PROJECT SPECIAL PROVISIONS

Roadway 7-1-95

SP1R01

CLEARING AND GRUBBING: **9-17-02**

Perform clearing on this project to the limits established by Method "III" shown on Standard No. 200.03 of the Roadway Standards.

The 2002 Standard Specifications shall be revised as follows:

Page 2-3, Article 200-5

Delete the first sentence of this article and insert the following:

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

SP2R01

SOIL NAIL RETAINING WALL:

1. General

The work under this section shall consist of design, plan preparation, and construction of soil nail retaining wall to the lines and grades shown in the plans and in accordance with these specifications.

Disturbance to the terrain or vegetation behind the wall will not be allowed, unless unclassified excavation is shown on the plans.

Soil nailing shall consist of excavating in lifts, drilling holes into the ground, placing and grouting the nail tendons in the holes, placing geocomposite drain strips and installing weep holes, applying temporary shotcrete facing, installing the nail head anchorage assembly, and constructing the permanent cast-in-place concrete facing (including the single-faced concrete barrier).

The term "Soil Nail" as used in this special provision is intended as a generic term and refers to a reinforcing bar grouted into a drilled hole installed in any type of ground including soil, weathered rock, and hard rock.

The Contractor shall be experienced in the construction of permanent soil nail retaining walls and have successfully constructed at least 3 projects in the last 3 years involving construction of permanent soil nail retaining walls totaling at least 11,000 square feet (1,000 square meters) of wall face area and at least 500 permanent soil nails.

A professional engineer registered in the state of North Carolina employed by the soil nailing Contractor and having experience in the construction of at least 3 completed permanent soil nail retaining wall projects over the past 3 years, shall supervise the work. The Contractor shall not use manufacturers' representatives to satisfy the supervising Engineer requirements of this section.

The Contractor shall also submit the experience qualifications and details for the referenced design and construction projects, including a brief project description with the owner's name and current phone number. The Engineer will have 15 calendar days to approve or reject the proposed soil nailing Contractor and Designer.

The Contractor is advised to review all available subsurface information and conduct additional investigations, as needed, to determine subsurface conditions such as high groundwater, unstable soil, hard rock, etc. that would adversely affect the cost of construction.

The Contractor shall submit 5 copies of plans and calculations to the Engineer for review and approval and shall allow 40 calendar days from the date they are received until the Engineer returns them.

A pre-construction meeting shall be held before the start of the work and shall be attended by representatives of the Contractor, Resident Engineer, and the Geotechnical Engineering Unit. Soil nailing requires organized coordination of each of these parties. The pre-construction meeting shall be conducted to clarify the construction requirements, to provide appropriate scheduling of the construction activities and to identify contractual relationships and responsibilities.

2. Design Criteria and Plan Requirements

Design and construction of the soil nail wall shall be in accordance with the Service Load Design (SLD) procedures contained in the FHWA "Manual for Design and Construction Monitoring of Soil Nail Walls", Report No. FHWA-SA-96-069 and the Soil Nailing Field Inspectors Manual, Publication No. FHWA-SA-93-068. The required partial safety factors, allowable strength factors and minimum global stability soil factors of safety shall be in accordance with the FHWA manual, unless specified otherwise. Estimated soil/rock design shear strength parameters, slope and external surcharge loads, type of wall facing and facing architectural requirements, soil nail corrosion protection requirements, known utility locations, easements, and right-of-ways will be as shown on the "Layout Drawings" or specified herein. Structural design of any individual wall elements not covered in the FHWA manual shall be by the service load or load factor design methods in conformance with Article 3.22 and other appropriate articles of the latest Edition of the AASHTO Standard Specifications for Highway Bridges including current interim specifications.

Calculations and details for the cast-in-place concrete facing shall be included in the soil nail wall package. The cast-in-place concrete facing shall be a minimum 8 inches in thickness. A minimum 6-inch thick by 1-foot wide unreinforced concrete leveling pad is required for the cast-in-place facing.

Temporary shotcrete facing is required and shall be a minimum of 4 inches in thickness and reinforced with welded wire and #4 bars running horizontally above and below the nails and behind the bearing plates.

Geocomposite drainage mats at minimum 10-foot centers are required.

A minimum nail inclination of 12 degrees shall be employed. The nail holes shall be a minimum of 6 inches and a maximum of 10 inches in diameter. Minimum clearance from end of soil nail to bottom of nail hole shall be 6 inches.

The wall shall be embedded a minimum of 2 feet below the proposed finished bottom of wall grade.

Nails shall not extend beyond the Right of Way or easement line.

The plans shall include but shall not be limited to the following:

Elevation views showing all nail locations, proposed ground line elevations and stations, proposed leveling pad elevations, and construction joint locations.
Plan views
Section views showing shotcrete and concrete reinforcement, vertical nail locations, nail inclinations, drainage details, etc.
Details of nail head anchorage assemblies, nail holes, drainage mats, etc.
Verification test nail locations and required design adhesion values.
Construction sequence

A professional engineer registered in the state of North Carolina shall seal all plans and design calculations.

3. Quality Assurance

The Contractor's superintendent shall have a minimum of three years experience and the drill operators and on-site supervisors shall have a minimum of one-year experience installing permanent soil nails or ground anchors. Before starting the work, the Contractor shall submit a list identifying the superintendent, drill rig operators, and on-site supervisors assigned to the project. The list shall contain a summary of each individual's experience, and shall be sufficiently complete for the Engineer to evaluate the individual qualifications. The Contractor shall not use consultants or manufacturer's representatives to satisfy the requirements of this section.

All nozzlemen shall have at least one year of continuous experience in similar shotcrete application work and shall demonstrate ability to satisfactorily place the material in accordance with the recommendations of ACI 506.3R Guide to Certification of Shotcrete Nozzlemen. The proposed nozzlemen shall present evidence that they have been certified to the requirements of ACI 506.3R within the last five years.

Work shall not be started nor materials ordered until the Contractor's personnel qualifications have been approved by the Engineer. The Engineer may suspend the work if the Contractor substitutes non-approved personnel for approved personnel. The Contractor shall be fully liable for costs resulting from the suspension of work, and no adjustments in the contract time resulting from the work suspension will be allowed.

4. Construction Submittals

The Contractor shall provide the following submittals for the Engineer's review and approval. Changes or deviations from the approved submittals must be re-submitted for approval by the Engineer. The Contractor will not be allowed to begin wall construction until all submittal requirements are satisfied and found acceptable to the Engineer. No adjustments in contract time will be allowed due to incomplete submittals. Items listed below that have been included on the contractor prepared plans need not be resubmitted.

At least 30 days before initiating the work, the Contractor shall submit the following to the Engineer:

Proposed schedule and detailed soil nail retaining wall construction sequences including access arrangements and detailed descriptions of all the equipment proposed for the project.

b. Methods of excavation to the staged lifts indicated in the plans and excavation equipment types.

c. Drilling methods and equipment.

d. Nail grout mix design including:
Brand and type of Portland cement.
Source, gradation, and quality of all aggregates.
Proportions of mix by weight
Compressive strength test results (per AASHTO T106) verifying the required minimum seven day grout compressive strengths, or previous test results completed within one year of the start of the work may be submitted for verification of the required compressive strength.

e. Nail grout placement procedures and equipment.

f. Soil nail testing methods and equipment including:
Details of the jacking frame and appurtenant bracing.
Details showing methods of isolating test nails during shotcrete application (i.e., methods to prevent bonding of the soil nail bar and the shotcrete).
Details showing methods of grouting the unbounded length of test nails after completion of testing.
Equipment list.

g. Identification number and certified calibration records for each load cell, test jack pressure gauge, and jack master pressure gauge to be used. Calibration records shall include the date tested, device identification number, and the calibration test results and

shall be certified for an accuracy of at least two percent of the applied certification loads by a qualified independent testing laboratory within 30 days before submittal.

h. Certified mill test results for nail bars together with properly marked samples from each heat specifying the ultimate strength, yield strength, elongation and composition.

i. Certifications of compliance for bearing plates and nuts.

j. A detailed construction dewatering plan addressing all elements necessary to divert, control, and dispose of surface water.

k. Certified concrete and shotcrete mix designs including:
Brand and type of Portland cement used.
Source, gradation and quality of aggregates as specified herein.
Proportions of mix by weight.
Proposed admixture, manufacturer, dosage, technical literature if allowed.
Compressive strength test results verifying the 3-day and 28-day compressive strengths.

l. Certified mill tests for all reinforcing steel together with properly marked samples from each heat specifying the minimum ultimate strength, yield strength, elongation and composition.

m. Complete engineering data for the drainage geotextile and geocomposite drain strip including a 1-ft square sample, manufacturers' certificate of compliance, and installation instructions.

n. Certifications of Compliance for weep hole drainage pipes and curing compounds (if used).

o. Specification and data for review on equipment proposed for the project including the shotcreting and compressed air equipment.

5. Materials

All materials shall conform to the requirements of the applicable sections of the Standard Specifications for Roads and Bridges of the North Carolina Department of Transportation and the following provisions:

Centralizers: PVC pipe or tube, steel, or other material not detrimental to the nail steel (wood shall not be used); securely attached to the nail bar; sized to position the nail bar within 1 inch of the center of the drill hole; sized to allow tremie pipe insertion to the bottom of the drill hole; and sized to allow grout to freely flow up the drill hole.

Nail Grout: Neat grout shall be used with a minimum seven-day compressive strength of 3000 psi per AASHTO T106 and a minimum cement of nine sacks per cubic yard.

Cement: Portland Cement conforming to AASHTO M85 Type I, II, or III.

Fine Aggregate: Clean, natural sand, AASHTO M6. Artificial or manufactured sand will not be accepted.

Coarse Aggregate: AASHTO M-80, Class B for quality.

Water: Potable, clean and free from substances deleterious to concrete and steel or elements that would cause staining.

Chemical Admixtures: ASTM C1141 and the following:

Accelerator: Fluid type, applied at nozzle, meeting requirements of ASTM D98, C494 Types C or E, and C266.

Water-reducer and Superplastisizer: AASHTO M-194, Type A, D, F, or G.

Air-Entraining Agent: AASHTO M-154.

Plasticizers: AASHTO M-194, Type A, D, F, or G.

Mineral Admixtures:

Fly Ash: AASHTO M-295, Type F or C.

Silica Fume: ASTM C1240, 90 percent minimum silicon dioxide solids content, not to exceed 12 percent by weight of cement.

Reinforcing Bars: AASHTO M-31, Grade 60 or 75, deformed. See Section 1070 of the Standard Specifications.

Welded Wire: AASHTO M55/ASTM A185 or A497.

Curing Compounds: AASHTO M-148, Type ID of Type 2.

Prepackaged Concrete: ASTM C928.

Excavation Face Protection: AASHTO M-171 or Polyethylene film.

Solid Bar Nails: AASHTO M31, Grade 60 or 75, threaded steel bars without splices or welds. All bars shall be new, straight, undamaged, and epoxy coated.

Epoxy Coating:	AASHTO M284. Minimum 12 mils electrostatically applied. Bend test requirements shall be waived.
Encapsulation:	Minimum 40 mils (0.040 inch) thick corrugated HDPE tubing conforming to AASHTO M252 or corrugated PVC tube conforming to ASTM 1784, Class 13464-B. Encapsulation shall provide at least 0.2 inches grout cover over the nail bar and be resistant to ultra violet light degradation, normal handling stresses, and grouting pressures. Factory fabrication of encapsulation is preferred. Upon the Engineers approval, the encapsulation may be field fabricated if done in strict accordance with the manufacturer's recommendations.
Bearing Plates:	AASHTO M183 steel plates Bearing plates shall be furnished by the nail bar manufacturer.
Nuts:	AASHTO M291, Grade B, hexagonal fitted with beveled washer or spherical seat to provide uniform bearing. Nuts shall be furnished by the nail bar manufacture.
Washer:	AASHTO M291 steel.
Joint Filler & Sealant:	Section 1028 of the Standard Specifications.
Geocomposite Drain:	Miradrain 6200 or Equal.
Weep Hole:	ASTM 1785 Schedule 40 PVC, solid and perforated wall.
Drainage Pipe:	Cell classification 12454-B or 12354-C, wall thickness SDR 35, with solvent weld or elastomeric gasket joints.
Fittings:	ASTM D3034, cell classification 12454-B or 12454-C, wall thickness SDR 35, with solvent weld or elastomeric gasket joints.

6. Handling and Storage

All steel reinforcement items and nail steel shall be carefully handled and shall be stored on supports to prevent contact with the ground. Damage to the nail steel as a result of abrasion, cuts or nicks, welds and weld spatter shall be cause for rejection. Grounding of welding leads to the nail steel will not be allowed. Nail steel shall be protected from dirt, rust, and other deleterious substances at all times. Corrosion or pitting of the nails will be cause for rejection. Any epoxy coated nails that are damaged or defective in a manner that adversely affects the strength or serviceability of the unit shall be repaired to the satisfaction of the Engineer or rejected and removed from the site by the Contractor at no additional cost to the Department. Epoxy coating shall be repaired using an epoxy field repair kit approved by the epoxy manufacturer.

Encapsulated nails shall be handled in a manner that does not crack or otherwise damage the grout inside the sheath.

Drainage geotextile and geocomposite drains shall be provided in rolls wrapped with a protective covering and stored in a manner which protects the fabric from mud, dust, dirt, debris, and shotcrete rebound. Protective wrapping shall not be removed until the geotextile or drain strip is installed. Extended exposure to ultra-violet light shall be avoided. Each roll of geotextile or drain strip in the shipment shall be labeled to identify that production run.

Cement shall be adequately stored to prevent moisture degradation and partial hydration. Cement that is caked or lumpy shall not be used.

7. Dewatering and Damage Control

Localized areas of perched water may be encountered at the interface of geologic units. The Contractor shall contact the Engineer if groundwater problems persist at the excavation face.

The Contractor shall provide all labor, equipment, and materials required to maintain the work area in a sufficiently dry condition such that adverse water related effects do not occur during the construction period. The Contractor shall provide positive control and discharge of all surface water and perched ground water, if encountered, to the extent necessary to prevent adverse conditions as determined by the Engineer.

