10 foot or grade within 0.10 foot during laying of subsequent sections, as not having been laid to line and grade. Take up and relay sections not to line and grade without additional compensation.

410-10.4 Placement of Multiple Barrel Culverts: For multiple barrel installations using single-cell precast box sections, provide positive lateral support between the precast box culverts consisting of non-shrink grout, concrete meeting the requirements of Section 347 or non-excavatable flowable fill prior to backfilling. Provide partial height backfill or bracing to maintain alignment, when approved by the Engineer.

410-10.5 Backfilling: Begin backfilling only after the Engineers approval. Seal blockouts and holes provided for lifting or joint restraint by plugging using an epoxy mortar or non-shrink grout in accordance with Sections 926 or 934 and properly cure to ensure a sound and watertight plug, prior to backfilling.

410-10.6 Underdrain and Weep Holes: Provide a continuous underdrain in accordance with Standard Plans, Index 400-289.

410-11 Joints.

410-11.1 General: Make field joints for precast concrete box culvert sections with either profile rubber gaskets or preformed joint sealants, unless otherwise detailed in the Plans or approved shop drawings. Joint openings at the outside face must not exceed 1-1/2 inches in the assembled position at any location along the joint perimeter. Ensure a minimum 50% overlap of the joint tongue and groove around the entire perimeter of the box in the assembled position.

Completely wrap the outside of each joint with Type D-3 geotextile filter fabric as specified in Section 985. Provide fabric with a minimum width of 2 feet and a length sufficient to ensure a minimum overlap of 24 inches. The filter fabric must extend a minimum of 12 inches beyond each side of the joint. Secure the fabric tightly against the box culvert sections with metal or plastic strapping. Other methods which will hold the fabric securely against the wall of the culvert until the backfill is placed and compacted, may be used when approved by the Engineer. When specified in the Plans, secure the joint by a suitable device capable of holding the sections to line and grade as well as fully home. Remove these devices and repair locations as necessary if intrusive into the concrete after placing and compacting sufficient backfill to secure the sections.

410-11.2 Profile Rubber Gaskets: Install field joints in accordance with the joint manufacturer's instructions and meet the following:

1. Meet the requirements of ASTM C1677,
2. Store all gaskets in a cool place prior to use,
3. Submit to the Engineer written details regarding configuration of the joint and gasket required to create a soil-tight seal. Do not apply mortar, joint compound or other filler which would restrict the flexibility of the joint.

410-11.3 Preformed Flexible Joint Sealants: Install field joints in accordance with the joint manufacturer's instructions and meet the following:

1. Meet the requirements of ASTM C990,
2. Submit to the Engineer a written recommendation of the size (cross-sectional area) of joint sealant which will create a soil-tight seal. Ensure that this amount is the minimum quantity of bitumen sealant used. Do not brush or wipe joint surfaces which are to be in contact with the joint sealant with cement slurry. Fill minor voids with non-shrink grout,
3. Thoroughly clean and dry all joint surfaces which are to be in contact with the sealant material. When recommended by the sealant manufacturer, apply a primer of the type recommended to all joint surfaces which are to be in contact with the sealant material.

4. Apply sealant to form a continuous seal around each joint. The sealant must be protected by a removable wrapper. Do not remove the paper wrapper on the exterior surface of the preformed flexible joint sealant until immediately prior to joining the precast sections. Apply the joint sealant only to dry surfaces. When the atmospheric temperature is below 60°F, either store the joint sealant in an area above 70°F, or artificially warm the joint sealant to 70°F in a manner satisfactory to the Engineer. After assembly, ensure that there is full contact and compression of the sealant for the entire perimeter of the joint, as evidenced by the presence of minor bulging along any visible edges of the sealant. Neatly trim any extruded sealant flush with the concrete surface.

410-11.4 Water-tight Joint Treatment: Provide water-tight joints when shown in the Contract Documents. Utilize an external sealing band in accordance with ASTM C877 in addition to the requirements of 410-11.2 or 410-11.3. Determine the minimum width of sealing bands by substituting the larger of the clear rise or span of the precast concrete box section, for the equivalent pipe diameter in ASTM C877 Tables 1 and 2. Install external sealing band wrap in accordance with the manufacturer's instructions prior to wrapping the joint with geotextile filter fabric.

410-12 Shop Drawings.

Submit details of all precast box culvert elements for approval to the Engineer prior to manufacturing in accordance with 5-1.4. These shop drawings must include the proposed layout, lifting devices, and a note describing the casting method for the precast box culverts and details of any modifications to cast-in-place sections or connections thereto. All details must be submitted as a complete package including modifications to cast-in-place sections.

410-13 Method of Measurement.

The quantity to be paid for will be plan quantity for the structure shown in the Contract Documents in accordance with 400-22 and 415-7.

410-14 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including the cost of special bedding material and its placement, additional cut-off or toe wall depth, temporary sheet piling, graded forms, joint materials, filter fabric material, attachment of the filter fabric, dewatering, excavation, channel excavation and lining, backfilling, restraining devices and any other materials or equipment necessary to make a complete and accepted installation.

Payment will be made under pay items for concrete (culverts), reinforcing steel (roadway), and FRP reinforcing.

SECTION 411
EPOXY INJECTION OF CRACKS IN CONCRETE STRUCTURES

411-1 Description.

Inject epoxy into cracks in portland cement concrete.

411-2 Materials.

Meet the requirements of Section 926 and as follows:

Use Type E compound epoxy for injection.

Use Type F-1 compound epoxy for sealing crack surfaces in preparation for injection.

Use epoxy materials listed on the Department's Approved Product List (APL).

411-3 Equipment.

For the equipment used to inject the epoxy, meet the recommendations of the epoxy injection material manufacturer and the following requirements:

1. Use equipment that has the capacity to automatically proportion the material components within the mix ratio tolerances set by the epoxy materials manufacturer.

2. Use equipment that has the capacity to automatically mix the epoxy component materials within the pump and injection apparatus. The Engineer will not allow batch mixing.

3. Use equipment that has the capacity to inject the epoxy resin under controlled variable pressures up to 200 psi, with a pressure gauge mounted at or near the nozzle to indicate the actual working pressure.

411-4 Injection Personnel Qualifications.

Employ personnel trained in performing injection work similar to that required for the project to carry out the epoxy injection of cracks in concrete. Provide an on-site supervisor for the epoxy injection work who is qualified by one of the following methods:

1. Certified by the manufacturer of the epoxy injection material as having the necessary competence to accomplish the epoxy injection work in a satisfactory and safe manner in compliance with these Specifications.

2. They can furnish documented evidence that they have a minimum of three years experience of on-site supervision of similar epoxy injection work and a list of five contracts in which similar epoxy injection was acceptably completed. Ensure that the listed experience in on-site supervision and completed contracts contains the project name and location, names of contracting parties, the owner's name, brief description of the work, and dates of completion of the epoxy injection work.

Submit written evidence showing personnel training and the on-site supervisor's qualification to the Department prior to beginning any epoxy injection work.

411-5 Crack Surface Preparation and Cleaning Requirements.

Clean the area surrounding the cracks of all deteriorated concrete, efflorescence and other contaminants detrimental to the adhesion of the surface sealing epoxy compound. Clean the interiors of the cracks with air under sufficient pressure to remove loose materials entrapped within the crack including efflorescence.