

**PROJECT SPECIAL PROVISIONS****ROADWAY****CLEARING AND GRUBBING – METHOD II:**

(9-17-02) (Rev 3-18-08)

SP2 R01

Perform clearing on this project to the limits established by Method “II” shown on Standard No. 200.02 of the *2006 Roadway Standard Drawings*.

Revise the *2006 Standard Specifications* as follows:

**Page 2-2, Article 200-3, Clearing, add the following as the 6th paragraph:**

At bridge sites, clear the entire width of the right of way beginning at a station 3 feet back of the beginning extremity of the structure and ending at a station 3 feet beyond the ending extremity of the structure.

**EMBANKMENTS:**

(5-16-06) (Rev 10-19-10)

SP2 R18

Revise the *Standard Specifications* as follows:

**Page 2-22, Article 235-3 MATERIALS, amend as follows:**

Add the following as the second sentence of the first paragraph:

Do not use material meeting the requirements of AASHTO M145 for soil classification A-2-5 and A-5 with a plasticity index (PI) of less than 8 within 12” of the subgrade.

Add the following as the second sentence of the second paragraph:

Aerate and dry material containing moisture content in excess of what is required to achieve embankment stability and specified density.

**Page 2-22, Subarticle 235-4(B) Embankment Formation, add the following:**

- (16) Do not place rock or broken pavement in embankment areas where piles or drilled shaft foundations are to be constructed. This shall include but not be limited to piles and foundations for structures, metal signal poles, overhead sign structures, and high mount lighting.

**EMBANKMENT WAITING PERIODS:**

For embankment construction waiting periods, see Structure Plans.

**BRIDGE APPROACH FILLS:**

(10-19-10)

SP4 R01

**Description**

Construct bridge approach fills in accordance with the contract. Bridge approach fills include bridge approach fills for sub regional tier bridges and reinforced bridge approach fills. Geotextiles include engineering fabrics and geomembranes.

**Materials**

Refer to Division 10 of the *Standard Specifications*:

<b>Item</b>	<b>Section</b>
Portland Cement Concrete, Class B	1000
Select Material	1016
Subsurface Drainage Materials	1044
Engineering Fabrics	1056

Use Class III or V Select Material for reinforced approach fills and only Class V Select Material (standard size no. 78M stone) for bridge approach fills for sub regional tier bridges. Provide polyvinyl chloride (PVC) plastic drainage pipes, fittings and outlet pipes for subsurface drainage materials for all bridge approach fills. For bridge approach fills for sub regional tier bridges, use Type 1 Engineering Fabric for filter fabric to encase no. 78M stone. For reinforced bridge approach fills, use Type 5 Engineering Fabric for woven fabrics and Type 2 Engineering Fabric and no. 78M stone for drains.

Load, transport, unload and store geomembranes such that they are kept clean and free of damage. Geomembranes with defects, flaws, deterioration or damage will be rejected. Do not unwrap geomembranes until just before installation and do not leave geomembranes exposed for more than 7 days before covering geomembranes with woven fabrics.

Use either polyvinyl chloride (PVC), high density polyethylene (HDPE) or linear low density polyethylene (LLDPE) geomembranes. For PVC geomembranes, provide grade PVC30 geomembranes meeting the requirements of ASTM D7176. For HDPE and LLDPE geomembranes, use geomembranes with a nominal thickness of 30 mils meeting the requirements of Geosynthetic Research Institute Standard Specifications GM13 or GM17, respectively.

**Construction Methods**

Excavate as necessary for bridge approach fills in accordance with the contract. Notify the Engineer when foundation excavation is complete. Do not place geomembranes or filter fabrics until obtaining approval of the excavation depth and foundation material.

Attach geomembranes or filter fabrics to back of end bent caps and wing walls with adhesives, tapes or other approved methods. Use wire staples as needed to hold filter fabrics in place until covered. Overlap adjacent fabrics a minimum of 18" such that overlaps are parallel to the roadway centerline. Glue or weld geomembrane seams to prevent leakage. Contact the Engineer when existing or future structures such as foundations, pavements, pipes, inlets or utilities will interfere with geotextiles.

For reinforced bridge approach fills, place woven fabrics within 2" of locations shown on the plans and in slight tension free of kinks, folds, wrinkles or creases. Place first layer of woven fabric directly on geomembranes with no void or material in between. Install woven fabrics with the machine direction (MD) parallel to the roadway centerline. The MD is the direction of the length or long dimension of the roll. Do not splice or overlap woven fabrics in the MD such that splices or overlaps are perpendicular to the roadway centerline. Install woven fabrics with the orientation, dimensions and number of layers shown on the plans. Wrap woven fabrics as shown on the plans or as directed by the Engineer.

For reinforced bridge approach fills, construct 1 ft by 1 ft drains consisting of 4" diameter perforated PVC pipes surrounded by no. 78M stone wrapped in type 2 fabric. For bridge approach fills for sub regional tier bridges, install 4" diameter perforated PVC drainage pipes as shown on the plans.

Firmly connect PVC pipes together as needed. Connect perforated pipes to outlet pipes near the back faces of wing walls. Provide drains with positive drainage towards outlets. Place pipe sleeves in or under wing walls for outlet pipes such that positive drainage is maintained. Use sleeves of sufficient strength to withstand wing wall loads.

Place select material in 8 to 10 inch thick lifts. Compact Class III Select Material in accordance with Subarticle 235-4(C) of the *Standard Specifications*. Do not displace or damage fabrics or drains when placing and compacting select material. End dumping directly on fabrics and drains is not permitted. Do not operate heavy equipment on woven fabrics or drains until they are covered with at least 8" of select material. Replace any damaged fabrics and drains to the satisfaction of the Engineer.

Use only hand operated compaction equipment for bridge approach fills for sub regional tier bridges and within 3 ft of end bent cap back or wing walls for reinforced bridge approach fills. At a distance greater than 3 ft for reinforced bridge approach fills, compact select material with at least 4 passes of an 8 – 10 ton vibratory roller. Smooth wheeled or rubber tired rollers are also acceptable for compacting select material. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet.

Use solvent cement for connecting outlet pipes and fittings such as wyes, tees and elbows. Provide connectors for outlet pipes and fittings that are watertight and suitable for gravity flow conditions. Cover open ends of outlet pipes with rodent screens as shown on the plans.

Connect drains to concrete pads or existing drainage structures at ends of outlet pipes as directed by the Engineer. Construct concrete pads and provide an Ordinary Surface Finish in accordance with Subarticle 825-6(B) of the *Standard Specifications*.

**Measurement and Payment**

*Reinforced Bridge Approach Fill, Station \_\_\_\_\_* will be paid at the contract lump sum price. Such price and payment will be full compensation for all reinforced bridge approach fills at each bridge for excavating and furnishing, transporting and placing geotextiles, select material, drains, pipe sleeves and concrete pads, compacting select material, connecting pipes to existing drainage structures and providing any labor, tools, equipment and materials to complete the work.

*Bridge Approach Fill – Sub Regional Tier, Station \_\_\_\_\_* will be paid at the contract lump sum price. Such price and payment will be full compensation for all bridge approach fills at each sub regional tier bridge for excavating and furnishing, transporting and placing filter fabrics, no. 78M stone, drainage pipes, pipe sleeves and concrete pads, compacting no. 78M stone, connecting pipes to existing drainage structures and providing any labor, tools, equipment and materials to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Reinforced Bridge Approach Fill, Station _____	Lump Sum
Bridge Approach Fill – Sub Regional Tier, Station _____	Lump Sum



**ROCK BLASTING:****(SPECIAL)****Description**

This project special provision governs fracturing rock for excavation and constructing stable rock cut slopes using controlled, production and trench blasting. Controlled blasting is used to form a certain slope by limiting the effects of blasting with cushion or trim blasting. Another type of controlled blasting known as presplitting is not addressed by this provision. Production blasting is used to fracture rock in manageable sizes for excavation. Trench blasting is used to create trenches in rock for utilities and pipes and construct open ditches. This provision also addresses secondary blasting and blasting adjacent to highway structures in lieu of Article 410-11 of the *Standard Specifications*.

Exercise care when using bulk ammonium nitrate and fuel oil (ANFO) near open water to prevent ANFO from leaching into lakes, streams, creeks and rivers. Control blasting to avoid damaging public and private property. Contain flyrock in the construction limits or perform blasting such that no flyrock occurs if required in the “Project Requirements” section of this provision. When blasting in the vicinity of an open travelway, have equipment standing by to remove material that interferes with traffic flow.

Perform rock blasting, develop blast plans, provide explosive materials, drill, load and stem holes, record drilling, conduct blast surveys, monitor blasts and submit drilling records, surveys and reports in accordance with the contract and accepted submittals.

**Project Requirements**

At a minimum, conduct pre-blast surveys for any building, residence or utility when the maximum charge per delay ( $W_{max}$ ) and the distance to the subject structure (D) may result in a peak particle velocity (PPV) equal to or greater than 0.4 in/sec (10 mm/sec) using the formulas in the “Peak Particle Velocity and Scaled Distance” section of this provision.

Blasting is subject to the “USBM Alternative Blasting Level Criteria” from the ISEE Blasters’ Handbook, 17<sup>th</sup> Edition for not-to-exceed limits. Warning levels for vibration are 0.25 in/sec (6 mm/sec) less than the not-to-exceed limits. For air-overpressure (noise), blasting is subject to a not-to-exceed limit of 133 dBL and a warning level of 120 dBL.

**Definitions**

*Air-Overpressure or Air Blast (Noise)* – The pulsating pressure changes above and below ambient air pressure generated by an explosion. Air-overpressure “linear scale” measurements include low frequency noise with a 2 hertz (Hz) response and are expressed in units of decibels-L (dBL).

*Blast Pattern* – A plan of blast hole locations or an expression of the burden and spacing distance and their relationship to each other.

*Burden* – The amount of rock broken by an explosive charge measured as the distance between the blast hole and the nearest free face.

*Charge per Delay (W)* – The sum of all charge weights firing within any 8 milliseconds (ms) time period. For example, if two 10 lb (4.5 kg) charges fire at 100 ms and one 15 lb (6.8 kg) charge fires at 105 ms, the charge per delay would be 35 lbs (15.8 kg).

*Cushion or Trim Blasting* – A controlled blasting technique in which a line of blast holes along a rock face are detonated during the last delay period of the blast. The main burden is moved from the face by production blast holes leaving only a small burden to be removed by the line of blast holes at the face. Charges in these holes are lighter than charges in the production blast holes.

*Deck Loading (Decking)* – A method of loading blast holes in which two or more explosive charges, called decks or deck charges, are loaded in the same hole separated by stemming or an air cushion.

*Delay Blasting* – The practice of initiating individual explosive decks, blast holes or rows of holes at predetermined time intervals using delays or delay detonators as compared to firing all blast holes simultaneously.

*Flyrock* – Rocks propelled through the air by the force of an explosion.

*Free Face* – A rock surface exposed to air or water that provides room for expansion upon fragmentation.

*Magazine* – Any building, structure or container, approved for storage of explosive materials other than an explosive manufacturing building.

*Misfire* – An event where all or some charges in a blast fail (do not detonate) when initiated or a term for any portion of explosive materials that fail to detonate as planned.

*Peak Particle Velocity (PPV)* – The maximum ground vibration velocity measured in the vertical, longitudinal or transverse direction. PPV measurement units are expressed in inches or millimeters per second (in/sec or mm/sec).

*Scaled Distance (Ds)* – A calculated value in units of  $\text{ft}/\text{lb}^{0.5}$  ( $\text{m}/\text{kg}^{0.5}$ ) describing relative vibration energy based on distance to a structure (D) and charge per delay (W). Ds is equal to D divided by the square root of W,  $D_s = D / W^{0.5}$  or  $W = (D / D_s)^2$ .

*Spacing* – The distance between blast holes in a row. In production blasting, the distance is measured parallel to the free face and perpendicular to the burden.

*Stemming* – Crushed stone placed in the unloaded collar area of blast holes for the purpose of confining explosive charges and limiting rock movement and air-overpressure.

*Subdrilling* – The portion of a blast hole that is drilled below or beyond the desired excavation depth or limit. Subdrilling is generally required to prevent the occurrence of high or tight areas of unfractured rock between blast holes.

## **Regulations**

Comply with all the latest applicable Federal, State and local codes, laws, rules and regulations as well as professional society standards for the storage, transportation and use of explosives. These include but are not limited to the following:

- The Occupational Safety and Health (OSH) Act of 1970 and the Construction Safety Act (CSA) of 1969, as amended

- Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296; Interim Final Rule
- Title 29, U. S. Code, Section 651 et seq., including safety and health regulations for construction
- Title 27, Code of Federal Regulations (27 CFR), Part 555, U. S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)
- Organized Crime Control Act of 1970, Title XI, Public Law 91-452, as amended
- Title 49, Code of Federal Regulations (49 CFR), Parts 105-177 (DOT RSPA) & Parts 301-399 (DOT FHA)
- Title 29, Code of Federal Regulations (29 CFR), Parts 1910 & 1926, N. C. Department of Labor, Division of Occupational Safety and Health
- The Mining Act of 1971, North Carolina General Statute, Chapter 74, Article 7, as amended
- Fire Code of North Carolina, Section 105.6.15 Explosives
- Administrative Rules, 13 NCAC 06.0521 – 13 NCAC 06.0526, N. C. Department of Labor
- “A Guide to the Safe Storage of Explosive Materials” and “North Carolina Occupational Safety and Health Standards in Construction for Blasting & Use of Explosives”, N. C. Department of Labor

Keep a copy of all regulations listed above at the project site.

Non-regulatory Industry Support Organizations:

- Blast Monitoring Equipment Operation Standards (1999), Vibration Subcommittee of the International Society of Explosive Engineers (ISEE)
- Institute of Makers of Explosives (IME) Safety Library Publications (SLPs)

In case of conflict, the more stringent regulation applies.

### **Submittals**

In lieu of a blasting plan in accordance with Article 107-11 of the *Standard Specifications*, the following submittals are required for rock blasting.

- Blasting Contractor Personnel and Experience including Blasting Consultant, if applicable
- General Blast Plan including Blast Monitoring Consultant, if applicable
- Site Specific Blast Plans including Pre-blast Surveys
- Post-blast Reports including Drilling Records, Blast Monitoring Report and Blast Damage Report, when necessary

For the site specific blast plans and post-blast reports, submit two hard copies of each to the Resident Engineer. After completing all blasting for a cut, structure or an excavation, submit electronic copies (PDF on CD or DVD) of all site specific blast plans and post-blast reports.

Allow 30 calendar days upon receipt by the Department for the review and acceptance of the Blasting Contractor personnel and experience and general blast plan. Provide these submittals in both electronic and hard copy form in accordance with the following:

Submit one hard copy to the Resident Engineer. At the same time, submit a second hard copy and an electronic copy (PDF on CD or DVD) directly to the Geotechnical Engineering Unit at the following addresses:

**For projects in Divisions 1-7, use the following Eastern Regional Office addresses:**

**Via US mail:**

Eastern Regional Geotechnical Manager  
North Carolina Department of  
Transportation  
Geotechnical Engineering Unit  
Eastern Regional Office  
1570 Mail Service Center  
Raleigh, NC 27699-1570

**Via other delivery service:**

Eastern Regional Geotechnical Manager  
North Carolina Department of  
Transportation  
Geotechnical Engineering Unit  
Eastern Regional Office  
3301 Jones Sausage Road, Suite 100  
Garner, NC 27529

**For projects in Divisions 8-14, use the following Western Regional Office addresses:**

**Via US mail:**

Western Regional Geotechnical Manager  
North Carolina Department of  
Transportation  
Geotechnical Engineering Unit  
Western Regional Office  
5253 Z Max Boulevard  
Harrisburg, NC 28075

**Via other delivery service:**

Western Region Geotechnical Manager  
North Carolina Department of  
Transportation  
Geotechnical Engineering Unit  
Western Regional Office  
5253 Z Max Boulevard  
Harrisburg, NC 28075

The Engineer may suspend blasting operations in accordance with Article 108-7 of the *Standard Specifications* if submittals are illegible, incomplete or not provided.

**(A) Blasting Contractor Personnel and Experience**

The Engineer may waive this submittal if a Blasting Consultant is not required and the Blasting Contractor and Blaster-in-Charge for this project were previously accepted within the last year for another NCDOT project with subsurface conditions and blasting of a scope and complexity similar to that anticipated for this project.

Obtain acceptance of the Blasting Contractor personnel and experience before submitting a general blast plan.