Damage caused by failure of the construction dewatering and drainage control plan to existing structures, soils, or structures included in the work shall be repaired by the Contractor to the Engineer's satisfaction at no additional cost to the Department.

The Contractor shall be responsible for the condition of any pipe or conduit which may be used for temporary construction dewatering, and all such pipes or conduits shall be maintained clean and free of sediment during construction. Upon substantial completion of the work, construction dewatering conduits shall be removed from the site. Alternatively, construction dewatering conduits shall be fully grouted (abandoned) or left in a manner that protects the structure and all adjacent facilities from migration of fines through the conduit and potential ground loss.

All dewatering and drainage control cost shall be considered incidental to the work including horizontal drains and paved ditch (concrete) and shall be at no additional cost to the Department.

8. Excavation

8.1 Mass Grading

Overexcavating the original ground beyond the final wall face shall not be allowed. Should overexcavation beyond the final wall face occur as a result of the Contractor's operations, such overexcavation shall be restored by the Contractor using a method approved by the Engineer and at no additional cost to the Department.

Blasting will not be allowed anywhere on the project.

8.2 Wall Face Excavation

Excavation shall proceed from the top down in a staged horizontal lift sequence as shown in the plans. The excavated surface ("neat line") shall be within 1 inch of its plan location. The ground level in front of the wall face shall not be excavated more than 3 feet below the level of the row of nails to be installed in that lift. A lift shall not be excavated until nail installation, reinforced shotcrete placement and nail testing for the preceding lift are complete and acceptable to the Engineer. Before advancing the excavation, shotcrete and nail grout on the preceding lift shall have been cured for a minimum one-day and three days, respectively. After a lift is excavated, the cut surface shall be cleaned of all loose materials, mud, rebound, and other foreign material that could prevent or reduce shotcrete bond. The excavated vertical wall face should not be exposed for more than 24 hours for any reason.

The Contractor shall take all necessary measures to ensure that installed nails are not damaged during excavation. Nails damaged or disturbed during excavation shall be repaired or replaced by the Contractor to the satisfaction of the Engineer at no cost to the Department. Hardened nail grout protruding from the final wall excavation more than 2 inches shall be removed in a manner that prevents fracturing the grout at the nail head. Sledgehammer removal of the grout shall not be allowed. The use of hand held rock chippers is acceptable provided their use does not damage or disturb the remaining grout at the nail head, the nail bar, nor the surrounding exposed ground.

Excavation to the final wall face ("neat line") and application of the shotcrete shall be completed in the same work shift unless otherwise approved by the Engineer. The Engineer must approve extensions of the excavation face exposure period. The Contractor shall demonstrate for each material type at his own expense that the unsupported final excavation face will be stable over the proposed extension of the exposure period. Extensions to the face exposure period shall be periodically reviewed and may be revoked by the Engineer at his discretion. Risk of damage to existing structures or structures included in this work shall be borne by the Contractor where approval for extended face exposure period is granted by the Engineer. Where extension of the face exposure period is allowed, the Contractor shall provide and install polyethylene sheets (properly anchored to the top and bottom of the excavation) to reduce degradation of the cut face caused by changes in soil moisture, unless otherwise approved by the Engineer.

8.3 Wall Discontinuities

Where the Contractor's excavation and installation methods result in a discontinuous wall along any continuous nail row, the ends of the wall at the points of discontinuity shall be constructed to prevent sloughing or failure of the temporary slopes. The Contractor shall submit a plan for wall discontinuity construction sequencing and shoring to the Engineer for review and approval at least 30 days before starting work on the affected wall sections.

8.4 Protrusions and Voids

The Contractor shall remove all cobbles, boulders, rubble, or debris which are encountered at the soil face during excavation and which protrude from the soil face more than 2 inches into the design shotcrete thickness shown on the plans. Any overexcavations shall be backfilled with shotcrete. Any shotcrete used to fill voids created by the removal of cobbles and boulders or other obstructions shall be considered incidental to the shotcrete wall facing and no additional

payment will be made. Generally, rocky ground such as colluvium, hard rock, fills with boulders and weathered rock will be difficult to excavate on a neat line without leaving pockets and voids. The Contractor should evaluate the subsurface conditions in order to anticipate the total volume of shotcrete needed.

8.5 Excavation Face Instability

Raveling or local instability of the final wall face excavation due to the presence of groundwater, problematic soil conditions, equipment vibrations or other causes shall be brought to the immediate attention of the Engineer.

Unstable areas shall be temporarily stabilized by means of buttressing the exposed face with an earth berm or other methods acceptable to the Engineer. Work shall be suspended in unstable areas until remedial measures submitted by the Contractor and approved by the Engineer have successfully arrested facial instability.

Timber backing or lagging behind soil nail walls that are to remain in place and is greater than 1 inch total thickness shall be pressure treated with wood preservative for soil and fresh water use in accordance with AWPB LP-22 to a minimum retention 4 pounds per cubic foot. Wood preservative shall be Creosote, Creosote-Coal tar solution, Penta Chlorophenol, Copper Naphthenate, ammonia copper arsenate, ammoniacal, copper zinc arsenate, acid copper chromate, or chromated copper arsenate.

9. Nail Installation

9.1 Classification of Materials

No classification of drilled materials will be made except for identification purposes. Nail installation shall include the removal and subsequent handling of all materials encountered in drilling the holes to the required lengths.

9.2 Equipment

Drilling equipment shall be designated to drill straight and clean holes. The size and capability of drilling equipment shall be suitable for installation of nails as specified herein. This will include drill rigs with the capability of nail installation and grout placement through the drill casing or hollow-stem auger where drill hole stability cannot be maintained in open holes. Sufficient casing/auger lengths shall be available on site to maintain uninterrupted installation of soil nails. Where hard drilling conditions such as rock, cobbles, boulders, or obstructions are encountered, a down-hole, pneumatic hammer drill bit may be required to advance the nail holes.

9.3 Drilling

Each nail hole shall be drilled at the locations and to the lengths and minimum diameters indicated in the plans unless otherwise approved by the Engineer. Cuttings shall be removed from the holes using compressed air or by mechanical auger flights. Compressed air shall not be used where raveling or erodible conditions cause significant disturbance or voids to develop or where facial instability is induced. Water, drilling muds, or other fluids used to assist in cutting

removal shall not be allowed. At final penetration depth, the nail hole shall be thoroughly cleaned and made ready for examination by the Engineer before nail bar installation or placement of grout. No portion of the nail hole shall be left open for more than 60 minutes before grouting unless otherwise approved by the Engineer.

9.4 Nail Hole Support

The Contractor shall provide positive support of the hole during drilling as required to prevent excessive groundwater infiltration or sloughing and caving of the hole before nail insertion and/or grouting. Where caving and sloughing occurs, no further drilling shall be allowed until the Contractor selects a method that prevents ground movement. Holes shall be continuously supported by casing or alternate methods approved by the Engineer. Drilling fluids such as bentonite or water will not be allowed as a means of hole support. All additional installation material, and other costs due to casing holes shall be at no additional expense to the Department.

Casing shall be of steel construction and shall be of ample strength to withstand handling and installation stresses, grout pressure, and surrounding earth and groundwater pressures. Casings shall be removed as the grout is placed. The casing extraction may be facilitated by the use of a vibratory extractor, if required. During removal, the casing shall be continually aligned with the hole.

9.5 Optional Nail Installation Methods

Optional nail installation methods shall require approval by the Engineer in accordance with submittals. At the Contractor's option, the initial reinforced shotcrete layer may be installed before drilling nail holes provided that this construction sequence has been documented in a submittal and approved by the Engineer. The Contractor's documentation shall include calculations demonstrating the bearing plates are adequate to service the design loads and transfer the stress to the wall by neglecting the bearing area beneath the plate encompassed by the drill hole or block out.

9.6 Production Nails

No drilling or bar placement for production nails shall be allowed without prior written approval by the Engineer of the proposed drilling, installation and grouting methods. Only installation methods, which have been successfully verification-tested, will be approved for production nail installation. Methods, which fail to meet the verification and proof test acceptance criteria, shall be rejected. Methods that differ from those used during installation of verification nails shall require additional verification testing before approval; the Contractor at no additional cost to the Department shall complete installation and testing.

Nails shall be installed at the locations and to the lengths as shown in the plans or designated by the Engineer. Nails may be added, eliminated, or relocated as determined by the Engineer to accommodate actual field conditions.

Bar sizes and grades shall be provided for each nail hole as indicated in the plans. The bar shall be fitted with centralizers as shown in the plans and inserted into the drill hole to the required depth without difficulty and in such a manner as to prevent damage to the drill hole and

corrosion protection during installation. Where the bar cannot be completely inserted, the Contractor shall remove the bar and clean or redrill the hole to permit unobstructed installation. Partially installed bars shall not be driven or forced into the drill hole but shall be rejected. When open-hole drilling methods are being used, the Contractor shall have hole cleaning tools on-site suitable for cleaning drill holes along their full length just before bar insertion and/or grouting.

9.7 Grouting

The drill hole shall be grouted after installation of the nail bar. Grouting before insertion of the nail bar may be allowed provided neat grout without sand is used and the nail bar is immediately inserted through the grout to the specified design length without difficulty. Nails inserted in the grout that has taken set shall be rejected and replaced by the Contractor at no additional cost to the Department. No portion of the nail hole shall be left open for more than 60 minutes before grouting unless otherwise approved by the Engineer. The grout shall be injected at the lowest point of each drill hole through a grouting conduit and the hole filled in one continuous operation. Gravity flow of grout into the nail hole from the excavation face will not be allowed. Cold joints in the grout placement will not be allowed, except for proof test nails. The grout shall be pumped through a grout tremie pipe, casing, hollow-stem auger, or drill rods. The conduit delivering the grout shall be maintained at least 5 feet below the surface of the grout as the conduit is withdrawn. The grouting conduit shall be withdrawn at a slow and even rate as the nail hole is filled in a manner that prevents the creation of voids. A sufficient quantity of grout to fill the entire nail hole shall be available in delivery trucks or grout mixing/pumping plants when the first grout is placed in each nail hole. The Engineer shall record the quantity of grout and the grouting pressures.

If the grouting of any nail is suspended for more than 30 minutes before grouting is completed or if the quality of the grout placement results in a nail that does not satisfy any of the requirements specified herein, then the steel and grout shall be removed from the hole, disposed of, and replaced with fresh grout and undamaged steel at no additional cost to the Department.

9.7.1 Grout Testing

Nail grout shall have a minimum compressive strength of 3000 psi in seven days. Nail grout shall be tested in accordance with AASHTO T106 at a frequency no less than every 50 cubic yards of grout placed or once per week which ever comes first.

9.7.2 Grouting Equipment

The grout equipment shall produce a uniformly mixed grout free of lumpy and undispersed cement. A positive displacement grout pump shall be provided. The pump shall be equipped with a pressure gauge which can measure at least twice but no more than three times the intended grout pressure and a stroke counter (for piston-type grout pumps). Grout pumps without the specified pressure gauge and piston-type grout pumps without a stroke counter cannot be used. The grouting equipment shall be sized to enable the entire nail to be grouted in one continuous operation. The mixer shall be capable of continuously agitating the grout during usage.

9.8 Attachment of Bearing Plate and Nut

The bearing plate and nut shall be attached as shown in the plans. The plate shall be seated by hand wrench tightening the nut such that uniform contact with the shotcrete is achieved while the shotcrete is still plastic and before its initial set. Where uniform contact between the plate and the shotcrete cannot be provided, the plate shall be seated on a mortar pad to provide uniform support. Once the mortar pad has attained strength (minimum one day), the nut shall be hand wrench tightened.

Bearing plates that are damaged or defective as determined by the Engineer shall be replaced at no cost to the Department.

9.9 Test Nail Unbonded Length

Isolation of the nail bar tendon for production proof test nails is required to prevent bonding of the shotcrete to the nail bar. Isolation through the shotcrete facing shall be made in a manner that maintains the tolerances of reinforcing steel behind the bearing plate. Blockouts in the shotcrete that result in no reinforcing below the nail head shall not be allowed. Details of the method of test nail isolation through the shotcrete facing and the method by which the unbonded length of production proof test nails will be maintained during testing and grouted back after testing shall be submitted to the Engineer for approval.

10. Shotcreting

This work shall consist of furnishing all materials, equipment, tools and labor required for placing and securing geocomposite drainage material, weep holes and reinforced shotcrete for the soil nail wall. The work shall include preparatory trimming and cleaning of soil/rock surfaces and shotcrete cold joints for the soil nail wall shown in the plans.

Shotcrete shall comply with the requirements of ACI 506R, "Specification for Shotcrete", except as otherwise specified. Shotcrete shall consist of an application of one or more layers of mortar or concrete conveyed through a hose and pneumatically projected at a high velocity against a prepared surface.

Shotcrete may be produced by either a dry-mix or a wet-mix process. The wet-mix process consists of thoroughly mixing all the ingredients except accelerating admixtures but including the mixing water, introducing the mixture into the delivery equipment and delivering it, by positive displacement, to the nozzle. The wet-mix shotcrete shall then be air jetted from the nozzle at high velocity onto the surface. Dry-mix process is shotcrete without mixing water that is conveyed through the hose pneumatically and the mixing water is introduced at the nozzle. For additional descriptive information, the Contractor's attention is directed to ACI 506R.

10.1 Mix Design

No shotcrete admixture shall be used without the Engineer's approval. Admixtures used to entrain air, to reduce water-cement ratio, to retard or accelerate setting time, or to accelerate the development of strength shall be thoroughly mixed at the rate specified by the manufacturer unless specified otherwise. Accelerating additives shall be compatible with the cement used, be

non-corrosive to steel and shall not promote other detrimental effects such as cracking and excessive shrinkage. The maximum allowable chloride ion content of all ingredients shall not exceed 0.10% when tested to AASHTO T260.

10.1.1 Aggregate

Aggregate for shotcrete shall meet the strength and durability requirement of AASHTO M-80 and M-43 and shall meet the following gradation requirements:

Sieve Size	% Passing by Weight
1/2 inch	100
3/8 inch	90-100
No. 4	70-85
No. 8	50-70
No. 16	35-55
No. 30	20-35
No. 50	8-20
No. 100	2-10

10.1.2 Proportioning

Shotcrete shall be proportioned and delivered with the following minimum contents per cubic yard: Cement content shall be 658 pounds per cubic yard. Aggregate cement ratio shall not be more than 4.5 by weight. Water/cement ratio shall not be greater than 0.45. For wet-mix shotcrete the air content at delivery to the pump shall be in the range of 7 to 10 percent when tested in accordance with ASTM C231.