**(1) Blasting Contractor**

Use a Blasting Contractor prequalified by the NCDOT Contractual Services Unit for rock blasting work (work code 070). Submit documentation that the Blasting Contractor has successfully completed at least 5 blasting projects within the last 3 years with subsurface conditions and blasting of a scope and complexity similar to that anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project.

**(2) Blaster-in-Charge**

The Blaster-in-Charge has total authority over the handling, use and security of explosives and is responsible for coordinating, planning and supervising explosives use. The Blaster-in-Charge is also responsible for designing blasts and preparing blast plans when a Blasting Consultant is not required and for monitoring blasts when a Blast Monitoring Consultant is not required. Either the Blaster-in-Charge or an alternate Blaster-in-Charge is required to be on-site during blasting.

Provide verification of employment with the Blasting Contractor for the Blaster-in-Charge and any alternate Blasters-in-Charge assigned to this project. Submit documentation that each Blaster-in-Charge has a minimum of 5 years experience in blasting with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. If there is a change in the Blaster-in-Charge, discontinue explosives use until a new Blaster-in-Charge is submitted and accepted.

**(3) Blasting Consultant**

When a Blasting Consultant is required in the "Project Requirements" section of this provision, submit an independent consultant to design blasts and prepare blast plans. Employees of the Contractor, any affiliated companies or product suppliers are not allowed to be independent consultants. Use a Blasting Consultant approved as a Geotechnical Engineer (key person) for a consultant prequalified by the NCDOT Contractual Services Unit for the rock blasting evaluation & design discipline.

**(B) Blast Plans**

Blast plans are required to be signed by the Blaster-in-Charge (and Blasting Consultant, if applicable). Review and acceptance of blast plans does not relieve the Contractor of

responsibility for the blast results or liability in accordance with Articles 107-11 and 107-12 of the *Standard Specifications*.

**(1) General Blast Plan**

Submit a general blast plan before beginning drilling, when revised drilling or blasting methods are proposed or as directed by the Engineer. At a minimum, include the following in the plan:

- Work procedures and safety precautions for the storage, transportation, handling and detonation of explosives
- Explosive products and devices for dry and wet blast holes including explosives, primers and detonators with material safety data sheets
- Drilling equipment and methods for maintaining blast hole alignment
- Typical plan, profile and sectional views for both production and controlled blasting showing hole diameter, depth, inclination and spacing, maximum blast limits, burden, subdrill depth and maximum charge per delay
- Initiation and delay methods and delay times
- Site specific blast plan format
- Blast hole drill log format
- Pre-blast survey criteria and method
- Blast monitoring report format and equipment including calibration information
- Post-blast report format
- Blast Monitoring Consultant, if applicable
- Test blast locations when required

Do not deliver explosives to the project site until the general blast plan is reviewed and accepted.

**(2) Site Specific Blast Plan**

After the general blast plan is accepted, submit a site specific blast plan at least 24 hours in advance of each blast. Site specific blast plans may be waived for non-critical blasts as determined by the Engineer. The following is required for the plan:

- Scaled drawings of the blast area with cross-sections showing the beginning and ending stations, hole diameter, depth, inclination, spacing, burden, subdrill depth and free face location and any joints, bedding planes, weathered zones, voids or other significant rock structure that may influence the blast
- A loading pattern diagram showing the location and amount of each type of explosive including primers and detonators
- The locations and depths of stemming, column heights and maximum charge per delay for each type of loading
- A delay and initiation diagram showing delay pattern, sequence and times
- Pre-blast surveys (once per structure; not required when submitted for a prior blast)

For site specific blast plans do not exceed the maximum charge per delay accepted in the general blast plan or submit a revised general blast plan to increase the maximum charge per delay allowed.

**(C) Pre-blast Surveys and Post-blast Reports**

**(1) Blast Monitoring Consultant**

When a Blast Monitoring Consultant is required in the “Project Requirements” section of this provision, use an independent consultant prequalified by the NCDOT Contractual Services Unit for vibration & noise monitoring work (work code 3120). Employees of the Contractor, any affiliated companies or product suppliers are not allowed to be independent consultants.

**(2) Peak Particle Velocity and Scaled Distance**

Use the following formulas to determine peak particle velocity (PPV) and scaled distance (Ds).

$$PPV = K(Ds)^m \quad \text{and} \quad Ds = D / (W_{max})^{0.5}$$

where: PPV = Peak Particle Velocity (in/sec or mm/sec)  
 K and m = Site specific constants defining initial energy and decay  
 Ds = Scaled Distance (ft/lb<sup>0.5</sup> or m/kg<sup>0.5</sup>)  
 D = Distance to subject structure (ft or m)  
 W<sub>max</sub> = Maximum charge per delay (lbs or kg)

Typically, a K of 240 (1725 for metric units) and an m of -1.6 may be used for the equations above. However, K and m are site specific and may be determined by performing a regression analysis of multiple PPV and Ds data pairs. Select K and m based on actual site conditions, rock type and structure, subsurface information and blast monitoring measurements.

**(3) Pre-blast Survey**

Conduct pre-blast surveys in accordance with the “Project Requirements” section of this provision and the accepted general blast plan. At a minimum, include the following in the survey:

- Summary naming the person who performed the survey and comments about each structure and existing condition
- Sketches of interior and exterior walls and foundations with existing cracks and a written description of the cracks including the length, width, type and angle
- 4 x 6 inch (100 x 150 mm) color 35-mm or 5-megapixel digital photographs or miniDV or DVD digital video documenting the existing cracks and condition of each structure

Submit pre-blast surveys with site specific blast plans.

**(4) Post-blast Report**

Within 3 days after each blast or before the next blast, whichever is sooner, submit a post-blast report signed by the Blaster-in-Charge that includes the following:

- Results and effectiveness of the blast and any proposed changes to subsequent site specific blast plans
- Blast monitoring report
- Blast damage report when necessary
- Drilling records including blast pattern and blast hole drill logs

**(a) Blast Monitoring**

At a minimum, monitor vibration and air-overpressure (noise) at the nearest building, residence or utility and the nearest building, residence or utility in the direction of the blast in accordance with the accepted general blast plan. Furnish seismographs capable of measuring particle velocities in the longitudinal, vertical and horizontal directions. Use monitoring equipment calibrated within one year of the date the data is collected. Interpret the recorded data and submit a blast monitoring report signed by the Blaster-in-Charge (or Blast Monitoring Consultant, if applicable) with the post-blast report that includes the following for each monitoring location:

- Type, identification and specific location of monitoring equipment
- Distance and direction to blast
- PPV in each direction and peak vector sum
- Maximum air-overpressure

If damage occurs from blasting, notify the Engineer immediately. Submit a blast damage report signed by the Blaster-in-Charge (and Blast Monitoring Consultant, if applicable) with the post-blast report that includes the following:

- Property owner's (and injured person's, if any) names, addresses and telephone numbers
- Details and description of property damage (and injury, if any) with photos or video
- Any associated tort claims, complaint letters and other applicable information

**(b) Drilling Records**

Identify each blast hole with a number on a blast pattern. Log the hole number, total depth, date drilled and the depth and description of significant conditions encountered such as water, voids and weak or



jointed seams. Submit the blast pattern and blast hole drill logs signed by the Driller with the post-blast report.

### **Blast Design Requirements**

#### **(A) Vibration and Air-overpressure**

Design blasts for the vibration and air-overpressure (noise) warning levels and not-to-exceed limits in the “Project Requirements” section of this provision. If warning levels are exceeded, the Engineer may require additional monitoring and the Contractor should be aware that future blasts could exceed the not-to-exceed limits. If not-to-exceed limits are exceeded, the Engineer may suspend blasting operations in accordance with Article 108-7 of the *Standard Specifications* and require test blasts and a revised general blast plan.

#### **(B) Production Blasts**

Design production blasts in accordance with the following unless otherwise approved:

- Maintain a minimum 6 ft (1.8 m) clearance between the production blast holes and final cut slope face
- Diameter of production blast holes may not exceed 6” (150 mm)
- Do not drill production blast holes below the bottom of adjacent controlled blast holes
- Use delay blasting to detonate production blast holes towards a free face

#### **(C) Controlled Blasts**

Controlled blasts are required for final cut slopes steeper than 2:1 (H:V) when the height of the rock face exceeds 15 ft (4.6 m).

##### **(1) Cushion Blasts**

Cushion blasts refer to either trim or cushion blasting. Design cushion blasts in accordance with the following unless otherwise approved:

- Diameter of cushion blast holes may not exceed 6” (150 mm)
- Minimize subdrilling to only that required for excavation of the final cut slopes
- Do not subdrill below final grade
- Bench height or lift thickness may not exceed 25 ft (7.6 m)
- Use a maximum of half the charge density and burden of the production blast holes for the cushion blast holes
- Do not use bulk ANFO or any other bulk loaded products
- Fire cushion blast holes after production blast holes with a minimum 25 ms delay

**(D) Trench Blasts**

Design trench blasts in accordance with the following unless otherwise approved:

- Diameter of trench blast holes may not exceed 3" (75 mm)
- Do not use bulk ANFO or any other bulk loaded products
- Use cartridge explosives or other types of explosives specifically designed for trench blasting
- Use a charge diameter ½ to ¾ inch (13 to 19 mm) less than the diameter of the trench blast holes

**Test Blasts**

A test blast is defined as drilling, blasting and excavation of a test section before beginning or restarting full scale blasting. When a test blast is required in the "Project Requirements" section of this provision or as directed by the Engineer, perform one or more test blasts for both production and controlled blasting (cushion or trim blasting) or trench blasting before beginning full scale blasting. Submit proposed test blast locations with the general blast plan. Also, if the Engineer suspends blasting operations after full scale blasting has begun, one or more test blasts may be required before resuming blasting. When this occurs, inform the Engineer of the test blast locations before submitting any site specific blast plans.

Perform test blasts in accordance with the submittal, blast design and construction requirements except submit site specific blast plans for test blasts 72 hours before beginning drilling. Full scale blasting may not begin or resume until the test blasts are acceptable to the Engineer. The Engineer will not consider whether a test blast is acceptable until the rock face is exposed and the post-blast report is submitted. Examples of results that may be unacceptable include excessive vibration, air-overpressure or flyrock, overbreakage, damage to the final cut slope face and overhangs.

**Construction Methods**

Before beginning drilling, conduct a pre-blast meeting to discuss the blasting and monitoring. Schedule this meeting after all blast plans have been accepted. The Resident Engineer, Roadway Construction Engineer, Geotechnical Operations Engineer, Contractor and Blaster-in-Charge (and Blasting Consultant and Blast Monitoring Consultant, if applicable) will attend this pre-blast meeting.

Drill and blast in accordance with site specific blast plans, the general blast plan, and this provision as directed by the Engineer. Use explosives in accordance with all applicable government regulations, professional society standards and manufacturer guidelines and recommendations.

Remove all overburden material along the top of the excavation for a minimum of 30 ft (9.1 m) beyond the blast holes or the end of the cut unless otherwise approved. Inspect the free face to ensure there is adequate burden.

Drill blast holes within 3" (75 mm) of plan location and control drilling to maintain the final cut slope angle. Accurately determine the angle at which the drill steel enters the rock. Cover all blast holes after drilling to prevent unwanted backfill and identify and mark each hole with hole number and depth. Blast holes are required to be free of obstructions the entire depth. Load holes without dislodging material or caving in the blast hole wall. Use standard size nos. 67 and 78M in accordance with Section 1005 of the *Standard Specifications* for stemming. Stem blast holes with diameters of 5" (250 mm) or greater with no. 67 coarse aggregate and blast holes with diameters less than 5" (250 mm) with no. 78M coarse aggregate. Do not stem blast holes with drill cuttings. Matting is required when blasting in close proximity to buildings, residences, utilities, traffic and populated areas. Soil cover may be used in lieu of matting if allowed by the Engineer.

Notify all occupants of residences, businesses and structures in the surrounding area and the Engineer at least 24 hours before blasting. Check for misfires immediately after each blast before signaling all clear. Remove any loose, hanging or potentially dangerous conditions by hand or machine scaling methods. Resume drilling only after scaling is complete.

When the height of a cut requires multiple lifts or benches, offset the controlled blast holes for each subsequent lift the minimum distance necessary to allow for drill equipment clearances. Adjust the alignment of controlled blast holes to account for this offset as well as any drift that occurred in the preceding lift.

The Engineer may suspend blasting operations in accordance with Article 108-7 of the *Standard Specifications* when vibration, air-overpressure or flyrock limits are exceeded, unsatisfactory rock cut slopes are produced or other reasons.

Remove all loose material from final rock faces by scaling. The Contractor is responsible for the final rock face. If blasting damages the final rock face, stabilize the slope at no additional cost to the Department with a method proposed by the Contractor and accepted by the Department.

### **Secondary Blasting**

Secondary blasting is used to reduce the size of naturally occurring boulders or those resulting from initial blasting. Secondary blasting methods include block holing or boulder busting. Block holing or boulder busting is the breaking of boulders by loading and firing small explosive charges in small diameter blast holes. Submit a combined general and site specific blast plan for secondary blasting. The Engineer may waive the pre-blast surveys, blast monitoring and post-blast reports at their discretion.

Mud capping, which is defined as placing an unconfined explosive charge in contact with a rock surface without the use of a blast hole and covering it with mud, is not allowed.

### **Blasting Adjacent to Highway Structures**

Do not blast adjacent to highway structures until the concrete strength reaches 2400 psi (16.5 MPa). When blasting adjacent to highway structures, limit PPV to 4 in/sec (100 mm/sec)

measured at a location on the structure nearest the blast. Perform blasting adjacent to highway structures in accordance with the submittal, blast design and construction requirements in this provision.

When blasting for foundation excavation, submit a combined general and site specific blast plan and the Engineer may waive the pre-blast surveys, blast monitoring and post-blast reports at their discretion.

### **Measurement and Payment**

No direct payment for rock blasting or scaling will be made. The contract unit price for *Unclassified Excavation* in accordance with Article 225-7 of the *Standard Specifications* or the lump sum price for *Grading* in accordance with Article 226-3 of the *Standard Specifications* will be full compensation for all necessary rock blasting and scaling in accordance with the contract.

No direct payment for rock blasting will be made for any pipe, utility or foundation excavation. Rock blasting for these items will be considered incidental to the compensation for the required excavation at the various locations. Where no direct payment for excavation is made, the cost for all rock blasting will be considered incidental to the required work and no separate payment for blasting will be made.

No additional payment will be made or extension of contract time allowed when the Engineer suspends blasting operations and requires test blasts, additional monitoring or submittals in accordance with this provision.

### **SHOULDER AND FILL SLOPE MATERIAL:**

(5-21-02)

SP2 R45 C

#### **Description**

Perform the required shoulder and slope construction for this project in accordance with the applicable requirements of Section 560 and Section 235 of the *2006 Standard Specifications* except as follows:

Construct the top 6 inches 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 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.

#### **Compensation**

When the Contractor elects to obtain material from an area located beneath a proposed fill sections which does not require excavation for any reason other than to generate acceptable shoulder and fill slope material, the work of performing the excavation will be considered

incidental to the item of *Borrow Excavation* or *Shoulder Borrow*. If there is no pay item for *Borrow* or *Shoulder Excavation* in the contract, this work will be considered incidental to *Unclassified Excavation*. Stockpile the excavated material in a manner to facilitate measurement by the Engineer. Fill the void created by the excavation of the shoulder and fill slope material with suitable material. Payment for material used from the stockpile will be made at the contract unit price for *Borrow Excavation* or *Shoulder Borrow*. If there is no pay item for *Borrow Excavation* or *Shoulder Borrow*, then the material will be paid for at the contract unit price for *Unclassified Excavation*. The material used to fill the void created by the excavation of the shoulder and fill slope material will be made at the contract unit price for *Unclassified Excavation*, *Borrow Excavation*, or *Shoulder Borrow*, depending on the source of the material.

Material generated from undercut excavation, unclassified excavation or clearing and grubbing operations that is placed directly on shoulders or slope areas, will not be measured separately for payment, as payment for the work requiring the excavation will be considered adequate compensation for depositing and grading the material on the shoulders or slopes.

When undercut excavation is performed at the direction of the Engineer and the material excavated is found to be suitable for use as shoulder and fill slope material, and there is no area on the project currently prepared to receive the material generated by the undercut operation, the Contractor may construct a stockpile for use as borrow at a later date. Payment for the material used from the stockpile will be made at the contract unit price for *Borrow Excavation* or *Shoulder Borrow*.

When shoulder material is obtained from borrow sources or from stockpiled material, payment for the work of shoulder construction will be made at the contract unit price per cubic yard for *Borrow Excavation* or *Shoulder Borrow* in accordance with the applicable provisions of Section 230 or Section 560 of the *2006 Standard Specifications*.

### **RIP RAPPED ENERGY DISSIPATOR BASIN:**

#### **Description**

This work consists of the construction and maintenance of an armored outlet structure located at culvert outlets or ditch termini.

The quantity of energy dissipator material(s) may be affected by site conditions during construction of the project. The quantity of materials may be increased, decreased, or eliminated entirely at the direction of the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

#### **Materials**

Refer to Division 10 of the *Standard Specifications*.

Item	Section
Class I Rip Rap	Section 1042
Filter Fabric for Drainage, Type 2	Section 1056

### Construction Methods

Rip Rapped Energy Dissipator Basins shall be constructed in accordance with the detail shown in the plans or as directed. From the outlet invert of a culvert (or bottom of a ditch) excavation will drop to a specified depth. Excavation will continue to widen through the dissipator. Rip rap shall be placed along the banks and bottom of the dissipator and along the apron.

### Measurement and Payment

*Class I Rip Rap* will be measured and paid for in accordance with Section 876 of the Standard Specifications.

*Filter Fabric for Drainage* will be measured and paid for in accordance with Section 876 of the Standard Specifications.

*Drainage Ditch Excavation* will be measured and paid for in accordance with Section 240 of the Standard Specifications.

Such price and payment will be full compensation for all work covered by this section, including, but not limited to furnishing all materials, labor, equipment, and incidentals necessary to construct the rock cross vanes.

### **SELECT GRANULAR MATERIAL:**

(3-16-10)

SP2 R80

Revise the *Standard Specifications* as follows:

**Page 2-29, Delete Section 265 SELECT GRANULAR MATERIAL** and replace it with the following:

### **SECTION 265 SELECT GRANULAR MATERIAL**

#### **265-1 Description**

Furnish and place select granular material in accordance with the contract or as directed by the Engineer.

#### **265-2 Materials**

Refer to Division 10 of the *Standard Specifications*.

<b>Item</b>	<b>Section</b>
Select Material, Class II	1016
Select Material, Class III	1016

**265-3 Construction Methods**

Use Class II or III Select Material over fabric for soil stabilization and only Class III Select Material for backfill in water.

Place select granular material to 3 ft above fabric and water level.

**265-4 Measurement and Payment**

Select granular material will be paid for as *Select Granular Material* unless the material is obtained from the same source as the borrow material and the contract includes a pay item for *Borrow Excavation*. When this occurs, select granular material will be paid for as *Borrow Excavation* in accordance with Article 230-5 of the *Standard Specifications* and no payment for *Select Granular Material* will be made.

*Select Granular Material* will be measured and paid for in cubic yards. When *Undercut Excavation* is in accordance with Section 226 (Comprehensive Grading) of the *Standard Specifications* and the Engineer requires undercut to be backfilled with select granular material, the second sentence of the sixth paragraph of Article 226-3 will not apply, as payment for the backfill will be made as specified in this provision.

Select granular material will be measured by in place measurement in accordance with Article 230-5 of the *Standard Specifications* or by weighing material in trucks in accordance with Article 106-7 of the *Standard Specifications* as determined by the Engineer. When select granular material is weighed in trucks, a unit weight of 135 pcf will be used to convert the weight of select granular material to cubic yards. At the Engineer's discretion, truck measurement in accordance with Article 230-5 of the *Standard Specifications* may be used in lieu of weighing material in trucks.

The contract unit prices for *Select Granular Material* and *Borrow Excavation* as described above will be full compensation for furnishing, hauling, handling, placing, compacting and maintaining select granular material.

Payment will be made under:

**Pay Item**

Select Granular Material

**Pay Unit**

Cubic Yard

**DRAINAGE PIPE:**

(7-18-06) (Rev 3-16-10)

SP3 R37

**Description**

Where shown in the plans the Contractor may use Reinforced Concrete Pipe, Aluminum Alloy Pipe, Aluminized Corrugated Steel Pipe, HDPE Pipe, or PVC pipe in accordance with the following requirements.

**Material**

<b>Item</b>	<b>Section</b>
Corrugated Aluminum Alloy Pipe	1032-2(A)
Aluminized Corrugated Steel Pipe	1032-3(A)(7)
Corrugated Polyethylene Pipe (HDPE)	1032-10
Reinforced Concrete Pipe – Class II or III	1032-9(C)
Polyvinyl-Chloride (PVC)	1032-11
Elbows	1032

Corrugated Steel Pipe will not be permitted in counties listed in the contract documents.

Only pipe with smooth inside walls will be allowed for storm drain systems. Storm drain systems are defined as pipe under curb and gutter, expressway gutter, and shoulder berm gutter that connects drainage structures and is not open ended.

**Construction Methods**

Pipe Culverts shall be installed in accordance with the contract documents.

Where allowed by the plans, use any of the several alternate pipes shown herein, but only one type of pipe and elbow will be permitted between drainage structures or for the entire length of a cross line pipe.

**Measurement and Payment**

\_\_\_" *Drainage Pipe* will be paid for as the actual number of linear feet installed and accepted. Measurement will be in accordance with the contract documents.

\_\_\_" *Drainage Pipe Elbow* will be measured and paid for in units of each.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___" Drainage Pipe	Linear Foot
___" Drainage Pipe Elbow	Each



**PIPE INSTALLATION AND PIPE CULVERTS:**

(1-19-10)(Rev 1-18-11)

SP3 R40 B

Revise the *Standard Specifications* as follows:

Replace Section 300 and Section 310 with the following:

**SECTION 300  
PIPE INSTALLATION**

**300-1 DESCRIPTION**

Excavate, undercut, provide material, condition foundation, lay pipe, joint and couple pipe sections, and furnish and place all backfill material as necessary to install the various types of pipe culverts and fittings required to complete the project.

Install pipe in accordance with the detail in the plans.

Do not waste excavation unless permitted. Use suitable excavated material as backfill; or in the formation of embankments, subgrades, and shoulders; or as otherwise directed. Furnish disposal areas for the unsuitable material. The Engineer will identify excavated materials that are unsuitable.

Where traffic is to be maintained, install pipe in sections so that half the width of the roadway is available to traffic.

**300-2 MATERIALS**

Refer to Division 10:

<b>Item</b>	<b>Section</b>
Flowable Fill	1000
Select Materials	1016
Joint Materials	1032-9(G)
Engineering Fabrics	1056

Provide foundation conditioning material meeting the requirements of Article 1016-3 for Class V or VI Select Material as shown in the contract documents.

Provide bedding material meeting the requirements of Article 1016-3 for Class II (Type 1 only) or Class III Select Material as shown in contract documents.

Provide backfill material meeting the requirements of Article 1016-3 for Class II (Type 1 for Flexible Pipe) or Class III Select Material as shown in the contract documents.

Provide filter fabric meeting the requirements of Article 1056-2 for any type of engineering fabric.

Provide foundation conditioning fabric meeting the requirements of Article 1056-2 for Type 2 Engineering Fabric.

Do not use corrugated steel pipe in the following counties:

Beaufort, Bertie, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Gates, Hertford, Hyde, Jones, Martin, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell, and Washington.

### **300-3 UNLOADING AND HANDLING**

Unload and handle pipe with reasonable care. Do not roll or drag metal pipe or plates over gravel or rock during handling. Take necessary precautions to ensure the method used in lifting or placing the pipe does not induce stress fatigue in the pipe. Use a lifting device that uniformly distributes the weight of the pipe along its axis or circumference. Repair minor damage to pipe when permitted. Remove pipe from the project that is severely damaged or is rejected as being unfit for use. Undamaged portions of a joint or section may be used where partial lengths are required.

### **300-4 PREPARATION OF PIPE FOUNDATION**

Prepare the pipe foundation in accordance with the applicable method as shown in the contract documents, true to line and grade, and uniformly firm.

Camber invert grade an amount sufficient to prevent the development of sag or back slope in the flow line. The Contractor shall determine the amount of camber required and submit to the Engineer for approval.

Where material is found to be of poor supporting value or of rock and when the Engineer cannot make adjustment in the location of the pipe, undercut existing foundation material within the limits established on the plans. Backfill the undercut with foundation conditioning material. Encapsulate the foundation conditioning material with foundation conditioning fabric prior to placing bedding material. Overlap all transverse and longitudinal joints in the fabric at least 18 inches.

Maintain the pipe foundation in a dry condition.

### **300-5 INVERT ELEVATIONS**

The proposed pipe culvert invert elevations shown on the Drainage Summary Sheets are based upon information available when the plans were prepared. If proposed invert elevations are adjusted during construction based upon actual conditions encountered, no claim for an extension of time for any reason resulting from this information will be allowed.

When a pipe culvert is to be installed in a trench and the average actual elevation of the pipe between drainage structures deviates from the average proposed elevation shown on the Drainage Summary Sheets by more than one foot a pay adjustment will be made as follows:

$$\text{Pay Adjustment (per linear foot)} = [(APE - AAE) \pm 1 \text{ foot}] (0.15 \times \text{CUP})$$

Where:

$$\text{CUP} = \text{Contract Unit Price of Pipe Culvert}$$

$$\text{AAE} = \text{Average Actual Elevation} \quad \left( \frac{\text{Actual Inlet elev.} + \text{Actual Outlet elev.}}{2} \right)$$

$$\text{APE} = \text{Average Plan Elevation} \quad \left( \frac{\text{Plan Inlet elev.} + \text{Plan Outlet elev.}}{2} \right)$$

When the actual location of a pipe culvert is changed from the location shown on the plans, the Engineer will make a pay adjustment deemed warranted based upon the relation of the pipe culvert as shown on the plans to the finished roadway and the relation of the pipe culvert as constructed to the finished roadway.

The top elevation column on the drainage summary sheet indicates the flow elevation at the top of structures intended to collect surface water.

The top elevation column on drainage structures not intended to collect surface water indicates the elevation at the top of the cover.

### **300-6 LAYING PIPE**

The Department reserves the right to perform forensic testing on any installed pipe.

#### **(A) Rigid Pipe**

Concrete and welded steel pipe will be considered rigid pipe. Lay pipe on prepared foundation, bell or groove end upgrade with the spigot or tongue fully inserted. Check each joint for alignment and grade as the work proceeds.

Use flexible plastic joint material except when material of another type is specified in the contract documents. Joint material of another type may be used when permitted.

Repair lift holes in concrete pipe, if present. Thoroughly clean and soak the lift hole and completely fill the void with an approved non-shrink grout. Submit alternate details for repairing lift holes to the engineer for review and approval.

For all pipes 42 inches in diameter and larger, wrap filter fabric around all pipe joints. Extend fabric at least 12 inches beyond each side of the joint. Secure fabric against the outside of the pipe by methods approved by the Engineer.

**(B) Flexible Pipe (Except Structural Plate Pipe)**

Corrugated steel, corrugated aluminum, corrugated polyethylene (HDPE), and polyvinylchloride (PVC) pipe will be considered flexible pipe. Place flexible pipe carefully on the prepared foundation starting at the downstream end with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.

Handle coated corrugated steel pipe with special care to avoid damage to coatings.

Join pipe sections with coupling band, fully bolted and properly sealed. Provide coupling bands for annular and helical corrugated metal pipe with circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections, and prevent backfill infiltration. Match-mark all pipe 60 inches or larger in diameter at the plant for proper installation on the project.

At locations indicated in the plans, corrugated steel pipe sections shall be jointed together with rod and lug coupling bands, fully bolted. Sleeve gaskets shall be used in conjunction with rod and lug couplings and the joints properly sealed. Coupling bands shall provide circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections and prevent infiltration of backfill material.

**300-7 BEDDING AND BACKFILLING**

Loosely place bedding material, in a uniform layer, a depth equal to the inside diameter of the pipe divided by 6 or 6 inches, whichever is greater. Leave bedding material directly beneath the pipe uncompacted and allow pipe seating and backfill to accomplish compaction. Excavate recesses to receive the bells where bells and spigot type pipe is used.

Place fill around the pipe in accordance with the applicable method shown on the plans in layers not to exceed 6 inches loose unless otherwise permitted. Compact to the density required by Subarticle 235-4(C). Approval of the backfill material is required prior to its use. Use select material as shown in the contract documents.

Take care during backfill and compaction operations to maintain alignment and prevent damage to the joints. Keep backfill free from stones, frozen lumps, chunks of highly plastic clay, or other objectionable material.

Grade and maintain all pipe backfill areas in such a condition that erosion or saturation will not damage the pipe foundation or backfill.

Excavatable flowable fill may be used for backfill when approved by the Engineer. When using excavatable flowable fill, ensure that the pipe is not displaced and does not float during backfill. Submit methods for supporting the pipe and material placement to the Engineer for review and approval.

Do not operate heavy equipment over any pipe until it has been properly backfilled with a minimum 3 feet of cover. Place, maintain, and finally remove the required cover that is above the proposed finished grade at no cost to the Department. Remove and replace, at no cost to the Department, pipe that becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations.

### **300-8 INSPECTION AND MAINTENANCE**

Prior to final acceptance, the Engineer will perform random video camera and or mandrel inspections to ensure proper jointing and that deformations do not exceed allowable limits. Replace pipes having cracks greater than 0.1 inches or deflections greater than 7.5 percent. Repair or replace pipes with cracks greater than 0.01 inches, exhibiting displacement across a crack, exhibiting bulges, creases, tears, spalls, or delamination. Maintain all pipe installations in a condition such that they will function continuously from the time the pipe is installed until the project is accepted.

### **300-9 MEASUREMENT AND PAYMENT**

#### **General**

No measurement will be made of any work covered by this section except as listed below. Removal and disposal of existing pavement is a part of the excavation for the new pipe culvert installation. Repair of the pavement will be made in accordance with Section 654.

#### **Foundation Conditioning**

##### **Using Local Material**

Undercut excavation is all excavation removed by undercutting below the bottom of the trench as staked. *Undercut Excavation* will be measured as the actual number of cubic yards of undercut excavation, measured in its original position and computed by the average end area method, that has been removed as called for in the contract and will be paid for at double the contract unit price for *Unclassified Excavation* as provided in Article 225-7.

Local material used for conditioning the foundation will be measured and paid for in accordance with Article 225-7 for *Unclassified Excavation* or in accordance with Article 230-5 for *Borrow Excavation* depending on the source of the material.

Local material used to replace pipe undercut excavation will be measured and paid for in accordance with Article 225-7 or Article 230-5.

##### **Using Other Than Local Material**

No measurement and payment will be made for *Undercut Excavation*. The material used to replace pipe undercut excavation will be classified as foundation conditioning material.

*Foundation Conditioning Material, Minor Structures* will be measured and paid for as the actual number of tons of this material weighed in trucks on certified platform scales or other certified weighing devices.

No direct payment will be paid for undercut excavation. Payment at the contract unit price for *Foundation Conditioning Material, Minor Structures* will be full compensation for all work of pipe undercut excavation.

#### **Foundation Conditioning Fabric**

*Foundation Conditioning Fabric* will be measured and paid for in square yards. The measurement will be based on the theoretical calculation using length of pipe installed and two times the standard trench width. No separate measurement will be made for overlapping fabric or the vertical fabric dimensions required to encapsulate the foundation conditioning material.

#### **Bedding and Backfill - Select Material**

No measurement will be made for select bedding and backfill material required in the contract documents. The select bedding and backfill material will be included in the cost of the installed pipe.

Where unclassified excavation or borrow material meets the requirements for select bedding and backfill and is approved for use by the Engineer, no deductions will be made to these pay items to account for use in the pipe installation.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Foundation Conditioning Material, Minor Structures	Ton
Foundation Conditioning Fabric	Square Yard

### **SECTION 310 PIPE CULVERTS**

#### **310-1 DESCRIPTION**

Furnish and install drainage pipe at locations and size called for in the contract documents. The work includes construction of joints and connections to other pipes, endwalls, and drainage structures.

**310-2 MATERIALS**

Refer to Division 10:

<b>Item</b>	<b>Section</b>
Plain Concrete Pipe Culvert	1032-9(B)
Reinforced Concrete Pipe Culvert	1032-9(C)
Precast Concrete Pipe End Sections	1032-9(D)
Concrete Pipe Tees and Elbows	1032-9(E)
Corrugated Aluminum Alloy Pipe Culvert	1032-2(A)
Corrugated Aluminum Alloy Pipe Tees and Elbows	1032-2(B)
Corrugated Steel Culvert Pipe and Pipe Arch	1032-3(A)
Prefabricated Corrugated Steel Pipe End Sections	1032-3(B)
Corrugated Steel Pipe Tees and Elbows	1032-3(C)
Corrugated Steel Eccentric Reducers	1032-3(D)
HDPE Smooth Lined Corrugated Plastic Pipe	1032-10
Polyvinylchloride (PVC) Pipe	1032-11

Suppliers that provide metal pipe culverts, fittings, and all other accessories covered by this section shall meet the requirements of the Department's Brand Certification program for metal pipe culverts, and be listed on the Department's pre-approved list for suppliers of metal pipe culvert.