10.1.3 Strength Requirements

Shotcrete shall be proportioned to produce a mix capable of attaining 2000 psi compressive strength in three days and 5000 psi in 28 days. The average compressive strength of each set of three cores must be equal to or exceed 85 percent with no individual core less than 75 percent of the specified compressive strength.

10.1.4 Mixing and Batching

Aggregate and cement may be batched by weight or by volume in accordance with the requirements of ASTM C91 and ASTM C685, respectively. Mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity. Ready mix shotcrete shall comply with AASHTO M-157. Shotcrete shall be batched, delivered and placed within 90 minutes of mixing.

10.2 Field Quality Control

Both preconstruction and production shotcrete test panels will be required. Test panels shall not be disturbed within the first 24 hours. Test panels shall be field cured under conditions similar to those anticipated for the work.

Field control tests shall be performed by qualified personnel in the presence of the Engineer. The Contractor shall provide equipment, materials, and the services of one or more employees as necessary to obtain shotcrete cores for testing including construction of test panel boxes, field curing requirements and coring. The Department in accordance with ACI 506R will perform compressive strength testing. The frequency specified for test panels is approximate. A greater or lesser number of panels may be made as required by the Engineer.

Preconstruction and production test panels shall be 18 x 18 inches and a minimum of 4 inches thick.

Test reports that indicate unsatisfactory compressive shotcrete properties shall result in suspension of the crew responsible for the unsatisfactory specimens until they have demonstrated that they are capable of producing acceptable work, or until additional specimen have been submitted, tested, and proven satisfactory. Cost associated with field quality control testing including additional testing and lost production due to tests failing to meet the specifications shall be borne by the Contractor.

10.2.1 Preconstruction Test Panels

The Contractor shall furnish at least two preconstruction test panels for each proposed mixture being considered and for each shooting position to be encountered on the job, made by each application crew. Preconstruction test panels shall be made by each application crew using the equipment, materials, mixture proportions and procedures proposed for the job before the commencement of work.

Preconstruction test panels for plain shotcrete shall be in accordance with ACI 506.2 and the following:

1. One preconstruction test panel shall be of the maximum shotcrete thickness shown in the plans and shall include the maximum anticipated reinforcing congestion. Cores extracted from the test panel shall demonstrate encapsulation of the reinforcement and shall be equal to core grade two or better in accordance with ACI 506.2.

2. One preconstruction test panel shall be at least 4 inches thick and constructed without reinforcement for compressive strength testing.

3. The sides of the test panels shall be sloped at 45 degrees

10.2.2 Production Test Panels

The Contractor shall furnish at least one production test panel or, in lieu of production test panels, six 3-inch diameter cores from the shotcrete face for every 5000 square feet or 50 cubic yards of shotcrete placed, whichever is less. The production test panels shall be constructed simultaneously with the shotcrete facing installation at times designated by the Engineer.

10.2.3 Core Testing

At least six core samples shall be cut from each pre-construction test panel and production test panel at the frequency specified herein. Cores shall be soaked in water for at least 40 hours in accordance with AASHTO T24. Cores shall be at least 3 inches in diameter and shall have a minimum length to diameter ratio of one. When the length of a core is less than twice the diameter, apply the correction factors given in ASTM C42 to obtain the compressive strength of individual cores. Three cores shall be tested at 3-days, and three cores shall be tested at 28-days each for compressive strength testing.

Core holes in the wall shall be filled solid with patching mortar or shotcrete after cleaning and thoroughly dampening.

10.2.4 Visual Observation

A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements after they are covered will be considered an indication of insufficient cover of reinforcement, or poor application and probable voids. In this case the application of shotcrete shall be immediately suspended and the work carefully inspected by the Engineer. The Contractor shall implement and complete corrective measures before resuming the shotcrete operations.

The shotcrete procedure may be corrected by adjusting the nozzle distance and orientation perpendicular to the surface, adjusting the water content of the shotcrete mix or other means acceptable to the Engineer. The shotcreted surface shall be broomed and roughened if needed to ensure proper bond of subsequent layers.

10.3 Shotcrete Alignment Control

Alignment wires and/or thickness control pins shall be provided to establish shotcrete thickness and maintain a plain surface. The maximum distance between the wires on any surface shall be equal to the vertical nail spacing. The Contractor shall ensure that the alignment wires are tight, true to line, and placed to allow further tightening.

10.4 Surface Preparation

Before shotcrete the "birds beak" ungrouted zone above the nail grout at the face, the contractor shall remove all loose materials from the surface of the grout and prepare the joint in accordance with all requirements for joint construction specified herein.

The Contractor shall remove all loose materials and loose dried shotcrete from previous placement operations from all receiving surfaces by methods acceptable to the Engineer. The removal shall be accomplished in such a manner as not to loosen, crack, or shatter the surfaces to receive the shotcrete. Any surface material which, in the opinion of the Engineer, is so loosened or damaged shall be removed to a sufficient depth to provide a base that is suitable to receive the shotcrete. Material that loosens as the shotcrete is applied shall be removed. No shotcrete shall be placed on frozen surfaces.

10.5 Delivery and Application

A clean, dry, oil-free supply of compressed air sufficient for maintaining adequate nozzle velocity for all parts of the work shall be maintained at all times. The equipment shall be capable of delivering the premixed material accurately, uniformly, and continuously through the delivery hose. Thickness, methods of support, air pressure, and rate of placement of shotcrete shall be controlled to prevent sagging or sloughing of freshly applied shotcrete.

The shotcrete shall be applied from the lower part of the area upward to prevent accumulation of rebound on uncovered surfaces. Where shotcrete is used to complete the ungrouted zone of the nail drill hole near the face, the nozzle shall be positioned into the mouth of the drill hole to completely fill the void. Rebound shall not be worked back into the construction nor shall the rebound be salvaged. Rebound which does not fall clear of the working area shall be removed. The nozzle shall be held at a distance and at an angle approximately perpendicular to the working face so that rebound will be minimal and compaction will be maximized. The nozzle should be rotated steadily in a small circular pattern.

10.6 Defective Shotcrete

Surface defects shall be repaired as soon as possible after initial placement of the shotcrete. All shotcrete which lacks uniformity, which exhibits segregation, honeycombing, or lamination, or which contains any voids or sand pockets shall be removed and replaced with fresh shotcrete by the Contractor to the satisfaction of the Engineer.

10.7 Construction Joints

Construction joints shall be uniformly tapered toward the excavation face over a minimum distance equal to the thickness of the shotcrete layer. The surface of the nail grout at the face of the wall shall be cleaned and prepared to receive shotcrete in a manner equal to all other construction joints.

10.8 Finish

Shotcrete finish shall be either an undisturbed gun finish as applied from the nozzle or a screened finish. Shotcrete extending into the cast-in-place section beyond the tolerances specified herein shall be removed.

10.9 Climate

Shotcrete shall not be placed in cold weather unless adequately protected when the ambient temperature is below 40°F, and the shotcrete is likely to be subjected to freezing temperatures before gaining sufficient strength to avoid damage. Cold weather protection shall be maintained until the strength of the in-place shotcrete is greater then 750 psi. Cold weather protection shall include heating under tents, blankets or other means acceptable to the Engineer. Materials shall be heated in order that the temperature of the shotcrete, when deposited, shall be not less than 50°F or more than 90°F.

Shotcrete application shall also be suspended during high winds and heavy rains when in the opinion of the Engineer the quality of the application is not acceptable. Newly placed shotcrete exposed to rain that wash out cement or otherwise makes the shotcrete unacceptable to the Engineer shall be removed and replaced. The Contractor shall provided polyethylene sheeting or equivalent when adverse exposure to weathering is anticipated. Polyethylene film shall be adequately secured to the top and bottom of the excavation.

11. CIP Concrete Facing

Construction of the concrete facing shall conform to the requirements of Section 420 of the Standard Specifications, unless otherwise specified herein. The exposed face of the concrete facing shall be formed with acceptable forming system. A properly designed form bracing system to resist the lateral concrete pressure is required to keep the finished wall in good alignment. Formwork and Falsework System shall be approved by the Engineer before the beginning of any formwork.

The vertical face of the wall shall be plumb or have a back-batter no greater than two percent (2%) for the total height of the wall. No forward leaning of the wall in any magnitude will be allowed.

The concrete shall be delivered to the formed area by means of tremie or drop chute to prevent the formation of honeycomb. Concrete shall be placed in maximum three-foot lifts, and vibration shall not be used to move the concrete horizontally.

Internal vibrations shall be used, and no external vibrations shall be allowed. Vibrate one lift at a time and extend the vibrator to 6 to 12 inches into the preceding lift. After a momentary pause, withdraw the vibrator slowly, at a rate of one to two inches per second. Insert the vibrator at an interval of 12 to 18 inches and adjust the interval as necessary to insure the affected area of vibrator overlap by a few inches. Maintain a constant time lag from the time of concrete placement to the time of vibration application through the entire wall.

Patching as needed shall be accomplished with epoxy mortars or specially mixed grouts for patching. Concrete from subsequent placements shall not be used for patching. Patch may be recessed slightly, and smearing fill material on the surrounding finished surface should not be allowed. Light sand blasting shall be used to improve the appearance of the finished surface of the wall as directed by the Engineer.

After stripping and patching, the finished wall surface shall be applied as soon as possible with one coat of cure and seal compound. The cure and seal compound must be compatible with the form release compound.

12. Wall Drainage Network

The drainage network consists of installing prefabricated geocomposite drainage strips and weep hole drain pipes as shown in the plans or as directed by the Engineer. All elements of the drainage network shall be installed before shotcreting.

12.1 Geocomposite Drainage Strips

Geocomposite drain strips shall be installed as shown in the plans. Drain strips at construction joints shall be placed such that the joint is aligned as close as practical along the middle of the longitudinal axis of the drain strip.

The geocomposite drain strip shall be at least 12 inches wide and shall be secured to the cut face with the geotextile side against the ground before shotcreting. Securing pins shall be at least 8 inches long with a 1.5 inch diameter head and shall be installed on a minimum grid pattern of 24 inches on center. Drain strips shall be made continuous. Splices shall be made with a 12 inch minimum overlap such that the flow is not impeded.

When the drain strips cannot be secured tight against the excavation face, polyethylene film shall be placed over the drain edges to prevent excess shotcrete from entering the sides of the drain. Alternatively, the drains may be installed in 16 inch wide strips and the film omitted.

12.2 Weep Hole Drainage Pipes

Weep hole drainage pipes shall be installed at locations shown in the plans or as directed by the Engineer. The distance between each weep hole shall be no more than 10 feet. The pipes shall be lengths of solid PVC pipe installed to direct water from the geocomposite drain strips to the outside of the C.I.P. concrete facing. The pipes shall be connected to the drain strips by installing prefabricated drain grates in accordance with the drain strip manufacturer's recommendations. The joint between the drain grate and the drain strip and the drainage pipe shall be sealed to prevent shotcrete intrusion. Damage of the geocomposite drainage board which, in the opinion of the Engineer, may cause interruption in flow shall require installation of additional weep holes, at the Contractor's expense.

13. Nail Testing

Both verification and proof testing of the nails shall be required. The Contractor shall supply all material, equipment, and labor to perform the tests. The Engineer will collect all required data with the assistance of the Contractor. Testing of nails shall not be performed within three days of nail grout placement or shotcrete application, whichever occurs last.

Where temporary casing of the unbonded test length of test nails is provided, the casing shall be placed in a manner which precludes causing any reaction between the casing and the grouted zone of the nail and/or the stressing apparatus during nail testing.

13.1 Testing Equipment

Testing equipment shall include two dial or vernier gauges, a dial gauge support, jack and pressure gauge, master pressure gauge and a reaction frame.

A minimum of two dial or vernier gauges capable of measuring to 0.001 inch shall be available at the site to measure the nail movement. The dial gauges shall have a minimum stroke of 3 inches. The dial gauges shall be aligned within five degrees from the axis of the nail and shall be supported independent of the jacking set-up and the wall. A hydraulic jack and pump shall be used to apply the test load.

The jack and pressure gauge shall be calibrated by an independent testing laboratory as a unit. The pressure gauge shall be graduated in 1000 psi increments or less and shall have a range not exceeding twice the anticipated maximum pressure during testing unless otherwise approved by the Engineer. The pressure gauge shall be used to measure the applied load. The minimum ram travel of the jack shall not be less than 4 inches. The jack shall be capable of applying each load in less than one minute.

The jack shall be independently supported and centered over the nail so that the nail does not carry the weight of the jack. A calibrated master pressure gauge shall also be kept at the site. The master gauge shall be calibrated with the test jack and pressure gauge as a unit. The loads on the nails during the verification tests shall be monitored with both pressure gauge and electric load cell. The load cell shall be used to maintain constant load hold throughout the creep test. The Contractor shall provide recent calibration curves in accordance with submittals. The stressing equipment shall be placed over the nail in such a manner that the jack, bearing plates, load cell, and stressing anchorage are in alignment. The jack shall be positioned at the beginning of the test such that unloading and repositioning of the jack during the test will not be required.

The reaction frame shall be sufficiently rigid and of adequate dimension such that excessive deformation of the test apparatus requiring repositioning of any components does not occur. Where the reaction frame bears directly on the shotcrete, the reaction frame shall be designed to prevent fracture of the shotcrete. No part of the reaction frame shall bear within 6 inches of the edge of the test nail blockout unless otherwise approved by the Engineer.

13.2 Verification Testing

Verification testing shall be performed horizontally before procuring materials for or installation of production nails to verify the Contractor's installation methods, soil conditions, nail capacity, and design assumptions. Verification tests shall be performed within the limits of the work area. Three verification tests are required at locations approved by the Engineer. Additional verification tests shall be required where ground conditions differ from those shown in the plans.