Do not use corrugated steel pipe in the following counties:

Beaufort, Bertie, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Gates, Hertford, Hyde, Jones, Martin, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrell, and Washington.

**310-3 PIPE INSTALLATION**

Install pipe, pipe tees, and elbows in accordance with Section 300.

**310-4 SIDE DRAIN PIPE**

Side drain pipe is defined as storm drain pipe running parallel to the roadway to include pipe in medians, outside ditches, driveways, and under shoulder berm gutter along outside shoulders greater than 4 feet wide.

Where shown in the plans, side drain pipe may be Class II Reinforced Concrete Pipe, aluminized corrugated steel pipe, corrugated aluminum alloy pipe, HDPE pipe, or PVC pipe. Corrugated steel pipe is restricted in the counties listed in Article 310-2. Install side drain pipe in accordance to Section 300. Cover for side drain pipe shall be at least one foot.

**310-5 PIPE END SECTIONS**

Choose which material to use for the required end sections. Both corrugated steel and concrete pipe end sections will work on concrete pipe, corrugated steel pipe, and HDPE smooth lined corrugated plastic pipe.

**310-6 MEASUREMENT AND PAYMENT**

*Pipe* will be measured and paid as the actual number of linear feet of pipe that has been incorporated into the completed and accepted work. Measurement of pipe will be made by counting the number of joints used and multiplying by the length of the joint to obtain the number of linear feet of pipe installed and accepted. Measurements of partial joints will be made along the longest length of the partial joint to the nearest 0.1 foot. Select bedding and backfill material will be included in the cost of the installed pipe.

*Pipe End Sections, Tees, Elbows, and Eccentric Reducers* will be measured and paid as the actual number of each of these items that have been incorporated into the completed and accepted work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___" R.C. Pipe Culverts, Class _____	Linear Foot
___" x ___" x ___" R.C. Pipe Tees, Class _____	Each
___" R.C. Pipe Elbows, Class _____.	Each
___" C.A.A. Pipe Culvert, ___" Thick	Linear Foot
___" x ___" x ___" C.A.A. Pipe Tees, ___" Thick	Each
___" C.A.A. Pipe Elbows, ___" Thick	Each
___" C.S. Pipe Culverts, ___" Thick	Linear Foot
___" x ___" C.S. Pipe Arch Culverts, ___" Thick	Linear Foot
___" x ___" x ___" C.S. Pipe Tees, ___" Thick	Each
___" C.S. Pipe Elbows, ___" Thick	Each
___" x ___" C.S. Eccentric Reducers, ___" Thick	Each
___" HDPE Pipe	Linear Foot
___" PVC Pipe	Linear Foot
___" Side Drain Pipe	Linear Foot
___" Side Drain Pipe Elbows	Each
___" Pipe End Section	Each



**FINE GRADING SUBGRADE, SHOULDERS AND DITCHES:**

(7-21-09)

SP5 R01

Revise the *Standard Specifications* as follows:

**Page 5-1, Article 500-1 DESCRIPTION**, replace the first sentence with the following:

Perform the work covered by this section including but not limited to preparing, grading, shaping, manipulating moisture content, and compacting either an unstabilized or stabilized roadbed to a condition suitable for placement of base course, pavement, and shoulders.

**AGGREGATE BASE COURSE:**

(12-19-06)

SP5 R03

Revise the *2006 Standard Specifications* as follows:

**Page 5-11, Article 520-5 Hauling and Placing Aggregate Base Material**, 6th paragraph, replace the first sentence with the following:

Base course that is in place on November 15 shall have been covered with a subsequent layer of pavement structure or with a sand seal. Base course that has been placed between November 16 and March 15 inclusive shall be covered within 7 calendar days with a subsequent layer of pavement structure or with a sand seal.

**PREPARATION OF SUBGRADE AND BASE:**

(1-16-96)

SP5 R05

On mainline portions and ramps of this project, prepare the subgrade and base beneath the pavement structure in accordance with the applicable sections of the *Standard Specifications* except use an automatically controlled fine grading machine utilizing string lines, laser controls, or other approved methods to produce final subgrade and base surfaces meeting the lines, grades, and cross sections required by the plans or established by the Engineer.

No direct payment will be made for the work required by this provision as it will be considered incidental to other work being paid for by the various items in the contract.

**ASPHALT PAVEMENTS - SUPERPAVE:**

(7-18-06)(Rev 10-18-11)

SP6 R01

Revise the *2006 Standard Specifications* as follows:

**Page 6-2, Article 600-9 Measurement and Payment**, delete the second paragraph.

**Page 6-12, Subarticle 609-5(C)(2), Required Sampling and Testing Frequencies**, first partial paragraph at the top of the page, delete last sentence and replace with the following:

If the Engineer allows the mix to remain in place, payment will be made in accordance with Article 105-3.

**Page 6-12, Subarticle 609-5(C)(2), Quality Control Minimum Sampling and Testing Schedule, first paragraph, delete and replace with the following:**

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

**Second paragraph, delete the fourth sentence and replace with the following:**

When daily production of each mix design exceeds 100 tons and a regularly scheduled full test series random sample location for that mix design does not occur during that day's production, perform at least one partial test series consisting of Items A and B in the schedule below.

**Page 6-12, Subarticle 609-5(C)(2)(c) Maximum Specific Gravity, add after (AASHTO T 209):**

or ASTM D2041

**Page 6-13, last line and on page and Page 6-14, Subarticle 609-5(C)(2)(e) Tensile Strength Ratio (TSR), add a heading before the first paragraph as follows:**

(i) Option 1

**Insert the following immediately after the first paragraph:**

(ii) Option 2

Mix sampled from truck at plant with one set of specimens prepared by the Contractor and then tested jointly by QA and QC at a mutually agreed upon lab site within the first 7 calendar days after beginning production of each new mix design.

**Second paragraph, delete and replace with the following:**

Test all TSR specimens required by either option noted above on either a recording test press or a test press that maintains the peak load reading after the specimen has broken.

**Subarticle 609-5(C)(3) Control Charts, delete the second sentence of the first paragraph and replace with the following:**

For mix incorporated into the project, record full test series data from all regularly scheduled random samples or directed samples that replace regularly scheduled random samples, on control charts the same day the test results are obtained.

**Page 6-15, Subarticle 609-5(C)(3) Control Charts, first paragraph on this page, delete the last sentence and substitute the following:**

Denote the moving average control limits with a dash green line and the individual test limits with a dash red line.

**Page 6-15, Subarticle 609-5(C)(3)(a), (b) and (c), replace (a) (b) and (c) with the following:**

- (a) A change in the binder percentage, aggregate blend, or  $G_{mm}$  is made on the JMF, or
- (b) When the Contractor elects to stop or is required to stop production after one or two moving average values, respectively, fall outside the moving average limits as outlined in Subarticle 609-5(C)(6), or
- (c) If failure to stop production after two consecutive moving averages exceed the moving average limits occurs, but production does stop at a subsequent time, re-establish a new moving average beginning at the actual production stop point.

**Page 6-15, Subarticle 609-5(C)(4) Control Limits, replace the first paragraph and the CONTROL LIMITS Table on page 6-16 with the following:**

The following are established as control limits for mix production. Apply the individual limits to the individual test results. Control limits for the moving average limits are based on a moving average of the last 4 data points. Apply all control limits to the applicable target source.

**CONTROL LIMITS**

Mix Control Criteria	Target Source	Moving Average Limit	Individual Limit
2.36 mm Sieve	JMF	±4.0 %	±8.0 %
0.075 mm Sieve	JMF	±1.5 %	±2.5 %
Binder Content	JMF	±0.3 %	±0.7 %
VTM @ $N_{des}$	JMF	±1.0 %	±2.0 %
VMA @ $N_{des}$	Min. Spec. Limit	Min Spec. Limit	-1.0%
$P_{0.075}/P_{be}$ Ratio	1.0	±0.4	±0.8
% $G_{mm}$ @ $N_{ini}$	Max. Spec. Limit	N/A	+2.0%
TSR	Min. Spec. Limit	N/A	- 15%

**Page 6-16, Subarticle 609-5(C)(5) Warning Bands, delete this subarticle in its entirety.**

**Pages 6-16 through 6-19, Subarticle 609-5(C)(6), delete the word "warning" and replace with the words "moving average".**

**Page 6-16, Subarticle 609-5(C)(6) Corrective Actions, first paragraph, first sentence, delete and replace with the following:**

Immediately notify the Engineer when moving averages exceed the moving average limits.

**Page 6-17, Subarticle 609-5(C)(6) Corrective Actions, delete the third full paragraph and replace with the following:**

Failure to stop production when required due to an individual mix test not meeting the specified requirements will subject all mix from the stop point tonnage to the point when the next individual test is back on or within the moving average limits, or to the tonnage point when production is actually stopped, whichever occurs first, to being considered unacceptable.

**Sixth full paragraph, delete the first, second, and third sentence and replace with the following:**

Immediately notify the Engineer when any moving average value exceeds the moving average limit. If two consecutive moving average values for any one of the mix control criteria fall outside the moving average limits, cease production of that mix, immediately notify the Engineer of the stoppage, and make adjustments. The Contractor may elect to stop production after only one moving average value falls outside the moving average limits.

**Page 6-18, Subarticle 609-5(C)(6) Corrective Actions, second full paragraph, delete and replace with the following:**

If the process adjustment improves the property in question such that the moving average after four additional tests is on or within the moving average limits, the Contractor may continue production with no reduction in payment.

**Page 6-18, Subarticle 609-5(C)(6) Corrective Actions, delete the third and fourth full paragraphs, including the Table for Payment for Mix Produced in the Warning Bands and substitute the following:**

If the adjustment does not improve the property in question such that the moving average after four additional individual tests is outside the moving average limits, the mix will be evaluated for acceptance in accordance with Article 105-3. Reduced payment for or removal of the mix in question will be applied starting from the plant sample tonnage at the stop point to the sample tonnage when the moving average is on or within the moving average limits. In addition, any mix that is obviously unacceptable will be rejected for use in the work.

**Page 6-19, Subarticle 609-5(C)(6) Corrective Actions, first paragraph, delete and replace with the following:**

Failure to stop production and make adjustments when required due to two consecutive moving average values falling outside the moving average limits will subject all mix produced from the stop point tonnage to the tonnage point when the moving average is back on or within the moving average limits or to the tonnage point when production is actually stopped, whichever occurs first, to being considered unacceptable. Remove this material and replaced with materials that comply with the Specifications at no additional costs to the Department, unless otherwise approved. Payment will be made for the actual quantities of materials required to replace the removed quantities, not to exceed the original amounts.

**Page 6-20, Subarticle 609-5(D)(1) General, delete the third full paragraph, and replace with the following:**

Perform the sampling and testing at the minimum test frequencies as specified above. Should the density testing frequency fail to meet the minimum frequency as specified above, all mix without the required density test representation will be considered unsatisfactory. If the Engineer allows the mix to remain in place, payment will be made in accordance with Article 105-3.

**Page 6-22, Subarticle 609-5(D)(4) Nuclear Gauge Density Procedures, third paragraph, insert the following as the second sentence:**

Determine the Daily Standard Count in the presence of the QA Roadway Technician or QA Nuclear Gauge Technician on days when a control strip is being placed.

**Page 6-23, Subarticle 609-5(D)(5) Limited Production Procedure, delete the first paragraph including (a), (b), (c) and substitute the following:**

Proceed on limited production when, for the same mix type and on the same contract, one of the following conditions occur (except as noted in the first paragraph below).

- (a) Two consecutive failing lots, except on resurfacing\*
- (b) Three consecutive failing lots on resurfacing\*
- (c) Two consecutive failing nuclear control strips.

\* Resurfacing is defined as the first new uniform layer placed on an existing pavement.

**Page 6-25, Article 609-6 QUALITY ASSURANCE, DENSITY QUALITY ASSURANCE, insert the following items after item (E):**

- (F) By retesting Quality Control core samples from control strips (either core or nuclear) at a frequency of 100% of the frequency required of the Contractor;
- (G) By observing the Contractor perform all standard counts of the Quality Control nuclear gauge prior to usage each nuclear density testing day; or
- (H) By any combination of the above.

**Page 6-28, Subarticle 610-3(A) Mix Design-General, delete the fourth and fifth paragraphs and replace with the following:**

Reclaimed Asphalt Pavement (RAP) or Reclaimed Asphalt Shingles (RAS) may be incorporated into asphalt plant mixes in accordance with Article 1012-1 and the following applicable requirements.

Reclaimed asphalt pavement (RAP) may constitute up to 50% of the total material used in recycled mixtures, except for mix Type S 12.5D, Type S 9.5D, and mixtures containing reclaimed asphalt shingle material (RAS). Reclaimed asphalt shingle (RAS) material may constitute up to 6% by weight of total mixture for any mix. When both RAP and RAS are used, do not use a combined percentage of RAS and RAP greater than 20% by weight of total mixture, unless otherwise approved. When the percent of binder contributed from RAS or a combination of RAS and RAP exceeds 20% but not more than 30% 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, unless otherwise approved. When the percent of binder contributed from RAS or a combination of RAS and RAP exceeds 30% of the total binder in the completed mix, the Engineer will establish and approve the virgin binder PG grade. Use approved methods to determine if any binder grade adjustments are necessary to achieve the performance grade for the specified mix type.

For Type S 12.5D and Type S 9.5D mixes, the maximum percentage of reclaimed asphalt material is limited to 20% and shall be produced using virgin asphalt binder grade PG 76-22. For all other recycled mix types, the virgin binder PG grade shall be as specified in Table 610-2A for the specified mix type.

When the percentage of RAP is greater than 20% but not more than 30% of the total mixture, use RAP meeting the requirements for processed or fractionated RAP in accordance with the requirements of Article 1012-1.

When the percentage of RAP is greater than 30% of the total mixture, use an approved stockpile of RAP in accordance with Subarticle 1012-1(C). Use approved test methods to determine if any binder grade adjustments are necessary to achieve the performance grade for the specified mix type. The Engineer will establish and approve the virgin asphalt binder grade to be used.

Page 6-34, Subarticle 610-3(C) Job Mix Formula, delete Table 610-2 and associated notes and replace with the following:

**TABLE 610-2  
SUPERPAVE MIX DESIGN CRITERIA**

Mix Type	Design ESALs Millions (a)	Binder PG Grade (b)	Compaction Levels No. Gyration @		Max. Rut Depth (mm)	Volumetric Properties (c)			
			N <sub>ini</sub>	N <sub>des</sub>		VMA % Min.	VTM %	VFA Min. - Max.	%G <sub>mm</sub> @ N <sub>ini</sub>
S-4.75A(e)	< 0.3	64 -22	6	50	-----	20.0	7.0 - 15.0	-----	-----
SF-9.5A	< 0.3	64 -22	6	50	11.5	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S-9.5B	0.3 - 3	64 -22	7	65	9.5	15.5	3.0 - 5.0	65 - 80	≤ 90.5
S-9.5C	3 - 30	70 -22	7	75	6.5	15.5	3.0 - 5.0	65 - 78	≤ 90.5
S-9.5D	> 30	76 -22	8	100	4.5	15.5	3.0 - 5.0	65 - 78	≤ 90.0
S-12.5C	3 - 30	70 -22	7	75	6.5	14.5	3.0 - 5.0	65 - 78	≤ 90.5
S-12.5D	> 30	76 -22	8	100	4.5	14.5	3.0 - 5.0	65 - 78	≤ 90.0
I-19.0B	< 3	64 -22	7	65	-----	13.5	3.0 - 5.0	65 - 78	≤ 90.5
I-19.0C	3 - 30	64 -22	7	75	-----	13.5	3.0 - 5.0	65 - 78	≤ 90.0
I-19.0D	> 30	70 -22	8	100	-----	13.5	3.0 - 5.0	65 - 78	≤ 90.0
B-25.0B	< 3	64 -22	7	65	-----	12.5	3.0 - 5.0	65 - 78	≤ 90.5
B-25.0C	> 3	64 -22	7	75	-----	12.5	3.0 - 5.0	65 - 78	≤ 90.0
	<b>Design Parameter</b>					<b>Design Criteria</b>			
All Mix Types	1. Dust to Binder Ratio (P <sub>0.075</sub> / P <sub>be</sub> )					0.6 – 1.4			
	2. Retained Tensile Strength (TSR) (AASHTO T283 Modified)					85% Min. (d)			

- Notes:
- (a) Based on 20 year design traffic.
  - (b) Volumetric Properties based on specimens compacted to N<sub>des</sub> as modified by the Department.
  - (c) AASHTO T 283 Modified (No Freeze-Thaw cycle required). TSR for Type S 4.75A, Type B 25.0B, and Type B 25.0C mixes is 80% minimum.
  - (d) Mix Design Criteria for Type S 4.75A may be modified subject to the approval of the Engineer.

Page 6-34, Insert the following immediately after Table 610-2:

**TABLE 610-2A  
SUPERPAVE MIX DESIGN CRITERIA**

Mix Type	Percentage of RAP in Mix		
	Category 1 % RAP ≤20%	Category 2 20.1% ≤ %RAP ≤ 30.0%	Category 3 %RAP > 30.0%
All A and B Level Mixes, I19.0C, B25.0C	PG 64 -22	PG 64 -22	TBD
S9.5C, S12.5C, I19.0D	PG 70 -22	PG 64-22	TBD
S 9.5D and S12.5D	PG 76-22	N/A	N/A

- Note: (1) Category 1 RAP has been processed to a maximum size of 2 inches.  
 (2) Category 2 RAP has been processed to a maximum size of one inch by either crushing and or screening to reduce variability in the gradations.  
 (3) Category 3 RAP has been processed to a maximum size of one inch, fractionating the RAP into 2 or more sized stockpiles

Page 6-35, Table 610-3 delete and replace with the following:

**TABLE 610-3  
ASPHALT PLACEMENT- MINIMUM TEMPERATURE REQUIREMENTS**

Asphalt Concrete Mix Type	Minimum Air Temperature	Minimum Surface Temperature
ACBC, Type B 25.0B, C, B 37.5C	35°F	35°F
ACIC, Type I 19.0B, C, D	35°F	35°F
ACSC, Type S 4.75A, SF 9.5A, S 9.5B	40°F	50°F*
ACSC, Type S 9.5C, S 12.5C	45°F	50°F
ACSC, Type S 9.5D, S 12.5D	50°F	50°F

\* 35°F if surface is soil or aggregate base for secondary road construction.

Page 6-44, Article 610-8 SPREADING AND FINISHING, third full paragraph, replace the first sentence with the following:

Use the 30 foot 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 layers, including resurfacing and asphalt in-lays, unless otherwise specified or approved.

Page 6-45, Article 610-8 SPREADING AND FINISHING delete the third paragraph on page 6-45 and replace with the following:

Use a Material Transfer Vehicle (MTV) when placing all asphalt concrete plant mix pavements which require the use of asphalt binder grade PG 76-22 and for all types of OGAF C, unless otherwise approved. Use a MTV for all surface mix regardless of binder grade placed on Interstate and US routes that have four or more lanes and median divided. Where required



above, utilize the MTV when placing all full width travel lanes and collector lanes. Use MTV for all ramps, loops, -Y- line travel lanes, full width acceleration and deceleration lanes, and full width turn lanes that are greater than 1,000 feet in length.

**Page 6-50, Article 610-13 DENSITY ACCEPTANCE, delete the second paragraph and replace with the following:**

As an exception, when the first layer of mix is a surface course and is being placed directly on an unprimed aggregate or soil base, the layer will be included in the "Other" construction category.

**Page 6-50, Article 610-13 DENSITY ACCEPTANCE, delete the formula and description in the middle of the page and replace with the following:**

	PF	=	$100 - 10(D)^{1.465}$
Where:	PF	=	Pay Factor (computed to 0.1%)
	D	=	the deficiency of the lot average density, not to exceed 2.0%

**Page 6-51, Article 610-15 MEASUREMENT AND PAYMENT, fourth paragraph, delete and replace with the following:**

Furnishing asphalt binder will be paid for as provided in Article 620-4.

**Page 6-53, Article 620-4 MEASUREMENT AND PAYMENT, modify as follows:**

**First Paragraph, delete and replace with the following:**

*Asphalt Binder for Plant Mix and Polymer Modified Asphalt Binder for Plant Mix* will be measured and paid for as the theoretical number of tons required by the applicable job mix formula based on the actual number of tons of plant mix completed and accepted on the job.

**Second paragraph, delete entire paragraph.**

**Sixth paragraph, delete the last sentence.**

**Seventh paragraph, delete the paragraph and replace with the following:**

The adjusted contract unit price will then be applied to the theoretical quantity of asphalt binder authorized for use in the plant mix placed during the partial payment period involved, except that where recycled plant mix is used, the adjusted unit price will be applied only to the theoretical number of tons of additional asphalt binder materials required by the job mix formula.

**Delete pay items and add the following pay items:**

<b>Pay Item</b>	<b>Pay Unit</b>
Asphalt Binder for Plant Mix	Ton
Polymer Modified Asphalt Binder for Plant Mix	Ton

**Page 6-55, Article 650-2 Materials, insert the following at the end of the list of items.**

Reclaimed asphalt shingles	1012-1(F)
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**Page 6-57, Subarticle 650-3(B), Mix Design Criteria, insert the following as the fourth paragraph.**

Reclaimed asphalt shingle (RAS) material may constitute up to 6% by weight of total mixture. The maximum percentage of binder contributed from reclaimed asphalt material will be 20% of the total binder in the completed mix.

**Page 6-59, Article 650-5 CONSTRUCTION REQUIREMENTS delete the second paragraph from the bottom of the page beginning “Use a Material Transfer Vehicle (MTV)...” and replace with the following:**

Use a Material Transfer Vehicle (MTV) when placing all asphalt concrete plant mix pavements which require the use of asphalt binder grade PG 76-22 and for all types of OGAFc, unless otherwise approved. Use a MTV for all surface mix regardless of binder grade placed on Interstate and US routes that have four or more lanes and median divided. Where required above, utilize the MTV when placing all full width travel lanes and collector lanes. Use MTV for all ramps, loops, -Y- line travel lanes, full width acceleration and deceleration lanes, and full width turn lanes that are greater than 1,000 feet in length.

**Page 6-61, Article 650-7 MEASUREMENT AND PAYMENT delete the second paragraph and replace with the following:**

Furnishing asphalt binder for the mix will be paid for as provided in Article 620-4 for *Asphalt Binder for Plant Mix* or *Polymer Modified Asphalt Binder for Plant Mix*. Adjustments in contract unit price due to asphalt binder price fluctuations will be made in accordance with Article 620-4.

**Page 6-64, Article 652-6 MEASUREMENT AND PAYMENT delete the second paragraph and replace with the following:**

*Asphalt Binder for Plant Mix* will be paid for in accordance with Article 620-4.

**Page 6-69, TABLE 660-1 MATERIAL APPLICATION RATES AND TEMPERATURES, add the following:**

Type of Coat	Grade of Asphalt	Asphalt Rate gal/yd <sup>2</sup>	Application Temperature °F	Aggregate Size	Aggregate Rate lb./sq. yd. Total
Sand Seal	CRS-2 or CRS-2P	0.22-0.30	150-175	Blotting Sand	12-15

**Page 6-75, Subarticle 660-9(B) Asphalt Seal Coat, add the following as sub-item (5):**

(5) Sand Seal

Place the fully required amount of asphalt material in one application and immediately cover with the seal coat aggregate. Uniformly spread the fully required amount of aggregate in one application and correct all non-uniform areas prior to rolling.

Immediately after the aggregate has been uniformly spread, perform rolling.

When directed, broom excess aggregate material from the surface of the seal coat.

When the sand seal is to be constructed for temporary sealing purposes only and will not be used by traffic, other grades of asphalt material meeting the requirements of Articles 1020-6 and 1020-7 may be used in lieu of the grade of asphalt required by Table 660-1 when approved.

**Page 6-76, Article 661-1 DESCRIPTION, add the following as the 2nd paragraph:**

Provide and conduct the quality control and required testing for acceptance of the UBWC in accordance with *Quality Management System for Asphalt Pavements (OGAFC, PADL, and Ultra-Thin HMA Version)*, included in the contract.

**Page 6-76, Article 661-2 MATERIALS, add the following after Asphalt Binder, Grade 70-28:**

Item	Section
Asphalt Binder, Grade 76-22	1020
Reclaimed Asphalt Shingles	1012

**Page 6-78, Subarticle 661-2(E), Asphalt Binder For Plant Mix, Grade PG 70-28, rename as POLYMER MODIFIED ASPHALT BINDER FOR PLANT MIX and add the following as the first paragraph:**

Use either PG 70-28 or PG 76-22 binder in the mix design. The grade of asphalt binder to be paid for the production of Ultra-thin will be *Polymer Modified Asphalt Binder For Plant Mix*.

**Page 6-79, Subarticle 661-2(G) Composition of Mix, add the following as the third sentence of the first paragraph.**

The percent of asphalt binder contributed from the RAS shall not exceed 20% of the total binder in the completed mix.

**Page 6-80, Article 661-2(G) Composition of Mix, replace Table 661-4 and associated notes with the following:**

Standard Sieves		1/2 in. Type A	3/8 in. Type B	1/4 in. Type C
ASTM	mm	(% Passing by Weight)		
¾ inch	19.0	100		
½ inch	12.5	85 - 100	100	
3/8 inch	9.5	60 - 80	85 - 100	100
#4	4.75	28 - 38	28 - 44	40 - 55
#8	2.36	19 - 32	17 - 34	22 - 32
#16	1.18	15 - 23	13 - 23	15 - 25
#30	0.600	10 - 18	8 - 18	10 - 18
#50	0.300	8 - 13	6 - 13	8 - 13
#100	0.150	6 - 10	4 - 10	6 - 10
#200	0.075	4.0 - 7.0	3.0 - 7.0	4.0 - 7.0

	1/2 in. Type A	3/8 in. Type B	1/4 in. Type C
Asphalt Content, %	4.6 - 5.6	4.6 - 5.8	5.0 - 5.8
Draindown Test, AASHTO T 305		0.1% max.	
Moisture Sensitivity, AASHTO T 283*		80% min.	
Application Rate, lb/ yd <sup>2</sup>	90	70	50
Approximate Application Depth, in.	3/4	5/8	1/2
Asphalt PG Grade, AASHTO M 320	PG 70-28 or PG 76-22	PG 70-28 or PG 76-22	PG 70-28 or PG 76-22

NOTE: \*Specimens for T-283 testing are to be compacted using the SUPERPAVE gyratory compactor. The mixtures shall be compacted using 100 gyrations to achieve specimens approximately 95 mm in height. Use mixture and compaction temperatures recommended by the binder supplier.

**Page 6-80, Subarticle 661-3(A) Equipment, add the following as the first paragraph:**

Use asphalt mixing plants in accordance with Article 610-5 of the *Standard Specifications*.

**Page 6-82, Subarticle 661-3(C), Application of Ultra-thin Bonded Wearing Course, delete the first paragraph and add the following as the first and second paragraphs:**

Use only one asphalt binder PG grade for the entire project, unless the Engineer gives written approval.

Do not place Ultra-thin Bonded Wearing Course between October 31 and April 1, when the pavement surface temperature is less than 50°F or on a wet pavement. In addition, when PG 76-22 binder is used in the JMF, place the wearing course only when the road pavement surface temperature is 60°F or higher and the air temperature in the shade away from artificial heat is 60°F or higher.

**Page 6-83, Article 661-4, MEASUREMENT AND PAYMENT delete third paragraph and replace with the following:**

*Polymer Modified Asphalt Binder For Plant Mix* will be paid for in accordance with Article 620-4. Asphalt binder price adjustments when applicable will be based on Grade PG 64-22, regardless of the grade used.

**Page 10-40, Subarticle 1012-1(A) General, add the following at the end of the last paragraph, last sentence:**

or ultra-thin bonded wearing course.

**Page 10-41, Table 1012-1, delete the entries for OG AFC and add new entries for OG AFC and a row for UBWC with entries:**

Mix Type	Coarse Aggregate Angularity <sup>(b)</sup> ASTM D5821	Fine Aggregate Angularity % Minimum AASHTO T304 Method A	Sand Equivalent % Minimum AASHTO T176	Flat & Elongated 5:1 Ratio % Maximum ASTM D4791 Section 8.4
S 9.5 D	100/100	45	50	10
OG AFC	100/100	N/A	N/A	10
UBWC	100/85	40	45	10

**Delete Note (c) under the Table 1012-1 and replace with the following:**

(c) Does not apply to Mix Types SF 9.5A and S 9.5B.

**Page 10-42, Subarticle 1012-1(B)(6) Toughness (Resistance to Abrasion), add as the last sentence:**

The percentage loss for aggregate used in UBWC shall be no more than 35%.

**Page 10-43, Subarticle 1012-1(F) Reclaimed Asphalt Shingle Material (RAS), delete and replace with the following:**

**(F) Reclaimed Asphalt Shingles (RAS)**

For use in asphalt mix, Reclaimed Asphalt Shingles (RAS) can be either manufacturer- waste shingles or post-consumer shingles that have been processed into a product that meets the requirements of this section.

Manufacturer-waste RAS (MRAS) are processed shingle materials discarded from the manufacturing of new asphalt shingles. It may include asphalt shingles or shingle tabs that have been rejected by the shingle manufacturer.

Post-consumer RAS (PRAS) are processed shingle materials recovered from mixed roofing material scrap removed from existing structures. Tear-off shingle scrap must be sorted and other roofing debris, including nails, plastic, metal, wood, coal tar epoxy, rubber materials, or other undesirable components, shall be removed. This sorting of the scrap must be done prior to grinding of the PRAS for use in asphalt production.

Sample and test PRAS for asbestos and provide results demonstrating that the bulk samples contain less than one percent of asbestos containing material in accordance with Federal, State of North Carolina, and Local regulations. Use NC-accredited Asbestos Inspectors or Roofing Supervisors to sample the PRAS to meet the above criteria. Maintain records on-site indicating shingle source(s), asbestos operation plan approved by Division of Public Health's Health Hazards Control Unit, and all asbestos analytical reports. All documentation will be subject to review by the Department.

Process RAS by ambient grinding or granulating methods such that 100% of the particles will pass the 9.50 mm (3/8") sieve when tested in accordance with AASHTO T27. Perform sieve analysis on processed asphalt shingles prior to ignition or solvent extraction testing.

RAS shall contain no more than 0.5% by total cumulative weight of deleterious materials. These materials include, but are not limited to, excessive dirt, debris, concrete, metals, glass, paper, rubber, wood, plastic, soil, brick, tars, or other contaminating substances.

Blend RAS with fine aggregate or RAP, meeting the requirements of this Section, if needed to keep the processed material workable.

MRAS and PRAS shall not be blended together for the production of hot mix asphalt.

### **(1) Mix Design RAS**

Incorporate RAS from stockpiles that have been tested for uniformity of gradation and binder content prior to use in an asphalt mix design.

### **(2) Mix Production RAS**

New Source RAS is defined as acceptable material which was not included in the stockpile when samples were taken for mix design purposes. Process new source RAS so that all materials will meet the gradation requirements prior to introduction into the plant mixer unit.

After a stockpile of processed RAS has been sampled and mix designs made from these samples, do not add new source RAS to the original stockpile without prior field testing to insure gradation and binder uniformity. Sample and test new source RAS before blending with the existing stockpile.

Store new source RAS in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAS may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity prior to its use in the recycled mix. Store RAS materials in such a manner as to prevent contamination.

Field approval of new source RAS will be based on the table below and volumetric mix properties on the mix with the new source RAS included. Provided these tolerances are met, volumetric properties of the new mix will then be performed. If all volumetric mix properties meet the mix design criteria for that mix type, the new source RAS may continue to be used.

If the gradation, binder content, or any of the volumetric mix properties are not within the allowable tolerances of the table below, do not use the new source RAS unless approved by the Engineer. The Contractor may elect to either not use the stockpile, to request an adjustment to the JMF, or to redesign the mix.

<b>NEW SOURCE RAS BINDER AND GRADATION TOLERANCES (Apply Tolerances to Mix Design Data)</b>	
<b>P<sub>b</sub> %</b>	<b>±2.5</b>
<i>Sieve Size, mm</i>	<i>Tolerance</i>
4.75	±5
2.36	±4
1.18	±4
0.300	±4
0.150	±4
0.075	±2.0

**Page 10-43 through 10-45, Subarticle 1012-1(G), delete this subarticle in its entirety and replace with the following:**

**(G) Reclaimed Asphalt Pavement (RAP)**

**(1) Mix Design RAP**

Incorporate RAP from stockpiles or other sources that have been tested for uniformity of gradation and binder content prior to use in an asphalt mix design. Use reclaimed asphalt pavement that meets all requirements specified for *one of* the following *two* classifications.