Details of the verification testing arrangement including the method of distributing test load pressures to the excavation surface (reaction frame), test nail bar size and grade, grouted hole diameter and reaction plate dimensioning shall be developed by the Contractor and submitted to the Engineer for approval. All nail testing shall be made using the same equipment, methods, and hole diameter as planned for the production nails. Changes in the drilling or installation method may require additional verification testing as determined by the Engineer and shall be provided at no additional cost to the Department. The nails used for the verification tests shall be sacrificial and shall not be incorporated into the production nail schedule.

Test nails shall have both bonded and unbonded lengths. Before testing only the bonded length of the test nail shall be grouted. The unbonded length of the test nail shall be at least 5 feet unless otherwise approved by the Engineer. The bonded length of the test nail shall be based on the bar grade and size such that the allowable bar load is not exceeded, but shall not be less than 10 feet unless otherwise approved by the Engineer. The allowable bar load during testing shall not be greater than 80 percent of the ultimate strength of the steel for Grade 150 bars nor greater than 90 percent of the yield strength for Grade 60 or 75 bars. The minimum bond length of 10 feet may require larger or higher grade bars than the production nails in order to achieve 200% of the design load without overstressing the bar. The Contractor shall provide higher capacity bars instead of shortening the bond length too less than the minimum.

The verification test bonded length L_{BV} shall not exceed the test allowable bar load divided by two times the design adhesion value. The following equation shall be used for sizing the test nail bond length to avoid overstressing the verification nail bar:

$$L_{BV} \leq \frac{C f_y A_s}{2 A_D}$$

Where: L_{BV} = Maximum Verification Test Nail Bond Length (ft)
f_y = Bar Yield Stress (ksi)
A_s = Bar Area (in^2)
A_D = Design Adhesion (kips/ft)
C = 0.8 for Grade 150 Bar and 0.9 for Grade 60 and 75 Bars

The design load during testing shall be determined by the following equation:

$$DTL = L_B \times A_D$$

Where: DTL = Design Test Load
L_B = As-Built Bonded Test Length (ft)
A_D = Design Adhesion (kips/ft)

Verification test nails shall be incrementally loaded to twice the design test load (DTL) followed by unloading in accordance with the following schedule. The Engineer shall record the soil nail movements at each load and unload increment.

LOADING		UNLOADING	
LOAD	HOLD TIME	LOAD	HOLD TIME
AL	1 minute	1.75DTL	Until Stable
0.25DTL	10 minutes	1.50DTL	Until Stable
0.50DTL	10 minutes	1.25DTL	Until Stable
0.75DTL	10 minutes	1.00DTL	Until Stable
1.00DTL	10 minutes	0.75DTL	Until Stable
1.25DTL	10 minutes	0.50DTL	Until Stable
1.50DTL	60 minutes	0.25DTL	Until Stable
1.75DTL	10 minutes	AL	Until Stable
2.00DTL	10 minutes		

Each load increment shall be held for at least ten minutes. The verification test nail shall be monitored for creep at 1.50 DTL load increment. Nail movements during the creep portion of the test shall be measured and recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. Extended creep measurements may be required and shall be monitored as determined by the Engineer. All load increments shall be maintained within five percent of the intended load during the creep test by use of the load cell. The nail shall be unloaded in increments of 25 percent with deflection measurements recorded at each unload increment. Each unload increment shall be held only for a sufficient time to allow stabilization of the movement reading.

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed five percent of the design test load (DTL). Dial gauges should be "zeroed" after the alignment load has been applied.

13.3 Proof Testing

Proof testing shall be performed on at least five percent of the production nails in each shotcrete lift to verify the Contractor's methods and the design nail capacity. The Engineer shall determine the locations and number of these tests.

Proof test nails shall have both bonded and unbonded lengths. Before testing only the bonded length of the test nail shall be grouted. The unbonded length of the test nail shall be at least 5 ft. The bonded length of the test nail will be such that the allowable bar load is not exceeded but shall not be less than 10 feet unless otherwise approved by the Engineer. The allowable bar load shall not exceed 80 percent of the ultimate steel strength for Grade 150 bars and 90 percent of the yield strength for Grade 60 and 75 bars.

The proof test bonded length L_{BP} shall not exceed the test allowable bar load divided by 1.5 times the design adhesion value. The following equation shall be used for sizing the test nail bond length to avoid overstressing the production bar:

$$L_{BP} \leq \frac{C f_y A_s}{1.5 A_D}$$

Where: L_{BP} = Maximum Proof Test Nail Bond Length (ft)
f_y = Bar Yield Stress (ksi)
A_s = Bar Stress Area (ft^2)
A_D = Design Adhesion (kips/ft)
C = 0.8 for Grade 150 Bar and 0.9 for Grade 60 and 75 Bars

Proof tests shall be performed by incrementally loading the nail to 150 percent of the design test load. The design test load shall be determined as for verification test nails. The nail movement at each load shall be measured and recorded by the Engineer in the same manner as for verification test. The load shall be monitored by a pressure gauge with a sensitivity and range

meeting the requirements of pressure gauges used for verification test nails. At load increments other than maximum test load, the load shall be held long enough to obtain a stable reading. Incremental loading for proof tests shall be in accordance with the following schedule.

AL
0.25DTL
0.50DTL
0.75DTL
1.00DTL
1.50DTL

AL = Nail Alignment Load
DTL = Nail Design Test Load

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed five percent of the design load (DTL). Dial gauges should be "zeroed" after the alignment load has been applied.
All load increments shall be maintained within five percent of the intended load. Depending on performance, either 10 minute or 60 minute creep tests shall be performed at the maximum test load (1.50 DTL). The creep period shall start as soon as the maximum test load is applied and the nail movement shall be measured and recorded at 1, 2, 3, 5, 6, and 10 minutes. Where nail movement between one minute and 10 minutes exceeds 0.04 inch, the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 20, 30, 50, and 60 minutes.

13.4 Test Nail Acceptance

A test nail will be considered acceptable when:

1. For verification tests, a creep rate less than 0.08 inches per log cycle of time between the six and 60 minute readings is observed during creep testing and the rate is linear or decreasing throughout the creep test load hold period.

2. For proof tests: (a) a total creep less than 0.04 inches is observed between the one and 10 minute readings creep test or a creep rate less than 0.08 inches per log cycle of time is observed during the 60 minute creep test between six and 60 minute readings and; (b) the creep rate is linear or decreasing throughout the creep test load hold period.

3. The total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test nail unbonded length.

4. A pullout failure does not occur at the maximum test load. Pullout failure load is defined as the load at which attempts to increase the test load simply result in continued excessive pullout movement of the test nail. The pullout failure load shall be recorded as part of the test data.

Proof test nails may be incorporated into the production nail schedule provided that (1) the unbonded test length of the nail hole has not collapsed during testing, (2) the minimum required hole diameter has been maintained, (3) corrosion protection is provided, and (4) the test nail length is equal to or greater than the scheduled production nail length. Test nails meeting these requirements shall be completed by satisfactorily grouting the unbonded test length. Maintaining the unbonded test length for subsequent grouting is the Contractor's responsibility. If the unbonded test length of production proof test nails cannot be grouted subsequent to testing due to caving conditions or other reasons, the Contractor shall replace the test nail with a similar production nail to the satisfaction of the Engineer at no additional cost to the Department.

13.5 Test Nail Acceptance

13.5.1 Verification Test Nails

The Engineer shall evaluate the results of each verification test. Installation methods that do not satisfy the nail testing requirements shall be rejected. The Contractor shall propose alternative methods and install replacement verification test nails. Where the design adhesion is not attainable by reasonable means, the Engineer will revise the production nail schedule. The Contractor shall incorporate any increases in the quantity, the lengths or the diameters of nails required by the Engineer. Reasonable means shall be considered to include gravity grouted nails installed as specified herein to the minimum diameter shown in the plans or to a maximum diameter of 10 inches.

13.5.2 Proof Test Nails

The Engineer may require that the Contractor replace some or all of the installed production nails between the failed proof test nail and the adjacent passing proof test nail. Nails which fail in proof test shall be abandoned and replaced with new proof test nails. Also, the Engineer may require that additional proof testing be conducted to verify that adjacent nails have sufficient load carrying capacity. Modifications may be required which include installing additional test or production nails, installing longer production nails, increasing the drill hole diameter, or modifying the installation methods.

14. Tolerances

14.1 Soil Nails

Bars shall be centered within 1 inch of the center of the hole. Individual nails shall be positioned plus or minus 6 inches from the design locations shown in the plans unless otherwise directed by the Engineer. Location tolerances shall be considered applicable to only one nail and not accumulative over large wall areas. The nail inclination shall be plus or minus two degrees of that shown in the plans. The Contractor shall use a magnetic angle-indicator tool to align the drill inclination before drilling each nail installation hole. Nails which encounter unanticipated obstructions during drilling shall be relocated as directed by the Engineer. Soil nails, which do not satisfy the specified tolerances due to the Contractor's installation, shall be replaced to the Engineer's satisfaction at no additional cost to the Department.

14.2 Shotcrete Facing

Shotcrete shall comply with the requirements of ACI 506R, "Specification for Shotcrete", except as otherwise specified. Shotcrete shall consist of an application of one or more layers of mortar or concrete conveyed through a hose and pneumatically projected at a high velocity against a prepared surface.

Shotcrete may be produced by either a dry-mix or a wet-mix process. The wet-mix process consists of thoroughly mixing all the ingredients except accelerating admixtures but including the mixing water, introducing the mixture into the delivery equipment and delivering it, by positive displacement, to the nozzle. The wet-mix shotcrete shall then be air jetted from the nozzle at high velocity onto the surface. Dry-mix process is shotcrete without mixing water that is conveyed through the hose pneumatically and the mixing water is introduced at the nozzle. For additional descriptive information, the Contractor's attention is directed to ACI 506R.

14.3 The location of the bearing plate shall not vary from its proposed location within the CIP facing vertical plane by more than 3/4 ".

15. Records

Accurate records shall be maintained by the Engineer and shall contain the following information for each nail:

a. Contractor's name

b. Drill rig operator's name

c. As-built, surveyed nail location

d. Deviation from specified tolerances

e. Nail diameter

f. As-built, surveyed nail elevation

g. Design nail length

h. Nail diameter

i. Installed nail length

j. Groundwater conditions

k. Caving or sloughing of excavation

l. Casing requirements

m. Drilling difficulties

n. Date and time of start and finish of drilling

o. Length and diameter of drilled hole

p. Date, time and method grout was placed including grout pressure

q. Total daily quantity of grout placed and quantity per hole

r. Design changes

The Contractor shall assist the Engineer as necessary to obtain the as-built nail locations and all other information as required by the Engineer. Upon completion of the work, the Contractor shall submit a complete record of the construction activities to the Engineer.

16. Measurement and Payment

No separate measurement for payment purposes will be made for this work. The price bid and payment will be full compensation for all work and materials associated with construction of the retaining wall as defined in the plans and these provisions including nails, form work, leveling pad, reinforcement, shotcrete and cast in place facings (including the single-faced concrete barrier), paved ditch (concrete), verification test nails and testing, strips, pipes and drains, etc.

Payment will be made under:

Soil Nail Retaining Wall,
Sta.12 + 30 -L- to 14 + 30 -L-.....Lump Sum

ROADWAY EXCAVATION **03-15-05**

Install erosion control measures as required by the plans prior to any kind of land-disturbing activity.

1. Unless otherwise required by the plans, construct embankments in such a manner that cut and fill slopes are completely graded to final slopes in a continuous operation, and permanently seeded and mulched in accordance with the requirements of the Specifications.

2. Should the Contractor fail to comply with the requirements specified in No. 1 above within the time frames established by the *Sedimentation and Pollution Control Act*, the Contractor shall perform temporary seeding and mulching on any exposed areas at his own expense.

3. When the Contractor fails or neglects to coordinate grading with the permanent seeding and mulching operation, the Engineer may suspend the Contractor's grading operation in accordance with the provisions of Article 108-7 of the *Standard Specifications* until the work is coordinated in a manner acceptable to the Engineer. Failure to perform the directed work may result in the Engineer having the work performed in accordance with Article 105-16 of the *Standard Specifications*.

SP2R25

TEMPORARY DETOURS: **8-15-00**

Construct the temporary detours required on this project in accordance with the typical sections in the plans or as directed by the Engineer.

Payment for the construction of the detours will be made at the contract unit prices for the various items involved. After the detours have served their purpose, remove the portions deemed unsuitable for use as a permanent part of the project as directed by the Engineer. Salvage and stockpile the aggregate base course removed from the detours at locations within the right of way, as directed by the Engineer, for removal by State Forces. Pipe culverts removed from the detours remain the property of the Contractor. Remove pipe culverts from the project when they are no longer needed. Place pavement and earth material removed from the detour in embankments or dispose of in waste areas furnished by the Contractor. No direct payment will be made for removing the aggregate base course, earth material and pavement, as the cost of same shall be included in the lump sum price bid for "Grading". Pipe culverts that are removed will be measured and will be paid for at the contract unit price per linear foot (meter) for "Pipe Removal". Such prices and payments will be full compensation for the work of removing, salvaging, and stockpiling aggregate base course; removing any pipe culverts; and for placing earth material and pavement in embankments or disposing of earth material and pavement in waste areas.

SP2R31

SHALLOW UNDERCUT: **2-19-02$_R$**

Perform undercut excavation and place a combination of fabric for soil stabilization and Class IV Subgrade Stabilization at locations as directed by the Engineer. Work includes performing undercut excavation, disposing of unsuitable material, furnishing and placing fabric for soil stabilization; and furnishing, placing and compacting Class IV Subgrade Stabilization.

MATERIALS

Fabric for Soil Stabilization.....Section 270
Class IV Subgrade Stabilization.....Section 1016-3, Class IV; or
Material meeting gradation
requirements of Table 520-1,
Column C

CONSTRUCTION METHODS

Perform undercut excavation in accordance with Section 225 and/or Section 226.

Place fabric for soil stabilization in accordance with Section 270.

Place Class IV Subgrade Stabilization by back dumping material on previously placed fabric.

Compact material to 95% of AASHTO T-99, Method "D" density or compact material to the highest density that can be reasonably obtained.

METHOD OF MEASUREMENT

Undercut Excavation will be measured in accordance with Section 225 and/or Section 226.