**(a) Millings**

Existing reclaimed asphalt pavement (RAP) that is removed from its original location by a milling process as specified in Section 607. Millings should be such that it has a uniform gradation and binder content and all materials will pass a 2" sieve prior to introduction into the plant mixer unit.

**(b) Processed RAP**

RAP that is processed in some manner (possibly by crushing and/or use of a blending method) to produce a uniform gradation and binder content in the RAP prior to use in a recycled mix. Process RAP so that all materials have a uniform gradation and binder content and will pass a 1" sieve prior to introduction into the plant mixer unit.

**(c) Fractionated RAP**

Fractionated RAP is defined as having two or more RAP stockpiles, where the RAP is divided into coarse and fine fractions. Grade RAP so that all materials will pass a 1" sieve. The coarse RAP stockpile shall only contain material retained on a 3/8" screen, unless otherwise approved. The fine RAP stockpile shall only contain material passing the 3/8" screen, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8" screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse, fine, or the combination of both. Utilize a separate cold feed bin for each stockpile of fractionated RAP used.

**(d) Approved Stockpiled RAP**

Approved Stockpiled RAP is defined as fractionated RAP which has been isolated and tested for asphalt content, gradation, and asphalt binder characteristics with the intent to be used in mix designs with greater than 30% RAP materials. Fractionate the RAP in accordance with Subarticle 1012-1(G)(1)(c). Utilize a separate cold feed bin for each approved stockpile of RAP used.



Perform extraction tests at a rate of 1 per 1000 tons of RAP, with a minimum of 5 tests per stockpile to determine the asphalt content and gradation. Separate stockpiles of RAP material by fine and coarse fractions. Erect and maintain a sign satisfactory to the Engineer on each stockpile to identify the material. Assure that no deleterious material is allowed in any stockpile. The Engineer may reject by visual inspection any stockpiles that are not kept clean, separated, and free of foreign materials.

Submit requests for RAP stockpile approval to the Engineer with the following information at the time of the request:

- (1) Approximate tons of materials in stockpile
- (2) Name or Identification number for the stockpile
- (3) Asphalt binder content and gradation test results
- (4) Asphalt characteristics of the Stockpile.

For the Stockpiled RAP to be considered for approval, the gradation and asphalt content shall be uniform. Individual test results, when compared to the target, will be accepted if within the tolerances listed below:

**APPROVED STOCKPILED RAP GRADATION and BINDER TOLERANCES**  
(Apply Tolerances to Mix Design Data)

<b>P<sub>b</sub> %</b>	<b>±0.3%</b>
<b>Sieve Size (mm)</b>	<b>Percent Passing</b>
25.0	±5%
19.0	±5%
12.5	±5%
9.5	±5%
4.75	±5%
2.36	±4%
1.18	±4%
0.300	±4%
0.150	±4%
0.075	±1.5%

Note: If more than 20% of the individual sieves are out of the gradation tolerances, or if more than 20% of the asphalt binder content test results fall outside the appropriate tolerances, the RAP shall not be used in HMA unless the RAP representing the failing tests is removed from the stockpile.

Do not add additional material to any approved RAP stockpile, unless otherwise approved by the Engineer.

Maintain at the plant site a record system for all approved RAP stockpiles. Include at a minimum the following: Stockpile identification and a sketch of all stockpile areas at the plant site; all RAP test results (including asphalt content, gradation, and asphalt binder characteristics).

**(2) Mix Production RAP**

During mix production, use RAP that meets the criteria for one of the following categories:

**(a) Mix Design RAP**

RAP contained in the mix design stockpiles as described above may be used in all applicable JMFs. These stockpiles have been pretested; however, they are subject to required QC/QA testing in accordance with Subarticle 609-5(C)(2).

**(b) New Source RAP**

New Source RAP is defined as any acceptable material that was not included in the stockpile or other source when samples were taken for mix design purposes. Process new source RAP so that all materials have a uniform gradation and binder content and will pass a 2" sieve prior to introduction into the plant mixer unit.

After a stockpile of millings, processed RAP, or fractionated RAP has been sampled and mix designs made from these samples, do not add new source RAP to the original stockpile without prior field testing to insure gradation and binder uniformity. Sample and test new source RAP before blending with the existing stockpile.

Store new source RAP in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAP may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity prior to its use in the recycled mix.

Unprocessed RAP is asphalt material that was not milled and/or has not been processed to obtain a uniform gradation and binder content and is not representative of the RAP used during the applicable mix design. Unprocessed RAP shall not be incorporated into any JMFs prior to processing. Different sources of unprocessed RAP may be stockpiled together provided it is generally free of contamination and will be processed prior to use in a recycled mix. RAP contamination in the form of excessive dirt, debris, clean stone, concrete, etc. will not be allowed. Incidental amounts of dirt, concrete, and clean stone may be acceptable. Unprocessed RAP may be processed and then classified as a new source RAP as described above.

Field approval of new source RAP will be based on Table 1012-2 below and volumetric mix properties on the mix with the new source RAP included. Provided the Table 1012-2 tolerances are met, volumetric properties of the new mix will then be performed. If all volumetric mix properties meet the mix design criteria for that mix type, the new source RAP may continue to be used.

If the gradation, binder content, or any of the volumetric mix properties are not within the allowable tolerances of Table 1012-2, do not use the new source RAP unless approved by the Engineer. The Contractor may elect to either not use the stockpile, to request an adjustment to the JMF, or to redesign the mix.

**TABLE 1012-2**  
**NEW SOURCE RAP GRADATION and BINDER TOLERANCES**  
**(Apply Tolerances to Mix Design Data)**

Mix Type	0-20% RAP			20 <sup>+</sup> -30 % RAP			30 <sup>+</sup> % RAP		
	Base	Inter.	Surf.	Base	Inter.	Surf.	Base	Inter.	Surf.
P <sub>b</sub> %	± 0.7%			± 0.4%			± 0.3%		
25.0	±10	-	-	±7	-	-	±5	-	-
19.0	±10	±10	-	±7	±7	-	±5	±5	-
12.5	-	±10	±10	-	±7	±7	-	±5	±5
9.5	-	-	±10	-	-	±7	-	-	±5
4.75	±10	-	±10	±7	-	±7	±5	-	±5
2.36	±8	±8	±8	±5	±5	±5	±4	±4	±4
1.18	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.300	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.150	-	-	±8	-	-	±5	-	-	±4
0.075	±4	±4	±4	±2	±2	±2	±1.5	±1.5	±1.5

**ASPHALT PAVEMENTS - WARM MIX ASPHALT SUPERPAVE:**

(5-19-09) (Rev 2-15-11)

SP6 R02A

Warm Mix Asphalt (WMA) is defined as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed.

Notify the Engineer at least 2 weeks before producing the WMA so the Engineer can arrange a pre-pave meeting. Discuss special testing requirements necessary for WMA at the pre-pave meeting. Include at the pre-pave meeting the Contractor's QC manager, Paving Superintendent, and manufacturer's representative for the WMA technology, the Department's Roadway Construction Engineer, Resident Engineer, State Pavement Construction Engineer, and Quality Assurance Supervisor.

Require a manufacturer's representative for the WMA technology used to be present on site at the plant during the initial production and on the roadway during the laydown of the warm mix asphalt.

The requirement for the manufacturer's representative to be present at the pre-pave meeting and on-site at the plant may be waived by the Engineer based on previous work experience with the specific WMA technology used.

If the use of WMA is suspended during production, and the Contractor begins using Hot Mix Asphalt (HMA), then the Contractor shall be required to use HMA for the remainder of the specific route or map unless otherwise approved by the Engineer.

Revise the *2006 Standard Specifications* as follows:

**Page 6-8, Article 609-1 Description, insert the following as the second paragraph:**

Warm Mix Asphalt (WMA) is defined as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed. Use WMA at the Contractor's option when shown in the contract.

**Page 6-9, Article 609-4 Field Verification of Mixture and Job Mix Formula Adjustments, second paragraph, insert the following immediately after the first sentence:**

When producing a WMA, perform field verification testing including Tensile Strength Ratio (TSR) testing in accordance with AASHTO T 283 as modified by the Department.

**Third paragraph, delete the third sentence and replace with the following:**

Verification is satisfactory for HMA when all volumetric properties except  $\%G_{mm}@N_{ini}$  are within the applicable mix design criteria and the gradation, binder content, and  $\%G_{mm}@N_{ini}$  are within the individual limits for the mix type being produced. Verification is satisfactory for WMA when all volumetric properties except  $\%G_{mm}@N_{ini}$  are within the applicable mix design criteria, the TSR meets the design criteria, and the gradation, binder content, and  $\%G_{mm}@N_{ini}$  are within the individual limits for the mix type being produced.

**Page 6-12, Subarticle 609-5(C)(2)(d) Bulk Specific Gravity of Compacted Specimens, add after (AASHTO T 312):**

When producing WMA, gyrate specimens to specified  $N_{des}$  compaction effort without reheating mix other than to desired compaction temperature. Record time needed to reheat samples (if any).

**Page 6-14, Subarticle 609-5(C)(2)(e) Tensile Strength Ratio, insert the following immediately after the third paragraph:**

When producing WMA, perform TSR testing:

- (i.) Prior to initial production for each JMF and
- (ii.) Every 15,000 tons.

After three (3) consecutive passing TSR tests for a specific JMF, a request may be submitted to the State Asphalt Design Engineer to revert to the *Hot-Mix Asphalt QMS Manual* procedures for TSR testing on that JMF. This request shall be submitted in writing and shall include all test result data (Material and Tests Unit Form 612s) performed on the specific JMF.

**Page 6-27, Article 610-1 Description, insert the following as the third paragraph:**

Warm Mix Asphalt (WMA) is defined as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed. Use WMA at the Contractor's option when shown in the contract.

**Page 6-27, Article 610-2 Materials, insert the following at the end of this Article:**

Use only WMA technologies on the allowable routes listed on the Department's approved list maintained by the Materials and Tests Unit. The Department's approved list can be found at the following website: <http://www.ncdot.org/doh/operations/materials/pdf/wma.pdf>.

**Page 6-31, Subarticle 610-3(B) Mix Design-Criteria, add the following as the fifth paragraph:**

When WMA is used, submit the mix design without including the WMA additive.

**Page 6-32, Subarticle 610-3(C) Job Mix Formula, add the following as the second paragraph:**

When WMA is used, document the technology used, the recommended dosage rate, and the requested plant mix temperature on the JMF submittal. Verify the JMF based on plant produced mixture from the field verification test.

**Immediately following PG 76-22 335°F, add the following paragraph:**

When WMA is used, produce an asphalt mixture within the temperature range of 225°F to 275°F.

**ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES:**

(11-21-00) (Rev. 7-19-11)

SP6 R15

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	4.4%
Asphalt Concrete Intermediate Course	Type I 19.0	4.8%
Asphalt Concrete Surface Course	Type S 4.75A	6.8%
Asphalt Concrete Surface Course	Type SF 9.5A	6.7%
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 *2006 Standard Specifications*.

**ASPHALT PLANT MIXTURES:**

(7-1-95)

SP6 R20

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.

**PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX:**

(11-21-00)

SP6 R25

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the *2006 Standard Specifications*.

The base price index for asphalt binder for plant mix is \$ **577.14** per ton.

This base price index represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals on **November 1, 2011**.

**FINAL SURFACE TESTING - ASPHALT PAVEMENTS (Rideability):**

(5-18-04) (Rev. 7-15-08)

SP6 R45

On portions of this project where the typical section requires two or more layers of new pavement, perform acceptance testing of the longitudinal profile of the finished pavement surface in accordance with these provisions using a North Carolina Hearne Straightedge (Model No. 1). Furnish and operate the straightedge to determine and record the longitudinal profile of the pavement on a continuous graph. Final surface testing is an integral part of the paving operation and is subject to observation and inspection by the Engineer as deemed necessary.

Push the straightedge manually over the pavement at a speed not exceeding 2 miles per hour. For all lanes, take profiles in the right wheel path approximately 3 feet from the right edge of pavement in the same direction as the paving operation, unless otherwise approved due to traffic control or safety considerations. As an exception, lanes adjacent to curb and gutter, expressway gutter, or shoulder berm gutter may be tested in the left wheel path. Make one pass of the straightedge in each full width travel lane. The full lane width should be comparable in ride quality to the area evaluated with the Hearne Straightedge. If deviations exist at other locations across the lane width, utilize a 10 foot non-mobile straightedge or the Hearne Straightedge to evaluate which areas may require corrective action. Take profiles as soon as practical after the pavement has been rolled and compacted, but no later than 24 hours following placement of the pavement, unless otherwise authorized by the Engineer. Take profiles over the entire length of final surface travel lane pavement exclusive of -Y- line travel lanes less than or equal to 1000 feet in length, ramps less than or equal to 1000 feet in length, turn lanes less than or equal to 1000 feet in length, structures, approach slabs, paved shoulders, loops, and tapers or other irregular shaped areas of pavement, unless otherwise approved by the Engineer. Test in accordance with this provision all mainline travel lanes, full width acceleration or deceleration lanes, -Y- line travel lanes greater than 1000 feet in length, ramps, full width turn lanes greater than 1000 feet in length, and collector lanes.

At the beginning and end of each day's testing operations, and at such other times as determined by the Engineer, operate the straightedge over a calibration strip so that the Engineer can verify correct operation of the straightedge. The calibration strip shall be a 100 foot section of pavement that is reasonably level and smooth. Submit each day's calibration graphs with that day's test section graphs to the Engineer. Calibrate the straightedge in accordance with the current NCDOT procedure titled *North Carolina Hearne Straightedge - Calibration and Determination of Cumulative Straightedge Index*. Copies of this procedure may be obtained from the Department's Pavement Construction Section.

Plot the straightedge graph at a horizontal scale of approximately 25 feet per inch with the vertical scale plotted at a true scale. Record station numbers and references (bridges, approach slabs, culverts, etc.) on the graphs. Distances between references/stations must not exceed 100 feet. Have the operator record the Date, Project No., Lane Location, Wheel Path Location, Type Mix, and Operator's Name on the graph.

Upon completion of each day's testing, evaluate the graph, calculate the Cumulative Straightedge Index (CSI), and determine which lots, if any, require corrective action. Document the evaluation of each lot on a QA/QC-7 form. Submit the graphs along with the completed QA/QC-7 forms to the Engineer, within 24 hours after profiles are completed, for verification of the results. The Engineer will furnish results of their acceptance evaluation to the Contractor within 48 hours of receiving the graphs. In the event of discrepancies, the Engineer's evaluation of the graphs will prevail for acceptance purposes. The Engineer will retain all graphs and forms.

Use blanking bands of 0.2 inches, 0.3 inches, and 0.4 inches to evaluate the graph for acceptance. The 0.2 inch and 0.3 inch blanking bands are used to determine the Straightedge Index (SEI), which is a number that indicates the deviations that exceed each of the 0.2 inch and 0.3 inch bands within a 100 foot test section. The Cumulative Straightedge Index (CSI) is a number representing the total of the SEIs for one lot, which consist of not more than 25 consecutive test sections. In addition, the 0.4 inch blanking band is used to further evaluate deviations on an individual basis. The CSI will be determined by the Engineer in accordance with the current procedure titled "North Carolina Hearne Straightedge - Calibration and Determination of Cumulative Straightedge Index".

The pavement will be accepted for surface smoothness on a lot by lot basis. A test section represents pavement one travel lane wide not more than 100 feet in length. A lot will consist of 25 consecutive test sections, except that separate lots will be established for each travel lane, unless otherwise approved by the Engineer. In addition, full width acceleration or deceleration lanes, ramps, turn lanes, and collector lanes, will be evaluated as separate lots. For any lot that is less than 2500 feet in length, the applicable pay adjustment incentive will be prorated on the basis of the actual lot length. For any lot which is less than 2500 feet in length, the applicable pay adjustment disincentive will be the full amount for a lot, regardless of the lot length.

If during the evaluation of the graphs, 5 lots require corrective action, then proceed on limited production for unsatisfactory laydown in accordance with Article 610-12 of the *Standard Specifications*. Proceeding on limited production is based upon the Contractor's initial

evaluation of the straightedge test results and shall begin immediately upon obtaining those results. Additionally, the Engineer may direct the Contractor to proceed on limited production in accordance with Article 610-12 due to unsatisfactory laydown or workmanship.