Fabric for Soil Stabilization will be measured in accordance with Article 270-4.

Class IV Subgrade Stabilization, as accepted in place, will be measured by the ton (metric ton), in accordance with Section 106-7.

BASIS OF PAYMENT

Payment will be made for quantities as measured above for the pay items listed below:

Pay Item	**Pay Unit**
Undercut Excavation	Cubic Yard (Cubic Meter)
Fabric for Soil Stabilization	Square Yard(Square Meter)
Class IV Subgrade Stabilization	Ton (Metric Ton)

SP2R35

BORROW EXCAVATION: **2-19-02**

Revise the 2002 Standard Specifications as follows:

Page 2-20, Article 230-6

After the first paragraph, insert the following paragraph:

"No direct payment will be made for the work of Evaluation of Potential Wetlands and Endangered Species as outlined above. Payment at the contract unit price for the pay item 'Borrow Excavation' or 'Grading - Lump Sum' will be considered full compensation for this work.'

SP2R37

FALSE SUMPS: **7-1-95c**

Construct false sumps in accordance with the details in the plans and at locations shown in the plans or at other locations as directed by the Engineer.

Payment for the work of construction of the false sumps will be made at the contract unit price per cubic yard (cubic meter) for "Unclassified Excavation or "Borrow Excavation" depending on the source of material, or included in "Grading-Lump Sum"

SP2R40

SHOULDER AND FILL SLOPE MATERIAL(LUMP SUM GRADING) **5-21-02**

General:

Perform the required shoulder and slope construction for this project in accordance with the applicable requirements of Section 226 of the Standard Specifications except as follows:

Construct the top 6 inches (150 mm) of shoulder and fill slopes with soils capable of supporting vegetation.

Provide soil with a P.I. greater than 6 and less than 25 and with a pH ranging from 5.5 to 6.8. Remove stones and other foreign material 2 inches (50 mm) or larger in diameter. All soil is subject to test and acceptance or rejection by the Engineer.

Obtain material from within the project limits or approved borrow source.

Where the material has been obtained from authorized stockpile or from a borrow source, measurement and payment will be made as provided in Section 230 of the Specifications "Borrow Excavation".

SP2R45

REINFORCED BRIDGE APPROACH FILLS: **03-18-03**

Description:

This work consists of all work necessary to construct reinforced bridge approach fills in accordance with these provisions and the plans, and as directed by the Engineer.

Materials:

Geomembrane

Provide geomembrane that is impermeable, composed of polyethylene polymers or polyvinyl chloride, and meets the following physical requirements:

Property	Requirements	Test Method
Thickness	25 mils (0.6 mm) Minimum	ASTM D1593
Tensile Strength at Break	100 lb/inch (18 KN/M) Minimum	ASTM D638
Puncture Strength	40 lbs (0.2KN) Minimum	FTMS 101 C 2065
Moisture Vapor Transmission Rate	0.018 ounce/yard^2 (0.615 gm/ m^2) per Day Maximum	ASTM E96

Fabric

Refer to section 1056 for Type 2 Engineering Fabric and the following:

Use a woven fabric consisting of strong rot-proof synthetic fibers such as polypropylene, polyethylene, or polyester formed into a stable network such that the filaments or yarns retain their relative positions to each other.

Fabric Property	Requirements	Test Method
Minimum Flow Rate	2 gallons/min/square foot (1358 cm^3/sec/square meter)	ASTM D 4491

Lamination of fabric sheets to produce the physical requirements of a fabric layer will not be accepted. Furnish letters of certification from the manufacturer with each shipment of the fabric and geomembrane attesting that the material meets the requirements of this provision; however, the material is subject to inspection, test, or rejection by the Engineer at any time.

During all periods of shipment and storage, wrap the geomembrane and fabric in a heavy-duty protective covering to protect the material from ultraviolet rays. After the protective wrapping has been removed, do not leave the material uncovered under any circumstances for longer than 4 days.

Select Material

Provide select material meeting the requirements of Class III, Type 1 or Type 2, or Class V select material of section 1016 of the Standard Specifications. When select material is required under water, use select material class V only, up to one foot (300mm) above the existing water elevation.

4" (100mm) Diameter Corrugated Drainage Pipe and Fittings

Provide pipe and fittings that meet all the applicable requirements of Section 815 or 816 of the Standard Specifications.

Construction:

Place the geomembrane and fabric as shown on the plans or as directed by the Engineer. Perform the excavation for the fabric reinforced fill to the limits shown on the plans. Provide an excavated surface free of obstructions, debris, pockets, stumps, and cleared of all vegetation. The geomembrane or fabric will be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation, handling or storage. Lay all layers smooth, and free from tension, stress, folds, wrinkles or creases. Place all the fabric layers with the machine direction (roll direction) perpendicular to the backwall face. Overlap geomembrane or fabric splices perpendicular to the backwall face a minimum of 18 inches (450 mm). Geomembrane or fabric splices parallel to the backwall face will not be allowed.

Deposit and spread select material in successive, uniform, approximately horizontal layers of not more than 10 inches (250 mm) in depth, loose measurement, for the full width of the cross section, and keep each layer approximately level. Place and compact each layer of select material fill no more than 10 inches (250 mm) thick with low ground pressure equipment. Use hand operated equipment to compact the fill material within three feet (0.9 m) of the backwall and wingwalls as directed by the Engineer. Compact select material to a density equal to at least 95% of that obtained by compacting a sample of the material in accordance with AASHTO T99 as modified by the Department. Compact the top eight inches (200 mm) of select material to a density to at least 100% of that obtained by compacting a sample of the material in accordance with AASHTO T99 as modified by the Department. Density requirements are not applicable to select material, class V; however compact the fill with at least four passes of low ground pressure equipment on the entire surface as directed by the Engineer. The compaction of each layer of select material must be inspected and approved by the Department prior to the placement of the next fill layer. No equipment will be allowed to operate on the drainage pipe or any geomembrane/fabric layer until it is covered with at least six inches (150 mm) of fill material. Compaction must not damage the drainage pipe, geomembrane, or fabric under the fill. Cover the geomembrane/fabric with a layer of fill material within four days after placement of the geomembrane/fabric. Geomembrane and fabric that is damaged as a result of installation will be replaced as directed by the Department at no additional cost.

Place the geomembrane on the ground, and attach and secure it tightly to the vertical face of the backwall and wingwalls with adhesives, duct-tape, nails or any other method approved by the Engineer. Place the first fabric layer on the surface of the geomembrane with the same dimensions of the geomembrane. No material or void is allowed between the geomembrane and the first fabric layer. Place and fold the remaining fabric layers on the edges as shown on the plans or as directed by the Engineer. Provide vertical separation between fabric layers as specified on the plans. The number of fabric layers will be shown in the plans.

Place four inch (100 mm) diameter perforated drainage pipe along the base of the backwall and sloped to drain as shown on the plans. Completely wrap perforated drainage pipe and #78M stone with Type 2 Engineering Fabric as shown on the plan detail. Install a pipe sleeve through the bottom of or under the wing wall prior to placing concrete for the wing wall. The pipe sleeve must be of adequate strength to withstand the wingwall load. Place the pipe sleeve in position to allow the drainage pipe to go through the wing wall with a proper slope. Connect four-inch (100-mm) diameter nonperforated (plain) drainage pipe with a coupling to the perforated pipe near the inside face of the wingwall. Place the nonperforated drainage pipe through the pipe

sleeve, extend down to the toe of the slope and connect, to a ditch or other drainage systems as directed by the Engineer. For bridge approaches in cut sections where no side slope is available, direct the drainage pipe outlet to the end slope down to the toe using elbows as directed by the Engineer.

Measurement and Payment:

Compensation:

All work covered by this provision will be paid for at the contract lump sum price for "Reinforced Bridge Approach Fills, Station _____". Such price and payment will be full compensation for both approach fills at each bridge installation, including but not limited to furnishing, placing and compacting select material, furnishing and placing geomembrane and woven fabric, furnishing and placing pipe sleeve, drainage pipe, and stone, furnishing and installing concrete pads at the end of outlet pipes, excavation and any other items necessary to complete the work.

Payment will be made under:

Reinforced Bridge Approach Fills, Station _____	Lump Sum	SP4R01

ASPHALT PAVEMENTS - SUPERPAVE **01-18-05**

Revise the 2002 *Standard Specifications* as follows:

PRIME COAT

Page 6-2, **Article 600-9**

Delete the first paragraph and substitute the following:

The quantity of prime coat to be paid will be the number of gallons (liters) of prime coat material that has been satisfactorily placed on the roadway. Each distributor load of prime coat material delivered and utilized on the project will be measured.

ASPHALT TACK COAT

Page 6-4, **Article 605-8**

Insert the following after paragraph one.

Take necessary precautions to limit the tracking and/or accumulation of tack coat material on either existing or newly constructed pavements. Excessive accumulation of tack may require corrective measures.

FIELD VERIFICATION AND JOB MIX FORMULA ADJUSTMENTS

Page 6-7, **Article 609-4**

Delete the first paragraph and substitute the following:

Conduct field verification of the mix at each plant within 30 calendar days prior to initial production of each mix design, when required by the Allowable Mix Adjustment Policy and when directed as deemed necessary.

Page 6-8, **Article 609-4**

Delete the first paragraph and substitute the following:

Retain records of these calibrations and mix verification tests, including Superpave Gyratory Compactor (SGC) printouts, at the QC laboratory. In addition, furnish copies, including SGC printouts, to the Engineer for review and approval within one working day after beginning production of the mix.

Page 6-8, **Article 609-4**

Add the following sentence at the end of the last paragraph:

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

Quality control minimum sampling and testing schedule:

Page 6-8, **Subarticle 609-5(A)**

Delete the second sentence in the fourth paragraph and substitute the following:

This person is responsible for monitoring all roadway paving operations and all quality control processes and activities, to include stopping production or implementing corrective measures when warranted.

Page 6-9, **Subarticle 609-5(C)1**

Delete the second sentence in the second paragraph and substitute the following:

Retain the QC compacted volumetric test specimens for 5 calendar days, commencing the day the specimens are prepared.

Page 6-9, **Subarticle 609-5(C)2**

At the bottom of this page, delete the sentence directly above the Accumulative Production Increment and substitute the following:

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

Page 6-10, **Subarticle 609-5(C)2**

Revise Items B, C, D and E on this page as follows:

B. Gradation on Recovered Blended Aggregate from Mix Sample (AASHTO T 30 Modified) Grade on all sieves specified on JMF
C. Maximum Specific Gravity (AASHTO T 209 or ASTM D 2041), optional (ASTM D 6857)
D. Bulk Specific Gravity of Compacted Specimens (AASHTO T166), optional (ASTM D 6752), Average of 3 specimens at N_{des} gyrations (AASHTO T 312)
E. Air Voids (VTM) (AASHTO T 269), Average of 3 specimens at N_{des} gyrations

Page 6-11, **Subarticle 609-5(C)2**

At the top of this page, delete Item B.," Reclaimed Asphalt Pavement..." and substitute the following:

B. Reclaimed Asphalt Pavement (RAP) Binder Content and Gradation (AASHTO T 308 Modified or T 164 and AASHTO T 30 Modified) (sampled from stockpiles or cold feed system at beginning of production and weekly thereafter). Have RAP approved for use in accordance with Article 1012-1(G). (Split Sample Required)

Page 6-11, **Subarticle 609-5(C)2**

Insert the following sampling and testing at the end of this Subarticle:

F. Uncompacted Void Content of Fine Aggregate, AASHTO T 304, Method A (natural sand only). Performed at Mix Design and when directed as deemed necessary. (Split Sample Required)

G. Reclaimed Asphalt Shingle Material (RAS) Binder Content and Gradation (AASHTO T 308 Modified or T 164 and AASHTO T 30 Modified) (sampled from stockpiles or cold feed system at beginning of production and weekly thereafter). Have RAS approved for use in accordance with Article 1012-1(F). (Split Sample Required)

CONTROL CHARTS

Page 6-11, **Subarticle 609-5(C)3**

Delete the first paragraph and substitute the following:

Maintain standardized control charts furnished by the Department at the field laboratory. For mix incorporated into the project, record full test series data from all regularly scheduled random

samples or directed samples which replace regularly scheduled random samples, on control charts the same day the tests are obtained.

In addition, partial test series results obtained due to reasons outlined in Subarticle 609-5(C)2 will be reported to Quality Assurance personnel on the proper forms, but will not be plotted on the control charts.

Page 6-12, **Subarticle 609-5(C)3**

Delete item 3 in the list below the second full paragraph and substitute the following:

3. If failure to stop production after two consecutive moving averages exceed the warning limits occurs, but production does stop at a subsequent time, re-establish a new moving average beginning at the actual production stop point.

Page 6-12, **Subarticle 609-5(C)3**

Delete the first and second sentence in the third full paragraph and substitute the following:

In addition, re-establish the moving averages for all mix properties.

CONTROL LIMITS

Page 6-12, **Subarticle 609-5(C) 4**

At the bottom of this page, delete the table and substitute the following:

CONTROL LIMITS

Mix Control Criteria	Target Source	Warning Limit	Moving Average Limit	Individual Limit
2.36mm Sieve	JMF	±4.0 %	±5.0 %	±8.0 %
0.075mm Sieve	JMF	±1.5 %	±2.0 %	±2.5 %
Binder Content	JMF	±0.3 %	±0.5 %	±0.7 %
VTM @ N_{des}	JMF	±1.0 %	±1.5 %	±2.0 %
VMA @ N_{des}	Min. Spec. Limit	-0.5%	-0.8%	-1.0%
$P_{0.075}$/ P_{be} Ratio	Max. Spec. Limit	0.0	N/A	+0.4%
$\%G_{mm}$ @ N_{ini}	Max. Spec. Limit	N/A	N/A	+2.0%
TSR	Min. Spec. Limit	N/A	N/A	-15.0%

Allowable Retesting for Mix Deficiencies:

Page 6-14, **Subarticle 609-5C(7)**

In the first paragraph, insert the following as the fourth sentence:

The Contractor under the supervision of the Department's QA personnel will perform these retests.