Limited production for unsatisfactory laydown is defined as being restricted to the production, placement, compaction, and final surface testing of a sufficient quantity of mix necessary to construct only 2500 feet of pavement at the laydown width. Once this lot is complete, the final surface testing graphs will be evaluated jointly by the Contractor and the Engineer. Remain on limited production until such time as acceptable laydown results are obtained or until three consecutive 2500 foot sections have been attempted without achieving acceptable laydown results. The Engineer will determine if normal production may resume based upon the CSI for the limited production lot and any adjustments to the equipment, placement methods, and/or personnel performing the work. Once on limited production, the Engineer may require the Contractor to evaluate the smoothness of the previous asphalt layer and take appropriate action to reduce and/or eliminate corrective measures on the final surface course. Additionally, the Contractor may be required to demonstrate acceptable laydown techniques off the project limits prior to proceeding on the project.

If the Contractor fails to achieve satisfactory laydown results after three consecutive 2500 foot 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. If production of a new mix design is allowed, proceed under the limited production procedures detailed above.

After initially proceeding under limited production, the Contractor shall immediately notify the Engineer if any additional lot on the project requires corrective action. The Engineer will determine if limited production procedures are warranted for continued production.

If the Contractor does not operate by the limited production procedures as specified above, the 5 lots, which require corrective action, will be considered unacceptable and may be subject to removal and replacement. Mix placed under the limited production procedures for unsatisfactory laydown will be evaluated for acceptance in accordance with Article 105-3.



The pay adjustment schedule for the Cumulative Straightedge Index test results per lot is as follows:

<b>Pay Adjustment Schedule for Cumulative Straightedge Index (CSI)</b> <b>(Obtained by adding SE Index of up to 25 consecutive 100 foot test sections)</b>				
*CSI	ACCEPTANCE CATEGORY	CORRECTIVE ACTION	PAY ADJUSTMENT	
			Before Corrective	After Corrective Action
0-0	Acceptable	None	\$300 incentive	None
1-0 or 2-0	Acceptable	None	\$100 incentive	None
3-0 or 4-0	Acceptable	None	No Adjustment	No Adjustment
1-1, 2-1, 5-0 or 6-0	Acceptable	Allowed	\$300 disincentive	\$300 disincentive
3-1, 4-1, 5-1 or 6-1	Acceptable	Allowed	\$600 disincentive	\$600 disincentive
Any other Number	Unacceptable	Required	Per CSI after Correction(s) (not to exceed 100% Pay)	

**\*Either Before or After Corrective Actions**

Correct any deviation that exceeds a 0.4 inch blanking band such that the deviation is reduced to 0.3 inches or less.

Corrective actions shall be performed at the Contractor's expense and shall be presented for evaluation and approval by the Engineer prior to proceeding. Any corrective action performed shall not reduce the integrity or durability of the pavement that is to remain in place. Corrective action for deviation repair may consist of overlaying, removing and replacing, indirect heating and rerolling. Scraping of the pavement with any blade type device will not be allowed as a corrective action. Provide overlays of the same type mix, full roadway width, and to the length and depth established by the Engineer. Tapering of the longitudinal edges of the overlay will not be allowed.

Corrective actions will not be allowed for lots having a CSI of 4-0 or better. If the CSI indicates *Allowed* corrective action, the Contractor may elect to take necessary measures to reduce the CSI in lieu of accepting the disincentive. Take corrective actions as specified if the CSI indicates *Required* corrective action. The CSI after corrective action shall meet or exceed *Acceptable* requirements.

Where corrective action is allowed or required, the test section(s) requiring corrective action will be retested, unless the Engineer directs the retesting of the of the entire lot. No disincentive will apply after corrective action if the CSI is 4-0 or better. If the retested lot after corrective action has a CSI indicating a disincentive, the appropriate disincentive will be applied.

Test sections and/or lots that are initially tested by the Contractor that indicate excessive deviations such that either a disincentive or corrective action is necessary, may be re-rolled with asphalt rollers while the mix is still warm and in a workable condition, to possibly correct the

problem. In this instance, reevaluation of the test section(s) shall be completed within 24 hours of pavement placement and these test results will serve as the initial test results.

Incentive pay adjustments will be based only on the initially measured CSI, as determined by the Engineer, prior to any corrective work. Where corrective actions have been taken, payment will be based on the CSI determined after correction, not to exceed 100 percent payment.

Areas excluded from testing by the N.C. Hearne Straightedge will be tested by using a non-mobile 10-foot straightedge. Assure that the variation of the surface from the testing edge of the straightedge between any two contact points with the surface is not more than 1/8 inch. Correct deviations exceeding the allowable tolerance in accordance with the corrective actions specified above, unless the Engineer permits other corrective actions.

Furnish the North Carolina Hearne Straightedge(s) necessary to perform this work. Maintain responsibility for all costs relating to the procurement, handling, and maintenance of these devices. The Department has entered into a license agreement with a manufacturer to fabricate, sell, and distribute the N.C. Hearne Straightedge. The Department's Pavement Construction Section may be contacted for the name of the current manufacturer and the approximate price of the straightedge.

No direct payment will be made for the work covered by this section. Payment at the contract unit prices for the various items covered by those sections of the specifications directly applicable to the work constructed will be full compensation for all work covered by this section including, but not limited to, performing testing in accordance with this specification, any corrective work required as a result of this testing and any additional traffic control as may be necessary.

### **TYING PROPOSED CONCRETE PAVEMENT TO PROPOSED ASPHALT**

#### **PAVEMENT:**

(7-1-95)

SP7 R10

Tie the proposed concrete pavement on this project into proposed asphalt pavements in accordance with the detail shown in the plans and the following:

- (A) Bevel the end of the proposed concrete pavement on a 1:1 slope and eliminate the dowels. No direct payment will be made for beveling the ends of the proposed concrete pavement as such work will be included in the cost of the concrete pavement being constructed.
- (B) An asphalt connection will be required from the end of the proposed concrete pavement to the proposed asphalt pavement. Construct this connection in accordance with the details in the plans or as directed by the Engineer. The various asphalt and base course items used to make this connection will be paid for at the contract unit prices for the various items involved.

**CONCRETE PAVEMENTS AND SHOULDERS:**

(10-16-07) (Rev 7-20-10)

SP7 R20

Revise the *2006 Standard Specifications* as follows:

**Page 10-2, Subarticle 1000-3(A) Composition and Design**, delete the Subarticle and substitute the following:

Submit concrete paving mix design in terms of saturated surface dry weights on M&T Form 312U for approval a minimum of 30 days prior to proposed use. Use a mix that contains a minimum of 526 pounds of cement per cubic yard, a maximum water cement ratio of 0.559, an air content in the range of 4.5 to 5.5 percent, a maximum slump of 1.5" and a minimum flexural strength of 650 psi and a minimum compressive strength of 4,500 psi at 28 days.

The cement content of the mix design may be reduced by a maximum of 20% and replaced with fly ash at a minimum rate of 1.2 pounds of fly ash to each pound of cement replaced. Use a maximum water-cementitious material ratio not to exceed 0.538.

The cement content of the mix design may be reduced by a maximum of 50% and replaced with blast furnace slag pound for pound.

Include in the mix design the source of aggregates, cement, fly ash, slag, and admixtures; the gradation and specific gravity of the aggregates; the fineness modulus (F.M.) of the fine aggregate; and the dry rodded unit weight and size of the coarse aggregate. Submit test results showing that the mix design conforms to the criteria, including the 1, 3, 7, 14 and 28-day strengths of the average of two beams and the average of two cylinders for each age made and tested in accordance with AASHTO R39, T22 and T97. Design the mix to produce an average strength sufficient to indicate that a minimum strength of 650 psi in flexure and 4,500 psi in compression will be achieved in the field within 28 days.

If any change is made to the mix design, submit a new mix design.

If any major change is made to the mix design, also submit new test results showing the mix design conforms to the criteria. A major change to the mix design is defined as:

- 1) A source change in Coarse aggregate, Fine aggregate, Cement or Pozzolan (applies only to a change from one type of pozzolan to another; e.g., Class F fly ash to Class C fly ash).
- 2) A quantitative change in Coarse aggregate (applies to an increase or decrease greater than 5 %), Fine aggregate (applies to an increase or decrease greater than 5 %), Water (applies to an increase only), Cement (applies to a decrease only), Pozzolan (applies to a decrease only).

Where concrete with a higher slump for hand methods of placing and finishing is necessary, submit an adjusted mix design for approval to provide a maximum slump of 3" and to maintain the water-cementitious material ratio established by the original mix design.

**Page 10-6, Table 1000-1**, under column titled “Minimum compressive Strength at 28 days, psi”, in row titled “Pavement”, delete “560 flexural” and substitute “4,500”.

**SECTION 700  
GENERAL REQUIREMENT FOR PORTLAND CEMENT CONCRETE PAVING**

**Page 7-1, Article 700-3 CONCRETE HAULING EQUIPMENT**, delete the fourth paragraph and substitute the following:

For concrete hauled in a transit mix (ready mix) truck, use Table 1000-2 to determine the maximum elapsed time. For concrete hauled in other equipment, minimize the elapsed time to be 60 minutes or less, unless otherwise approved. The elapsed time is defined as the period from first contact between mixing water and cement until the entire operation of placing and finishing up to micro-surfacing, including corrective measures if necessary, has been completed.

**Page 7-2, Article 700-4 PREPARATION OF SUBGRADE AND BASE**, fourth paragraph, delete the 3rd and 4th sentence and substitute the following:

Set pins at a distance no farther than 50 feet apart. When located on a vertical curve, set pins no farther than 25 feet apart.

**Page 7-3, Subarticle 700-5(A)(4)**, delete the 2nd and 3rd paragraph and substitute the following:

Where additional pavement, aggregate or soil must be placed adjacent to new pavement by machine methods, do not place it until the concrete has attained a compressive strength of at least 3000 psi.

Construction equipment or hauling equipment will not be allowed over the pavement until the concrete has attained a compressive strength of 3,000 psi.

**Page 7-5, Article 700-7 FINISHING**, insert the following as the second sentence:

The use of excessive water for finishing will not be allowed.

**Page 7-5, Subarticle 700-8(C) Hot Weather**, 1st sentence:

Substitute 90°F for 80°F.

**Page 7-7, Subarticle 700-11(A) General**, delete the fourth paragraph and substitute the following:

Immediately after sawing the joint to the dimensions shown on the plans, completely remove the resulting slurry from the joint. Immediately reapply curing membrane following the sawing operation to damaged areas in the vicinity of the joint.

**Page 7-8, insert the following as Subarticle 700-11(G):**

**(G) Verification of Dowel Bar Alignment**

Use either properly secured dowel baskets or a dowel bar inserter, provided the ability to correctly locate and align the dowels at the joints is demonstrated as described below.

Provide a calibrated magnetic imaging device that will document dowel bar location and alignment. Calibrate the magnetic imaging device to the type and size dowel bar used in the work. Utilize this device as a process control and make necessary adjustment to ensure the dowels are placed in the correct location.

Scan at least 25% percent of the joints in the initial placement or 1.0 mile of pavement, whichever is greater, at random intervals throughout the pavement each time the paving train is mobilized. Mark scanned joints on the pavement.

Scan all joints in this initial placement if the dowel bars exhibit longitudinal translation (side shift), horizontal translation, vertical translation (depth), horizontal skew, or vertical tilt, above the allowable tolerances defined below. In addition, continue scanning no less than 25% of the joints until it is established that the dowel bar inserter or secured dowel basket assemblies are consistently placing the dowel bars at the correct location (meeting the tolerances defined below). Once the engineer determines that consistency is established, the contractor may reduce the percentage of scanned joints to no less than 10%. Any time inconsistency in the placement of the dowel bars becomes evident, additional scanning may be required up to 100% of the joints.

If consistency of the proper dowel bar alignment cannot be established within a reasonable time frame, the Engineer will have the option of suspending the paving operation.

Provide a report of the scanned joints within 48 hours of completing the day's production. The report should include the station and lane of the joint scanned, as well as the horizontal location, depth, longitudinal translation (side shift), horizontal skew, and vertical tilt, of each dowel bar in the joint. If a dowel bar inserter is used, the joint score described below should also be provided in the report.

Longitudinal translation (side shift) is defined as the position of the center of the dowel bar in relation to the sawed joint. The maximum allowable longitudinal translation (side shift) is 2 inches.

Horizontal translation is defined as difference in the actual dowel bar location from its theoretical position as detailed in the standard details. The maximum allowable horizontal translation is 2 inches.

Vertical translation (depth) is the difference in the actual dowel bar location from the theoretical midpoint of the slab. The maximum allowable vertical translation is 1/2 inch higher than the theoretical midpoint, and 1 inch lower than the theoretical midpoint.

Dowel bar misalignment, either vertical tilt or horizontal skew is defined as the difference in position of the dowel bar ends with respect to each other. Vertical tilt is measured in the vertical axis whereas horizontal skew is measured in the horizontal axis.

If a dowel bar inserter is used, determine a joint score for each joint scanned. The joint score is a measure of the combined effects from the dowel's horizontal skew or vertical tilt. The joint score is determined by summing the product of the weight (shown in the table below) and the number of bars in each misalignment category and adding 1. The vertical tilt and horizontal skew should be evaluated and the greater misalignment shall be utilized in determining the joint score. If two lanes are poured simultaneously, the joint score is calculated for the 24 foot section.

Misalignment Category, mm	Weight
$0 \leq d \leq 15$	0
$15 < d \leq 20$	2
$20 < d \leq 25$	4
$25 < d \leq 38$	5
$38 \leq d$	10

where d is the individual dowel bar misalignment.

A joint that has a joint score of 10 or greater will be considered locked.

When a locked joint as defined above is discovered, scan the two joints immediately adjacent to the locked joint. If either of the adjacent joints are deemed to be locked, provide a written proposal to address the dowel misalignment for each locked joint. No corrective action should be performed without written approval.

Any and all corrective action necessitated by improper joint alignment shall be at no cost to the Department.

**Page 7-9, Article 700-13 USE OF NEW PAVEMENT OR SHOULDER**, delete the Article and substitute the following:

Traffic or other heavy equipment will not be allowed on the concrete pavement or shoulder until the estimated compressive strength of the concrete using the maturity method has exceeded 3,000 psi unless otherwise permitted.

Estimate the compressive strength of concrete pavement in accordance with the most current version of ASTM C 1074 *Standard Practice for Estimating Concrete Strength by the Maturity Method* unless otherwise specified herein.

Furnish thermocouples or thermistors and digital data logging maturity meters that automatically compute and display the maturity index in terms of a temperature-time factor. The maturity meters must be capable of storing a minimum of 28 days worth of data and exporting data into an Excel spreadsheet. Submit the proposed equipment to the Engineer for approval.

When establishing a strength-maturity relationship, perform compressive tests at ages 1, 3, 7, 14 and 28 days in accordance with AASHTO Test Method T22.

Use the temperature-time factor maturity function to compute the maturity index from the measured temperature history of the concrete. Set the datum temperature at  $-10^{\circ}\text{C}$  to calculate the temperature-time factor in Equation 1 of ASTM C 1074.

Establish and submit a strength-maturity relationship in conjunction with each concrete pavement mix design. Determine the temperature-time factor corresponding to the strength-maturity relationship at 3,000 psi, TTF. Any changes to plant operations, material sources, or mix proportions will affect the strength-maturity relationship. If any changes occur during production, develop a new strength-maturity relationship unless otherwise directed.

Verify the strength-maturity relationship during the first day's production. Utilize the temperature-time factor developed at mix design TTF to verify the production strength-maturity relationship. Verify the strength-maturity relationship at a minimum of every 10 calendar days or when production is suspended for more than 10 days. If the verification sample's compressive strength when tested at TTF is less than 3,000 psi, immediately suspend early opening of traffic on pavement that has not obtained TTF until a new strength-maturity relationship is developed.

No permanent traffic will be allowed on the pavement until construction of the joints, including all sawing, sealing, and curing that is required, has been completed.

Take particular care to protect the exposed pavement edges and ends.

**Page 7-11, Subarticle 700-15(E) Flexural Strength**, delete the Subarticle and replace with the following:

**(E)Compressive Strength**

Determine the compressive strength of concrete using one set of two 6" x 12" cylinders at 28 calendar days. Test samples will be made by the Engineer from the concrete as it comes from the mixer. The samples will be made and cured in accordance with AASHTO T 23. Test specimens will be tested by the Engineer in accordance with AASHTO T 22. Furnish curing facilities for the test samples in accordance with Section 725.

**Page 7-11, Subarticle 700-15(F) Thickness**, delete the first and second paragraphs and replace with the following:

The thickness of the pavement will be determined by measurement of cores in accordance with AASHTO T 148.