FIELD COMPACTION QUALITY CONTROL

Page 6-15, **Subarticle 609-5(D)1**

Delete the first and second sentences in the fourth paragraph and substitute the following:

Base and intermediate mix types (surface mixes not included) utilized for pavement widening of less than 4.0 feet and all mix types used in tapers, irregular areas and intersections (excluding full width travel lanes of uniform thickness), will not be subject to the sampling and testing frequency specified above provided the pavement is compacted using approved equipment and procedures. However, the Engineer may require occasional density sampling and testing to evaluate the compaction process.

Page 6-16, **Subarticle 609-5(D)1**

Delete item number 2 at the top of this page. Item number 3 should be re-numbered as 2 after the specified deletion.

Pavement Samples (Cores)

Page 6-16, **Subarticle 609-5(D)(2)**

In the first paragraph, delete the second sentence and insert the following as the last sentence in that paragraph:

The use of a separator medium beneath the layer to be tested is prohibited.

LIMITED PRODUCTION PROCEDURE

Page 6-17, **Subarticle 609-5(D) 5**

Delete the first paragraph and substitute the following:

Proceed on limited production when, for the same mix type, one of the following items occur:

(1) Two consecutive failing lots, excluding lots representing an individual resurfacing map or portion thereof.

(2) Three consecutive failing lots, with each lot representing an individual resurfacing map or portion thereof.
(3) Two consecutive failing nuclear control strips.

Pavement within each construction category (New and Other), as defined in Article 610-13, and pavement placed simultaneously by multiple paving crews will be evaluated independently for limited production purposes.

Delete the first sentence in the last paragraph and substitute the following:

If the Contractor does not operate by the limited production procedures as specified above, the two consecutive failing density lots, three consecutive failing lots with each lot representing an individual resurfacing map or portion thereof, or two consecutive failing nuclear control strips, whichever is applicable, and all mix produced thereafter will be considered unacceptable.

DOCUMENTATION (RECORDS)

Page 6-18, **Subarticle 609-5(E)**

Delete the third and fourth sentence in the first full paragraph and substitute the following:

Maintain all QC records, forms and equipment calibrations for a minimum of 3 years from their completion date.

Delete the second full paragraph and substitute the following:

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

QUALITY ASSURANCE

Page 6-18, **Article 609-6**

In Item 1 under Plant Mix Quality Assurance, substitute "5 percent" for "10 percent".

In Item 2 under Plant Mix Quality Assurance, substitute "sampling and testing procedures" for "tests".

In Item 4 under Plant Mix Quality Assurance, add "for that increment" after the word "sample".

In Item 5 under Plant Mix Quality Assurance, add "at a frequency equal to or greater than 10 percent of the QC sample frequency"; or

Insert the following after Item 5 under Plant Mix Quality Assurance:

6. By any combination of the above.

Delete the paragraph below Plant Mix Quality Assurance, and replace with the following:

The Engineer will conduct assurance tests on both split QC samples taken by the Contractor and verification samples taken by the Department. These samples may be the regular quality control samples or a sample selected by the Engineer from any location in the process or verification samples taken at random by the Department. The frequency will be equal to or greater than 5 percent of that required of the Contractor as stated in Subarticle 609-5(C)2. The Engineer may select any or all samples for assurance testing.

In Item 1 under Density Quality Assurance, delete the wording at the end of the sentence "at a frequency equal to or greater than 10 percent of the frequency required of the Contractor".

In Item 3 under Density Quality Assurance, substitute 5 percent for 10 percent.

Page 6-19, **Article 609-6**

In Item 4 under Density Quality Assurance, add "at a frequency equal to or greater than 10 percent of the QC sample frequency."

Insert the following after Item 4 under Density Quality Assurance:

5. By periodically directing the recalculation of random numbers for the Quality Control core or nuclear density test locations. The original QC test locations may be tested by QA and evaluated as verification tests.

LIMITS OF PRECISION

Page 6-19, **Article 609-6**

In the limits of precision table, delete the last three rows and substitute the following:

QA retest of prepared QC Gyratory Compacted Volumetric Specimens	± 0.015
Retest of QC Core Sample	± 1.2% (% Compaction)
Comparison of QA Core Sample	± 2.0% (% Compaction)
QA Verification Core Sample	± 2.0% (% Compaction)
Nuclear Comparison of QC Test	± 2.0% (% Compaction)
QA Nuclear Verification Test	± 2.0% (% Compaction)

In the first sentence of the paragraph below the limits of precision table, insert "or verification test results" after "quality assurance test results".

In the third sentence of the second paragraph below the limits of precision table, insert "or verification test results" after "quality assurance test results".

ASPHALT CONCRETE PLANT MIX PAVEMENTS – DESCRIPTION

Page 6-20, **Article 610-1**

Insert the following after the last paragraph:

A high frequency of asphalt plant mix, density, or mix and density deficiencies occurring over an extended duration of time may result in future asphalt, which is represented by mix and/or density test results not in compliance with minimum specification requirements, being excluded from acceptance at an adjusted contract unit price in accordance with Article 105-3. This acceptance process may apply to all asphalt produced and /or placed and may continue until the Engineer determines a history of quality asphalt production and placement is reestablished.

MATERIALS

Page 6-21, **Article 610-2**

Delete reference of Anti-strip additive (chemical) to **Article 1020-2** and substitute **Article 1020-8**.

COMPOSITION OF MIXTURES (MIX DESIGN AND JOB MIX FORMULA)

Page 6-21, **Subarticle 610-3(A)**

At the end of the second paragraph, add the following sentence:

In addition, submit Superpave gyratory compactor printouts for all specimens compacted at N_{des} and N_{max} during the mix design process.

Insert the following paragraph after the second paragraph:

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

Insert the following at the end of the third paragraph:

When the percent of binder contributed from RAS or a combination of RAS and RAP exceeds 20 percent of the total binder in the completed mix, the virgin binder PG grade shall be one grade below (both high and low temperature grade) the binder grade specified in Table 610-2 for the mix type.

Delete the fourth paragraph and substitute the following:

For Type S 12.5D mixes, the maximum percentage of reclaimed asphalt material is limited to 15% and shall be produced using virgin asphalt binder grade PG 76-22. For all other recycled mix types, when the percentage of RAP is 15 percent or less of the total mixture, the virgin binder PG grade shall be as specified in Table 610-2 for the specified mix type. When the percentage of RAP is greater than 15 but not more than 25 percent of the total mixture, the virgin binder PG grade shall be one grade below (both high and low temperature grade) the specified grade for the mix type. When the percentage of RAP is greater than 25 percent of the total mixture, the Engineer will establish and approve the asphalt binder grade.

Page 6-22, **Subarticle 610-3(A)**

Insert the following sentence at the end of the Item 4:

If natural sand is utilized in the proposed mix design, determine and report the Uncompacted Void Content of the natural sand in accordance with AASHTO T-304, Method A.

Page 6-23, **Subarticle 610-3(A)**

Under the quantities of mix components insert the following sentence:

When requested by the Engineer, submit to the Department's Materials and Tests Unit, in Raleigh, six (6) Superpave Gyratory Compactor specimens compacted to a height of 75 mm and to a void content (VTM) of 4.0% +/- 0.5% for performance rut testing with the Asphalt Pavement Analyzer.

JOB MIX FORMULA

Page 6-24, **Subarticle 610-3(C)**

Delete Table 610-1 and associated notes. Substitute the following:

TABLE 610-1
SUPERPAVE AGGREGATE GRADATION DESIGN CRITERIA

Standard Sieves	Percent Passing Criteria (Control Points)											
	Mix Type (Nominal Maximum Aggregate Size)											
	4.75 mm (a)		9.5 mm (c)		12.5 mm (c)		19.0 mm		25.0 mm		37.5 mm	
(mm)	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
50.0											100.0	
37.5									100.0		90.0	100.0
25.0							100.0		90.0	100.0		90.0
19.0					100.0		90.0	100.0		90.0		
12.5			100.0		90.0	100.0		90.0				
9.5	100.0		90.0	100.0		90.0						
4.75	90.0	100.0		90.0								
2.36	65.0	90.0	32.0(b)	67.0(b)	28.0	58.0	23.0	49.0	19.0	45.0	15.0	41.0
1.18												
0.600												
0.300												
0.150												
0.075	4.0	8.0	4.0	8.0	4.0	8.0	3.0	8.0	3.0	7.0	3.0	6.0

(a) For Type S 4.75A, a minimum of 50% of the aggregate components shall be manufactured material from the crushing of stone.
(b) For Type SF 9.5A, the percent passing the 2.36mm sieve shall be a minimum of 60% and a maximum of 70%.
(c) For the final surface layer of the specified mix type, use a mix design with an aggregate blend gradation above the maximum density line on the 2.36 mm and larger sieves.

Page 6-25, **Subarticle 610-3(C),**

Delete Table 610-2 and associated notes. Substitute the following:

TABLE 610-2
SUPERPAVE MIX DESIGN CRITERIA

	Design	Binder	Compaction Levels			Volumetric Properties (c)			
Mix	ESALs	PG							
Type	millions	Grade	No. Gyrations @			VMA	VTM	VFA	%Gmm
(f)	(a)	(b)	N_{ini}	N_{des}	N_{max}	% Min.	%	Min. - Max.	@ N_{ini}
S-4.75A	<0.3	64 -22	6	50	75	20.0	7.0-15.0		
SF-9.5A	<0.3	64 -22	6	50	75	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S-9.5B	0.3 - 3	64 -22	7	75	115	15.0	3.0 - 5.0	65 - 80	≤ 90.5
S-9.5C	3 - 30	70 -22	8	100	160	15.0	3.0 - 5.0	65 - 76	≤ 90.0
S-12.5C	3 - 30	70 -22	8	100	160	14.0	3.0 - 5.0	65 - 75	≤ 90.0
S-12.5D	> 30	76 -22	9	125	205	14.0	3.0 - 5.0	65 - 75	≤ 90.0
I-19.0B	< 3	64 -22	7	75	115	13.0	3.0 - 5.0	65 - 78	≤90.5
I-19.0C	3 - 30	64 -22	8	100	160	13.0	3.0 - 5.0	65 - 75	≤ 90.0
I-19.0D	> 30	70 -22	9	125	205	13.0	3.0 - 5.0	65 - 75	≤ 90.0
B-25.0B	< 3	64 -22	7	75	115	12.0	3.0 - 5.0	65 - 78	≤ 90.5
B-25.0C	> 3	64 -22	8	100	160	12.0	3.0 - 5.0	65 - 75	≤ 90.0
B-37.5C	> 3	64 -22	8	100	160	11.0	3.0 - 5.0	63 - 75	≤ 90.0
	Design Parameter					*Design Criteria*			
All	1. $\%G_{mm}$ @ N_{max}					≤ 98.0% (d)			
Mix	2. Dust to Binder Ratio ($P_{0.075}$ / P_{be})					0.6 - 1.4			
Types	3. Retained Tensile Strength (TSR) (AASHTO T 283 Modified)					85 % Min. (e)			

Notes:
(a) Based on 20 year design traffic.
(b) When Recycled Mixes are used, select the binder grade to be added in accordance with Subarticle 610-3(A).
(c) Volumetric Properties based on specimens compacted to N_{des} as modified by the Department.
(d) Based on specimens compacted to N_{max} at selected optimum asphalt content.
(e) AASHTO T 283 Modified (No Freeze-Thaw cycle required). TSR for Type S 4.75A, Type B 25.0 and Type B 37.5 mixes is 80% minimum.
(f) Mix Design Criteria for Type S 4.75A may be modified subject to the approval of the Engineer

WEATHER, TEMPERATURE, AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES

Page 6-26, **Article 610-4, Table 610-3**

Delete the title of **Table 610-3** and substitute the following title:

ASPHALT PLACEMENT- MINIMUM TEMPERATURE REQUIREMENTS

In the first column, third row; delete reference to the ACSC Types S 9.5A and S 12.5B mix.

Add the following minimum placing temperatures for mix types S 4.75A and SF 9.5A.

Asphalt Concrete Mix Type	Minimum Air Temperature	Minimum Road Surface Temperature
ACSC, Type S 4.75A, SF 9.5A	40°F (5°C)	50°F (10°C)

SPREADING AND FINISHING

Page 6-32, **Article 610-8**

Insert the following after the second sentence within the sixth paragraph.

Take necessary precautions during production, loading of trucks, transportation, truck exchanges with paver, folding of the paver hopper wings, and conveying material in front of the screed to prevent segregation of the asphalt mixtures.

Page 6-32, **Article 610-8**

Delete the last paragraph beginning on this page and continuing on the next page and substitute the following:

Use pavers equipped with an electronic screed control that will automatically control the longitudinal profile and cross slope of the pavement. Control the longitudinal profile through the use of either a mobile grade reference(s), including mechanical, sonic and laser grade sensing and averaging devices, an erected string line(s) when specified, joint matching shoe(s), slope control devices or the approved methods or combination of methods. Unless otherwise specified, use a mobile grade reference system capable of averaging the existing grade or pavement over a minimum 30 foot (9.1 meter) distance or by non-contacting laser or sonar type ski with at least four referencing stations mounted on the paver at a minimum length of 24 feet. Establish the position of the reference system such that the average profile grade is established at the approximate midpoint of the system. The transverse cross-slope shall be controlled as directed by the Engineer.

Page 6-33, **Article 610-8**

Delete the second full paragraph on this page and substitute the following:

Use the 30 foot (9.1 meter) minimum length mobile grade reference system or the non-contacting laser or sonar type ski with at least four referencing stations mounted on the paver at a minimum length of 24 feet to control the longitudinal profile when placing the initial lanes and all adjacent lanes of all courses, including resurfacing and asphalt in-lays, unless other specified or approved. A joint matching device short (6 inch [152.4 mm] shoes) may be used only when approved.

At the end of the third full paragraph, add the following sentence:

Waiver of the use of automatic screed controls does not relieve the Contractor of achieving plan grades and cross-slopes.

Insert the following as the last paragraph:

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

DENSITY REQUIREMENTS

Page 6-34, **Article 610-10,**

Delete **Table 610-4** and substitute the following table and associated notes:

Table 610-4
MINIMUM DENSITY REQUIREMENTS

MIX TYPE	MINIMUM % of G_{mm}
SUPERPAVE MIXES	(Maximum Specific Gravity)
S 4.75A	85.0[(a,b)]
SF 9.5A	90.0
S 9.5X, S 12.5X, I 19.0X, B 25.0X, B 37.5X	92.0

(a) All S 4.75A pavement will be accepted for density in accordance with Article 105-3

(b) Compaction to the above specified density will be required when the S 4.75 A mix is applied at a rate of 100 lbs/sy (55 kg/m^2)

Page 6-34, **Article 610-10**

Delete the second paragraph and substitute the following:

Compact base and intermediate mix types (surface mixes not included) utilized for pavement widening of less than 4.0 feet (1.2 meters) and all mix types used in tapers, irregular areas and intersections (excluding full width travel lanes of uniform thickness), using equipment and procedures appropriate for the pavement area width and/or shape. Compaction with equipment other than conventional steel drum rollers may be necessary to achieve adequate compaction. Occasional density sampling and testing to evaluate the compaction process may be required. Densities lower than that specified in Table 610-4 will be accepted, in accordance with Article 105-3, for the specific mix types and areas listed directly above.

SURFACE REQUIREMENTS AND ACCEPTANCE

Page 6-35, **Article 610-12**

Delete the first paragraph and substitute the following:

Construct pavements using quality paving practices as detailed herein. Construct the pavement surface smooth and true to the plan grade and cross slope. Immediately correct any defective areas with satisfactory material compacted to conform with the surrounding area. Pavement imperfections resulting from unsatisfactory workmanship such as segregation, improper longitudinal joint placement or alignment, non-uniform edge alignment and excessive pavement repairs will be considered unsatisfactory and if allowed to remain in place will be accepted in accordance with Article 105-3.

When directed due to unsatisfactory laydown or workmanship, operate under the limited production procedures. Limited production for unsatisfactory laydown is defined as being restricted to the production, placement, compaction, and final surface testing (if applicable) of a sufficient quantity of mix necessary to construct only 2500 feet (750 meter) of pavement at the laydown width.

Remain on limited production until such time as satisfactory laydown results are obtained or until three consecutive 2500 foot (750 meter) sections have been attempted without achieving satisfactory laydown results. If the Contractor fails to achieve satisfactory laydown results after three consecutive 2500 foot (750 meter) sections have been attempted, cease production of that mix type until such time as the cause of the unsatisfactory laydown results can be determined. As an exception, the Engineer may grant approval to produce a different mix design of the same mix type if the cause is related to mix problem(s) rather than laydown procedures.

Mix placed under the limited production procedures for unsatisfactory laydown or workmanship will be evaluated for acceptance in accordance with Article l05-3.

DENSITY ACCEPTANCE

Page 6-36, **Article 610-13**

Delete the second paragraph and substitute the following:

The pavement will be accepted for density on a lot by lot basis. A lot will consist of one day's production of a given job mix formula on a contract. As an exception, separate lots will be established when the one of the following occurs:

(1) Portions of pavement are placed in both "New" and "Other" construction categories as defined below. A lot will be established for the portion of the pavement in the "New" construction category and a separate lot for the portion of pavement in the "Other" construction category.

(2) Pavement is placed on multiple resurfacing maps, unless otherwise approved prior to paving. A lot will be established for each individual resurfacing map or portion thereof.

(3) Pavement is placed simultaneously by multiple paving crews. A lot will be established for the pavement placed by each paving crew.

(4) Pavement is placed in different layers. A lot will be established for each layer.

(5) Control strips are placed during limited production.

The Engineer will determine the final category and quantity of each lot for acceptance purposes.

Page 6-36, **Article 610-13**

Delete the first sentence in the third paragraph and insert the following:

The "New" construction category will be defined as pavements of uniform thickness, exclusive of irregular areas, meeting all three of the following criteria:

Delete the sixth paragraph and substitute the following:

A failing lot for density acceptance purposes is defined as a lot for which the average of all test sections, and portions thereof, fails to meet the minimum specification requirement. If additional density sampling and testing, beyond the minimum requirement, is performed and additional test sections are thereby created, then all test results shall be included in the lot average. In addition, any lot or portion of a lot that is obviously unacceptable will be rejected for use in the work.

Page 6-36, **Article 610-13**

Delete the last paragraph and substitute the following:

Any density lot not meeting minimum density requirements detailed in Table 610-4 will be evaluated for acceptance by the Engineer. If the lot is determined to be reasonably acceptable, the mix will be paid at an adjusted contract price in accordance with Article 105-3. If the lot is determined not to be acceptable, the mix will be removed and replaced with mix meeting and compacted to the requirement of these specifications.

BASIS OF PAYMENT, ASPHALT PAVEMENTS

Page 6-37, **Article 610-16**

Add the following to the second paragraph:

The quantity of hot mix asphalt pavement, measured as provided in Article 610-15, will be paid for at the contract unit prices per ton (metric ton) for "Asphalt Concrete Surface Course, Type S 4.75A, and SF 9.5A".

Add the following to the payment item description:

Asphalt Concrete Surface Course, Type S 4.75A ..... Ton (Metric Ton)
Asphalt Concrete Surface Course, Type SF 9.5A ..... Ton (Metric Ton)

Delete reference to the Asphalt Concrete Surface Course, Types S 9.5A and S 12.5B in both the second paragraph and in the payment description.

ASPHALT BINDER FOR PLANT MIX - METHOD OF MEASUREMENT

Page 6-39, **Article 620-4**

Delete the first sentence of the second paragraph and substitute the following:

Where recycled plant mix is being produced, the grade of asphalt binder to be paid for will be the grade for the specified mix type as required in Table 610-2 unless otherwise approved.

OPEN-GRADED ASPHALT FRICTION COURSE CONSTRUCTION REQUIREMENTS

Page 6-43, **Article 650-5**

Add the following paragraph after the first paragraph:

Do not place open-graded asphalt friction course between October 31 and April 1 of the next year, unless otherwise approved. Place friction course, Type FC-1 mixes, only when the road surface temperature is 50°F (10°C) or higher and the air temperature is 50°F (10°C) or higher.

The minimum air temperature for Type FC-1 Modified and FC-2 Modified mixes will be 60°F (15°C).

AGGREGATES FOR ASPHALT PLANT MIXES

Page 10-34, **Subarticle 1012-1(B)4**

Delete and substitute the following:

(4) Flat and Elongated Pieces:

Use coarse aggregate meeting the requirements of Table 1012-1 for flat and elongated pieces when tested in accordance with ASTM D 4791 (Section 8.4) on the No. 4 (4.75 mm) sieve and larger with a 5:1 aspect ratio (maximum to minimum) for all pavement types, except there is no requirement for Types S 4.75A, SF 9.5A, and S 9.5B.

Page 10-35, **Table 1012-1**

Delete **Table 1012-1** and substitute the following:

Table 1012-1
AGGREGATE CONSENSUS PROPERTIES[a]

Mix Type	Course Aggregate Angularity[b]	Fine Aggregate Angularity	Sand Equivalent	Flat & Elongated
		% Minimum	% Minimum	5 : 1 Ratio % Maximum
	ASTM D 5821	AASHTO T 304 Method A	AASHTO T 176	ASTM D 4791 Section 8.4
S 4.75 A		40	40	
SF 9.5 A S 9.5 B I 19.0 B B 25.0 B	75 / -	40	40	10[c]
S 9.5 C S 12.5 C I 19.0 C B 25.0 C B 37.5 C	95 / 90	45	45	10
S 12.5 D I 19.0 D	100 / 100	45	50	10
OGAFC	100 / 100	N/A	N/A	10

(a) Requirements apply to the course aggregate blend and/or fine aggregate blend
(b) 95/90 denotes that 95% of the course aggregate (+No.4 or + 4.75mm sieve)has one fractured face and 90% has two or more fractured faces.
(c) Does not apply to Mix Types SF 9.5 A or S 9.5 B

Page 10-36, **Subarticle 1012-1(C)1**

Insert the following after the fourth paragraph:

When natural sand is utilized in "C" or "D" level asphalt mixes, do not exceed the maximum natural sand percentage in the mix design and/or production aggregate blend detailed in Table 1012-1A.

Table 1012-1A

Uncompacted Void Content of Fine Aggregate AASHTO T 304 Method A	Maximum Percent Natural Sand Included in Mix Design and/or Production*
Less than 42.0	10
Equal to 42.0 to 44.9	15
Equal to 45.0 and greater	20

*Maximum percent natural sand may be exceeded with approval from Pavement Construction Engineer upon satisfactory evaluation of pavement performance testing

FINE AGGREGATE ANGULARITY

Page 10-36, **Subarticle 1012-1(C)6**

Delete reference to AASHTO TP 33 Method A and substitute AASHTO T 304, Method A.

Page 10-37, **Subarticle 1012-1(H)**

Delete this Subarticle. It is a duplicate of Subarticle 1012-1(F) located on Page 10-36.

ASPHALT BINDER

Page 10-46, **Article 1020-2**

Delete the first paragraph and substitute the following:

Use Performance Graded Asphalt Binder meeting the requirements of AASHTO M 320. See Article 610-3 for the specified grades. Submit a Quality Control Plan for asphalt binder production in conformance with the requirements of AASHTO R 26 to the Materials and Tests Unit.

SP6R01

ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES: **11-21-00$_R$**

The approximate asphalt binder content of the asphalt concrete plant mixtures used on this project will be as follows:

Asphalt Concrete Base Course, Type B 25.0__	4.3%
Asphalt Concrete Intermediate Course, Type I 19.0__	4.7%

Asphalt Concrete Surface Course, Type S 4.75A	7.0%
Asphalt Concrete Surface Course, Type SF 9.5A	6.5%
Asphalt Concrete Surface Course, Type S 9.5__	6.0%
Asphalt Concrete Surface Course, Type S 12.5__	5.5%

The actual asphalt binder content will be established during construction by the Engineer within the limits established in the Standard Specifications or Project Special Provisions.

SP6R15

ASPHALT PLANT MIXTURES: **7-1-95$_c$**

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

SP6R20

PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX: **11-21-00**

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the Standard Specifications as modified herein.

The base price index for asphalt binder for plant mix is $200.00 per ton (metric ton).

This base price index represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals on January 1, 2005.

SP6R25

DISPOSAL OF WASTE AND DEBRIS: **2-19-02**

Revise the 2002 Standard Specifications as follows:

Page 8-9, Subarticle 802-2(7. Buffer Zones:)

At the end of the last sentence in this subarticle, add the words "unless superseded by an environmental permit."

SP8R03

GUARDRAIL POSTS AND OFFSET BLOCKS: **06-22-04**

Revise the *2002 Standard Specifications* as follows:

Page 10-69, Subarticle 1046-3

Delete this sub-article in its entirety and replace with the following:

1046-3 POSTS AND OFFSET BLOCKS.

(A) General:

The Contractor may at his option furnish either of the following types of steel guardrail posts. Only one type of post will be permitted at any one continuous installation. Use structural steel posts throughout the project, unless otherwise directed or detailed in the plans.

1. Steel W6 x 8.5 or W6 x 9.0 posts
2. Steel 4.5" x 6.0" "C" shape posts (C150 x 12.2 kg/m)

The Contractor may at his option furnish either of the following types of treated timber posts if specifically directed or detailed in the plans. Only one type of post will be permitted at any one continuous installation.

1. Timber 6" x 8" (152 mm x 203 mm) posts.
2. Timber 8" x 8" (203 mm x 203 mm) posts.

(B) Structural Steel Posts:

Fabricate steel posts for guardrail of the size and weight shown on the plans from structural steel complying with the requirements of Section 1072. Metal from which C shape posts are fabricated shall meet the requirements of ASTM A570 for any grade of steel, except that mechanical requirements shall meet the requirements of ASTM A36. Punch or drill the holes for connecting bolts. Burning will not be permitted. After fabrication, the posts shall be galvanized in accordance with Section 1076.

(C) Treated Timber Posts:

Timber guardrail posts shall be of treated southern pine meeting the requirements of Article 1082-2 and 1082-3.

Bore bolt holes to a driving fit for the bolts. A minus tolerance of 1 percent will be allowed in the length of the post. Perform all framing and boring before the posts receive preservative treatment.

(D) Offset Blocks:

Provide 8-inch deep recycled plastic or composite offset blocks that have been approved for use with the guardrail shown in the standard drawings and/or plans. Only one type of offset block will be permitted at any one continuous installation. Prior to beginning the installation of recycled offset block, submit the FHWA acceptance letter for each type of block to the Engineer for approval.

Treated timber offset blocks with steel beam guardrail will not be allowed unless required by Specifications, directed by the Engineer or detailed in the plans. Steel offset blocks with steel beam guardrail will not be allowed.

Recycled plastic or composite offset blocks shall be made from no less than 50% recycled plastic or composite, and shall meet the following minimum requirements:

- Specific Gravity: 0.950
- Compressive Strength in Lateral Direction:..... 1600 psi (11 MPa)
- Maximum Water Absorption: ..... 10% by weight
- Maximum Termite and Ant Infestation:..... 10%
- Testing..... Shall pass NCHRP Report 350, Test Level 3 by CRASH TESTING

Revise the *2002 Standard Roadway Drawings* as follows:

Sheet 4 of 6, Standard 862.03, delete the note and substitute the following:

Note: The midpost and offset block of the WTR section will require special bolt hole drilling in the thrie beam offset block and line post.

SP8R57

GUARDRAIL ANCHOR UNITS, TYPE 350: **04-20-04**

DESCRIPTION

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the Standard Specifications, and at locations shown in the plans.

MATERIALS

The Contractor may at his option, furnish any one of the guardrail anchor units.

Guardrail anchor unit (ET-2000) as manufactured by:

TRINITY INDUSTRIES, INC.
2525 N. STEMMONS FREEWAY
DALLAS, TEXAS 75207
TELEPHONE: 1-800-644-7976

The guardrail anchor unit (SKT 350) as manufactured by:

ROAD SYSTEMS, INC.
3616 OLD HOWARD COUNTY AIRPORT
BIG SPRING, TEXAS 79720
TELEPHONE: (915) 263-2435

Prior to installation the Contractor shall submit to the Engineer:

1. FHWA acceptance letter for each guardrail anchor unit certifying it meets the requirements of NCHRP Report 350, Test Level 3, in accordance with Section 106-2 of the Standard Specifications.

2. Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Section 105-2 of the Specifications.

No modifications shall be made to the guardrail anchor unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

CONSTRUCTION

Guardrail end delineation is required on all approach and trailing end sections for both temporary and permanent installations. Guardrail end delineation consists of yellow reflective sheeting applied to the entire end section of the guardrail in accordance with Section 1088-3 of the Standard Specifications and is incidental to the cost of the guardrail anchor unit.

MEASUREMENT AND PAYMENT

Measurement and payment will be made in accordance with Articles 862.5 and 862-6 of the Standard Specifications.

Payment will be made under:

Guardrail Anchor Units, Type 350..... Each

SP8R65

PREFORMED SCOUR HOLE WITH LEVEL SPREADER APRON: 10-15-02

Description:

Construct and maintain preformed scour holes with spreader aprons at the locations shown on the plans and in accordance with the details in the plans. Work includes excavation, shaping and maintaining the hole and apron, furnishing and placing filter fabric, rip rap (class as specified in the plans) and permanent soil reinforcement matting.

Materials:

Materials shall meet the requirements of Division 10 and this provision:

Plain rip rap.....Article 1042
Filter Fabric.....Article 1042-2

The permanent soil reinforcement matting shall be permanent erosion control reinforcement mat and shall be constructed of 100% coconut fiber stitch bonded between a heavy duty UV stabilized cuspated (crimped) netting overlaid with a heavy duty UV stabilized top net. The three nettings shall be stitched together on 1.5 inch (38 mm) centers UV stabilized polyester thread to form a permanent three dimensional structure. The mat shall have the following physical properties:

Property	Test Method	Value	Unit
Ground Cover	Image Analysis	93	%
Thickness	ASTM D1777	0.63 (16)	in (mm)
Mass Per Unit Area	ASTM D3776	0.92 (0.50)	lb/sy (kg/m2)
Tensile Strength	ASTM D5035	480 (714.2)	lb/ft (kg/m)
Elongation	ASTM D5035	49	%
Tensile Strength	ASTM D5035	960 (1428.5)	lb/ft (kg/m)
Elongation	ASTM D5035	31	%
Tensile Strength	ASTM D1682	177 (80.3)	lbs (kg)
Elongation	ASTM D1682	22	%
Resiliency	ASTM D1777	>80	%
UV Stability *	ASTM D4355	151 (68.5)	lbs (kg)
Color(Permanent Net)		UV Black	
Porosity (Permanent Net)	Calculated	>95	%
Minimum Filament Diameter (permanent net)	Measured	0.03 (0.8)	in (mm)

*ASTM D1682 Tensile Strength and % strength retention of material after 1000 hours of exposure in a Xenon-arc weatherometer.

A certification (Type 1, 2, or 3) from the manufacturer showing:

1) the chemical and physical properties of the mat used, and
2) conformance of the mat with this specification will be required.

Soil Preparation:

All areas to be protected with the mat shall be brought to final grade and seeded in accordance with Section 1660. The surface of the soil shall be smooth, firm, stable and free of rocks, clods, roots or other obstructions which would prevent the mat from lying in direct contact with the soil surface. Areas where the mat is to be placed will not need to be mulched.

Measurement:

The quantity of "Preformed Scour Holes with Level Spreader Aprons" to be paid for shall be the actual number which have been incorporated into the completed and accepted work.

Basis of Payment:

The quantity of scour holes with spreader aprons, measured as provided above, will be paid for at the contract unit price each for "Preformed Scour Hole with Level Spreader Apron." Such price and payment will be full compensation for all work covered by this provision.

SP8R105

AGGREGATE PRODUCTION: **11-20-01**

Provide aggregate from a producer who utilizes the new Aggregate Quality Control/Quality Assurance Program that is in effect at the time of shipment.

No price adjustment is allowed to contractors or producers who utilize the new program. Participation in the new program does not relieve the producer of the responsibility of complying with all requirements of the Standard Specifications. Copies of this procedure are available upon request from the Materials and Test Unit.

SP10R05

CONCRETE BRICK AND BLOCK PRODUCTION: **11-20-01**

Provide concrete brick and block from a producer who utilizes the new Solid Concrete Masonry Brick/Unit Quality Control/Quality Assurance Program that is in effect on the date that material is received on the project.

No price adjustment is allowed to contractors or producers who utilize the new program. Participation in the new program does not relieve the producer of the responsibility of complying with all requirements of the Standard Specifications. Copies of this procedure are available upon request from the Materials and Test Unit.

SP10R10

FINE AGGREGATE: **11-19-02**

Revise the 2002 Standard Specifications as follows:

Page 10-17, Table 1005-2

Make the following change to the table:

For Standard Size 2MS the following gradation change applies.

The minimum percent shown for material passing the No. 8 (2.36mm) sieve has been changed from 84 to **80.**

SP10R15

BORROW MATERIAL **02-17-04**

Revise the 2002 Standard Specifications as follows:

Page 10-44

Section 1018-2 II (b) Delete the last sentence in its entirety.

SP10R17

TRAFFIC CONTROL **01-18-05**

Revise the *2002 Standard Specifications* as follows:

Article 1089-1 WORK ZONE SIGNS is deleted. Substitute the following:

(A) General:

Rigid sign retroreflective sheeting requirements for Types VII, VIII and IX (prismatic) fluorescent are described in Tables 1089-A, 1089-B and 1089-C. Cover the entire sign face of the sign substrate with NCDOT approved Type VII, VIII or IX (prismatic) fluorescent orange reflective sheeting. Apply the reflective sheeting in a workmanlike manner so that there are no bubbles or wrinkles in the material.

Roll-up sign retroreflective requirements are described in Table 1089-D.

1. Work Zones Signs (Stationary)

Use Type VII, VIII or IX (prismatic) fluorescent orange retroreflective sheeting that meets the following reflective requirements in Tables 1089-A, 1089-B or 1089-C respectively. Use approved composite or aluminum for sign backing. Signs and sign supports must meet or exceed NCHRP 350 requirements for Breakaway Devices.

Table 1089-A
Minimum Coefficient of Retroreflection R_A for
TYPE VII Fluorescent Orange Sheeting
(Candelas per lux per square meter)

Observation Angle	Entrance Angle	
	-4°	30°
0.1°	300	170
0.2°	230	130
0.5°	72	41

Table 1089-B
Minimum Coefficient of Retroreflection R_A for
TYPE VIII Fluorescent Orange Sheeting
(Candelas per lux per square meter)

Observation Angle	Entrance Angle	
	-4°	30°
0.1°	300	135
0.2°	210	95
0.5°	75	35

Table 1089-C
Minimum Coefficient of Retroreflection R_A for
TYPE IX Fluorescent Orange Sheeting
(Candelas per lux per square meter)

Observation Angle	Entrance Angle	
	-4°	30°
0.1°	200	110
0.2°	115	65
0.5°	72	41
1.0°	24	14

2. Work Zones Signs (Barricade Mounted)

   Use approved composite or roll-up signs for barricade mounted sign substrates. Approved composite barricade mounted warning signs (black on orange) must be Type VII, VIII or IX sheeting which meet the retroreflective requirements of Table 1089-A, 1089-B or 1089-C. Roll-up mounted barricade warning signs (black on orange) must meet the retroreflective requirements in Table 1089-D. Sign and barricade assembly must meet or exceed the requirements of NCHRP 350 for Work Zone Category II Devices.

3. Work Zones Signs (Portable)

   Use approved composite or roll-up sign substrates on portable sign stands.

   Composite - Use Type VII, VIII or IX (prismatic) fluorescent orange retroreflective sheeting that meets the following reflective requirements in Tables 1089-A, 1089-B or 1089-C. Signs and sign supports must meet or exceed NCHRP 350 requirements for Breakaway Devices.

Roll-up Signs - Use fluorescent orange retroreflective roll-up signs that meet the following reflective requirements:

Table 1089-D
Minimum Coefficient of Retroreflection R_A for Fluorescent Orange Roll-Up Signs
(Candelas per lux per square meter)

Observation Angle	Entrance Angle	
	-4°	30°
0.1°	300	120
0.2°	200	80
0.5°	90	34

Use roll up signs that have a minimum 3/16" x 1 1/4" horizontal rib and 38" x 1 1/4" vertical rib and has been crash test to meet NCHRP 350 requirements and Traffic Control qualified by the Work Zone Traffic Control Unit.

Add the following after 1089-1(C):

(D) Warranty

Warranty requirements for rigid sign retroreflective sheeting Types VII, VIII and IX are described in Section 1093-9 (F) and Tables 1089 A, B and C.
Roll-up fluorescent orange retroreflective signs will maintain 80% of its retroflectivity (Table 1089-D) for years 1 – 2 and 50% for year 3.

Rigid and Rollup Fluorescent orange signs will maintain a Fluorescence Luminance Factor (Y_F)* of 13% for three (3) years.
*Fluorescence Testing Method is described in ASTM E2301 Test Methods for Fluorescent Retro reflective Sheeting.

Rigid and Roll up fluorescent orange signs shall maintain a total Luminance Factor (Y) of 25 for three (3) years and conform to the requirements of Table 1089-E when measured in accordance with ASTM D4956.

Table 1089-E
Fluorescent Orange colorimetric requirements

Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355

BARRICADES

Article 1089-3(A) General, delete both paragraphs and substitute the following:

Type III Barricades shall be constructed of perforated square steel tubing and/or angle iron. Provide Type III barricades that use a cross member or stabilization bar and meet the requirements of NCHRP 350 for Work Zone Category II Devices with composite and roll-up signs attached.

Use approved composite or plastic barricade rails that have a smooth face and have alternating orange and white retroreflective stripes that slope at an angle of 45 degrees.

Article 1089-3(C) Reflective Sheeting, delete the first paragraph only and substitute the following:

Use Type VII, VIII or IX (prismatic) retroreflective fluorescent orange sheeting on both sides of the barricade rails. The rail sheeting retroreflectivity values shall meet the retroreflectivity requirements in Table 1089-A, 1089-B or 1089-C and shall be listed on the Department's approved product list or accepted as traffic qualified by the Traffic Control Unit.

SP10R30

DRUMS: **07-16-02**

Revise the 2002 Standard Specifications as follows:

Page 10-195, Subarticle 1089-5(C)

Delete the first (1st) sentence of the first (1st) paragraph and insert the following:

"Provide a minimum of three orange and two white alternating horizontal circumferential stripes covering the entire outside with each drum."

SP11R05

WORK ZONE SIGNS **01-18-05**

Revise the *Standard Specifications* as follows:

DESCRIPTION

Page 11-5, **Article 1110-1 Description**

Replace the second paragraph with the following:

> Furnish, install, maintain and relocate portable work zone signs and portable work zone sign stands in accordance with the plans and specifications. When portable work zone signs and portable work zone sign stands are not in use for periods longer than 30 minutes, collapse sign stand and reinstall once work begins.

Replace the last sentence in the third paragraph with the following:

Use work zone signs (portable) only with portable work zone sign stands specifically designed for one another. Work Zone Signs (portable) may be roll up or approved composite.

MATERIALS

Page 11-5, **Article 1110-2 Part (A) General**:

Add the following:

Barricade Mounted Signs.....Article 1089-3

MATERIAL QUALIFICATIONS

Page 11-5, **Article 1110-2 Part (B) Material Qualifications.**

Delete the first sentence in the first paragraph and replace with the following:

Provide portable work zone sign stands, portable signs and sign sheeting which are listed on the North Carolina Department of Transportation's approved product list or accepted as traffic qualified by the Traffic Control Unit.

Delete "Traffic Control Section" in the second sentence of the first paragraph and insert "Traffic Control Unit".

CONSTRUCTION METHODS

Page 11-6, Article 1110-3 CONSTRUCTION METHODS.

Replace **Article 1110-3 (B) Work Zone Signs (Barricade Mounted)** with the following:

Mount approved composite or roll-up signs to barricade rails so that the signs do not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails. Signs are to be mounted a minimum of 1' from the ground to the bottom of the sign.

Replace **Article 1110-3 (C, 2) Work Zone Signs (Portable)** with the following:

Install portable work zone signs to carry roll-up or approved composite at a minimum height of 1' from the bottom of the sign to the ground on two lane-two way roadways.

Install portable work zone signs to carry roll-up or approved composite at a minimum height of 5' from the bottom of the sign to the ground on multi-lane roadways.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Method of Measurement and Basis of Payment will be in accordance with Section 1110-5 and 1110-6 of the *Standard Specifications*.

SP11R15

BARRICADES **01-18-05**

Revise the *2002 Standard Specifications* as follows:

Page 11- 12, **Article 1145-2 Materials**, delete the contents and substitute the following:

(A) General

Refer to Division 10:

Barricades..... Article 1089-3

(B) Material Qualifications

Provide Type III barricades and barricade rails that are listed on the North Carolina Department of Transportation's approved product list or accepted as traffic qualified by the Traffic Control Unit. For more information on the Traffic Qualification process, contact the Traffic Control Unit at Century Center Building B, 1020 Birch Ridge Drive, Raleigh, NC 27610; (919) 250-4159, or see the approved product list on the NCDOT web site at: www.doh.dot.state.nc.us/construction/tc/Apv_Prod/apv_prod.htm

(C) Historical Performance:

Historical performance of Type III barricades and barricade rails will be used in determining future use of the material by the NCDOT, even if the Type III Barricade is traffic-qualified. Poor past or poor current performance of Type III Barricades at any site, whether or not related to a specific contract may be grounds for non-acceptance of a product on any project under contract.

MEASUREMENT AND PAYMENT

Method of Measurement and Basis of Payment will be in accordance with Section 1145-5 and 1145-6 of the *Standard Specifications*.

SP11R20

PAVEMENT MARKING GENERAL REQUIREMENTS: **07-16-02**

Revise the 2002 Standard Specifications as follows:

Page 12-10, Subarticle 1205-3(J)

Delete the first (1st) sentence of the first (1st) paragraph and insert the following:

"Have at least one member of every pavement marking crew working on a project certified through the NCDOT Pavement Marking Technician Certification Process. For more information contact the Traffic Control, Marking and Delineation Section of the North Carolina Department of Transportation at 919-250-4151 or http://www.doh.dot.state.nc.us/preconstruct/traffic/congestion/TC/"

SP12R01