Take 4-inch diameter cores in the presence of the Engineer. Take the cores when the concrete has attained a compressive strength of at least 3,000 psi and at least 72 hours have elapsed since placement of the pavement. If the concrete has not attained a compressive strength of at least 3,000 psi, the gross vehicle weight rating of vehicles supporting the coring operation may not exceed 7,000 pounds. Take cores no later than 30 days after the pavement has been placed. The core locations for each lot will be selected at random by the Engineer.

Patch all core holes within 72 hours of taking the core, using a Department approved nonshrink grout compatible with the pavement or shoulder concrete.

### SECTION 710 CONCRETE PAVEMENT

**Page 7-12. Article 710-1 DESCRIPTION**, 1st sentence:

Insert *and cylinders* after the words *test beams*.

Insert *verifying dowel bar alignment;* after the words *sealing joints;*.

**Page 7-12. Article 710-3 COMPOSITION OF CONCRETE**, after the first paragraph, insert the following:

Prior to placement, concrete produced by the plant must demonstrate that it is represented by the mix design submitted. The Engineer will make compressive and flexural samples from plant produced mix for testing at 1, 3, 7, 14 and 28 days of age. The strength results must be within 10% of the strengths reported by the Contractor during the mix design process. If the plant produced mix meets this criteria at 14 days of age, the Engineer will notify the Contractor that placement of concrete may commence.

If any major change as defined in section 1000-3 is made to the mix design, the process shall be initiated again.

**Page 7-12. Article 710-4 ACCEPTANCE OF CONCRETE**, delete the first sentence and replace with the following:

Test the concrete pavement for acceptance with respect to compressive strength and thickness on a lot by lot basis in accordance with the requirements of Article 700-15 and the following requirements:



For all concrete pavement, including mainline, shoulders, ramps, tapers, intersections, entrances, crossovers, and irregular areas not otherwise defined, produce a lot consisting of 1,333.3 square yards or fraction thereof placed within 28 calendar days. From each lot, make a minimum of one set of two 6" x 12" cylinders from a randomly selected batch of concrete. The average compression strength of the two cylinders is considered one test. If Division of Highways personnel make and test additional sets of cylinders for a lot, these sets will be averaged with the original set to determine the strength. In the case of low strength, the Engineer will perform an investigation.

**Page 7-13, Article 710-6 FINISHING**, insert the following at the end of the 6th paragraph.

Provide a textured surface with an average texture depth of 0.8 mm as tested in accordance with ASTM E 965 *Test Method for Measuring Pavement Macrottexture Depth Using a Sand Volumetric Technique* with no single test having a texture depth of 0.5 mm or less. Perform four randomly located tests in accordance with ASTM E 965 within the initial pavement lot of each mobilization and provide test results to the Engineer. A lot is defined in Article 710-4. If the average of the four tests does not meet the above criteria, make appropriate changes to the surface texture operations and test the next lot as detailed above. Once the surface texture process is established to meet minimum texture requirements, maintain consistency within the operation to provide the above minimum texture depth. Perform additional sand patch tests in accordance with ASTM E 965 when directed.

Should the surface texture become damaged or reduced by rain or any other action, reestablish or restore surface texture by an approved method.

**Page 7-15, Article 710-9 THICKNESS TOLERANCES**, delete the 4th and 5th paragraph and substitute with the following:

When the measurement of the core from a lot is deficient by 0.2" or less from the plan thickness, full payment will be made. When such measurement is deficient by more than 0.2" from the plan thickness, take 2 additional cores at random within the lot and calculate the average thickness of the lot from the 3 cores.

In determining the average thickness of the pavement lot, the Engineer will use all 3 core measurements. Individual core measurements which are greater than the plan thickness plus 0.2" will be considered as the plan thickness plus 0.2". Individual cores which are less than the plan thickness minus 1.0" will be considered as the plan thickness minus 1.0 inch. If the average measurement of the 3 cores is within 0.2" from the plan thickness, full payment will be made. If the average measurement of the 3 cores is deficient by more than 0.2" from the plan thickness, an adjusted unit price in accordance with Subarticle 710-10(B) will be paid for the lot represented.

Areas found deficient in thickness by more than 1.0" will be removed and replaced with concrete of the thickness shown on the plans. Any full lane or full shoulder width repairs to the concrete pavement must be performed in accordance with the *North Carolina*

*Department of Transportation Partial and Full Depth Repair Manual* and not be less than 1/2 of the panel length (7.5 feet).

When the measurement of any core (original core or additional cores taken to calculate the average) is less than the plan thickness by more than 1.0", the extent of the removal area due to thickness deficiency will be determined by taking additional exploratory cores at approximately 10 foot intervals parallel to the center line in each direction from the deficient core until an exploratory core is found in each direction which is within 1.0" of the plan thickness. The pavement between these exploratory cores will be removed full lane width wide and replaced with concrete of the thickness shown on the plans. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price.

Patch all core holes within 72 hours of taking the core, using a Department approved nonshrink grout compatible with the pavement concrete.

**Page 7-16, Subarticle 710-10(A) General**, delete the second paragraph and substitute the following:

Separate measurement will be made of pavement that is deficient in thickness by more than 0.2" and of pavement that is deficient in compressive strength.

**Page 7-17, Subarticle 710-10(C) Concrete Pavement Varying In Flexural Strength**, delete the title, first paragraph and the equation for the pay factor calculation and substitute the following:

**(C) Concrete Pavement Varying in Compressive Strength**

The pay factor for pavement achieving a compressive strength in 28 days of 4,500 psi or greater is 100%. The pay factor for pavement achieving a compressive strength in 28 days between 3000 psi and 4,500 psi is determined by the following formula:

$$\text{Pay Factor (\%)} = 0.0333(\text{PSI}) - 50$$

(pay factor rounded to nearest tenth of one percent)

**Page 7-17, Subarticle 710-10(C) Concrete Pavement Varying In Flexural Strength**, delete the first sentence of the third paragraph and substitute the following:

Any pavement that fails to attain 3,000 psi in compression is subject to removal.

**Page 7-19, Article 720-4 ACCEPTANCE OF CONCRETE**, delete the first sentence and substitute the following:

Concrete shoulders will be tested for acceptance with respect to compressive strength and thickness on a lot by lot basis.

**Page 7-19, Article 720-9 THICKNESS TOLERANCES**, replace the first paragraph with the following:

The thickness of the shoulder will be determined by measurement of cores in accordance with AASHTO T 148.

**Page 7-20, Subarticle 720-10(C) Concrete Shoulder Varying in Flexural Strength**, delete the title and the first sentence of the second paragraph and substitute the following, respectively:

**(C) Concrete Pavement Varying in Compressive Strength**

The quantities of concrete shoulder that fail to meet 4,500 psi, measured as provided in Article 710-10, will be paid for at an adjusted unit price per square yard completed in place and accepted.

**SECTION 725**

**FIELD LABORATORY FOR PORTLAND CEMENT CONCRETE PAVEMENT**

**Page 7-21, Article 725-2, GENERAL REQUIREMENTS**, replace with the following:

Furnish and maintain for the exclusive use of the Engineer a field office and laboratory in which to house and use all testing equipment needed. Only Department representatives will have access to these facilities. Provide a field office that is dust and water tight, floored, and has an adequate foundation so as to prevent excessive floor movement. Provide a field office that contains 6 or more 110 volt electrical double outlets properly grounded and spaced; a telephone; at least 2 windows, satisfactory locks on all doors and windows; adequate lighting, heating, and air conditioning; sink; running water to sink; and satisfactory exhaust fan. Provide a field office that meets the following approximate minimum requirements: 200 square feet of floor space; 10 feet interior width; 6 feet 6 inches interior height; 20 square feet of counter space, 2.5 to 3 feet high and 2 feet deep with cabinets or drawers below the counter top; and 6 square feet of desk space not enclosed with cabinets. Locate the office in a position that will permit full view of the plant from the interior of the office. At or near the office, furnish toilet facilities, with waste disposal, available for use of the Department personnel. Maintain these toilets in a neat and clean condition.

Provide a laboratory trailer adjacent to the field office that is at least 400 square feet in area, approximately 20 feet wide, 20 feet long, and 7 feet in height. Provide a laboratory trailer that contains 6 or more 110 volt electrical double outlets properly grounded and spaced; satisfactory locks on all doors and windows; adequate lighting, heating, and air conditioning; sink; running water to sink; and satisfactory exhaust fans. Provide two workbenches that are approximately 10 feet long, 2 feet wide, and 2.5 feet high. One workbench shall be installed inside the trailer and the other across the end of the trailer. Provide a shelter or roof over the outside workbench to provide protection from weather. Provide, in the laboratory, an adequate number of water storage tanks to hold all acceptance beams and cylinders and any additional beams and cylinders made for the purpose of determining early strengths. Construct the water storage tanks of non-corroding materials and have requirements for

automatic control of the water temperature. Maintain the water in the tank at a temperature of 73°F ±3°F. Equip each tank with a recording thermometer with its bulb located in the water. Provide sufficient tank volume to maintain all beams and cylinders, stored with the long axis vertical, in a fully submerged condition for the duration of the required curing period. Furnish a wooden mixing board at least 3/4 inch thick and approximately 4 feet wide and 4 feet long that is covered on one side with sheet metal of at least 22 gage, at the shelter. Provide facilities to maintain the test beams and cylinders at temperature between 60°F and 80°F during initial curing.

**MASONRY DRAINAGE STRUCTURES:**

(10-16-07)

SP8 R01

Revise the *2006 Standard Specifications* as follows:

**Page 8-31, Article 840-4 Measurement and Payment**, add the following at the end of the second paragraph:

For that portion of *Masonry Drainage Structure* measured above a height of 10.0 feet, payment will be made at 1.3 times the contract unit price per linear foot for *Masonry Drainage Structure*.

**BORROW EXCAVATION AND SHPO DOCUMENTATION FOR BORROW/WASTE**

**SITES:**

(12-18-07) (4-15-08)

SP8 R02

Revise the *2006 Standard Specifications* as follows:

**Division 2 Earthwork**

**Page 2-16, Subarticle 230-1(D)**, add the words: *The Contractor specifically waives* as the first words of the sentence.

**Page 2-17, Article 230-4(B) Contractor Furnished Sources, first paragraph, first sentence** replace with the following:

Prior to the approval of any borrow sources developed for use on any project, obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the removal of the borrow material from the borrow sources(s) will have no effect on any known district, site building, structure, or object, architectural and/or archaeological that is included or eligible for inclusion in the National Register of Historic Places.

**Division 8 Incidentals**

**Page 8-9, Article 802-2 General Requirements**, add the following as the 1st paragraph:

Prior to the removal of any waste from any project, obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the deposition of the waste material to the proposed waste area will have no effect on any known district, site building, structure, or object, architectural and/or archaeological that is

included or eligible for inclusion in the National Register of Historic Places. Furnish a copy of this certification to the Engineer prior to performing any work in the proposed waste site.

**Page 8-10, Article 802-2, General Requirements, 4th paragraph, add the following as the 2nd sentence:**

The Department's borrow and waste site reclamation procedures for contracted projects is available on the NCDOT website and shall be used for all borrow and waste sites on this project.

**ENDWALLS:**

(5-20-08)

SP8 R25

Revise the *Standard Specifications* as follows:

**Page 8-28, Article 838-4 Replace the 1st and 2nd paragraph with the following:**

*Endwalls* will be measured and paid for in cubic yards of concrete or brick that have been completed and accepted. This quantity will be computed from the dimensions shown on the plans or from revised authorized dimensions. Where precast concrete units have been approved and are used in lieu of cast-in-place units the quantity to be paid for will be computed the same as if cast-in-place units were used, as no reduction in pay quantity will be made due to the use of precast in lieu of cast in place endwalls.

*Reinforced Endwalls* will be measured and paid for in cubic yards of concrete or brick that have been completed and accepted. This quantity will be computed from the dimensions shown on the plans or from revised authorized dimensions. Where precast concrete units have been approved and are used in lieu of cast-in-place units the quantity to be paid for will be computed the same as if cast-in-place units were used, as no reduction in pay quantity will be made due to the use of precast in lieu of reinforced cast in place endwalls.

**GUARDRAIL ANCHOR UNITS, TYPE 350:**

(4-20-04) (Rev 8-16-11)

SP8 R65

**Description**

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the *2006 Standard Specifications*, and at locations shown in the plans.

**Materials**

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

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

Trinity Industries, Inc.  
2525 N. Stemmons Freeway  
Dallas, Texas 75207  
Telephone: 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:

(A) 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 *2006 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Section 105-2 of the *2006 Standard 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 Methods**

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 *2006 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 862-6 of the *2006 Standard Specifications*.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Guardrail Anchor Units, Type 350	Each

**FENCE:**

(3-6-06)

SP8 R86

Revise the *2006 Standard Specifications* as follows:

**Page 8-54, Subarticle 866-3(A), second sentence,**

Add *existing fencing* after stumps

**FIELD OFFICE (Month):**

(6-1-07)

SPI 8-2

**Description**

This work consists of furnishing, erecting, equipping, and maintaining a field office for the exclusive use of Department Engineers and Inspectors at a location on the project approved by the Engineer. Provide a field office that complies with the current ADA Design and Accessibility Standards, the National Electric Code, local, state, and federal regulations and the following requirements.

**Procedures**

The field office and equipment will remain the property of the Contractor upon completion of the contract. The field office shall be separated from buildings and trailers used by the Contractor and be erected and functional as an initial operation. Failure to have the field office functional when work first begins on the project will result in withholding payment of the Contractor's monthly progress estimate. The field office shall be operational throughout the duration of the project and be removed upon completion and final acceptance of the project.

Provide a field office that is weatherproof, tightly floored and roofed, constructed with an air space above the ceiling for ventilation, supported above the ground, has a width of at least 10 feet, and the floor-to-ceiling height that is at least 7 feet 6 inches. Provide inside walls and a ceiling that are constructed of plywood, masonite, gypsum board, or other suitable materials. Have the exterior walls, ceiling, and floor insulated.

Provide a field office with a minimum floor space of 500 square feet and that is equipped with the following:

<b><u>Number</u></b>	<b><u>Item</u></b>
1	Double-pedestal desk (approximately 60 by 34 inches, at least 2,000 square inches).
1	Plan and drafting table (approximately 30 by 96 inches) with adjustable stool.
1	Computer table having a minimum size of 48 by 30 by 29 inches.
1	Plan rack for 24 by 36 inch drawings with 6 plan clamps.
1	Printing calculator.
2	2-drawer fire protection file, 15 inch drawer width, minimum UL rating of Class 350.

6	Office chairs with at least two having casters.
2	Wastebaskets.
1	Pencil sharpener.
1	Copy machine (8 inch x 11 inch copies)
1	Telephone.
1	Fax Machine.
1	Answering machine.

### **Windows and Doors**

Provide a field office with at least three windows with blinds, each having an area of at least 540 square inches, capable of being easily opened and secured from the inside and having at least two exterior passage doors. Provide doors at least 30 inches in width and 78 inches in height. Provide screens for windows and doors. Equip exterior passage doors with locks, and furnish at least two keys to the Engineer.

### **Steps**

Provide accessibility in compliance with the current ADA Design and Accessibility Standards, and the State Building Code and maintain them free from obstructions.

### **Storage Facility For Nuclear Gage**

Furnish the field office with an outside storage facility for the Department's nuclear gage. The storage facility shall not be located within 10 feet of any other structure including the field office.

### **Lighting, Heating, and Air Conditioning**

The field office shall have satisfactory lighting, electrical outlets, heating equipment, an exhaust fan, and an air conditioner connected to an operational power source. Provide at least one of the light fixtures that is a fluorescent light situated over the plan and drafting table. Furnish electrical current and fuel for heating equipment.

### **Fire Extinguishers**

Furnish and maintain one fire extinguisher for each required exterior passage door. Fire extinguishers may be chemical or dry powder. UL Classification 10-B:C (minimum), suitable for Type A:B:C fires. Mount and maintain fire extinguishers in accordance with OSHA Safety and Health Standards.

### **Toilets**

Provide a toilet conforming to the requirements of the state and local boards of health or other bodies or courts having jurisdiction in the area. When separate facilities for men and women are not available, place a sign with the words "Rest Room" (with letters at least 1 inch in height)



over the doorway, and provide an adequate positive locking system on the inside of the doorway. Maintain responsibility for the water and sewer connections or the installation and connection of a water well and septic tank and drain field. These facilities shall conform to all local and state permits.

### **Utilities**

Except for telephone service, make necessary utility connections, maintain utilities, pay utility service fees and bills, and handle the final disconnection of utilities. Furnish a telephone in each field office and permit the work necessary to install it.

### **Storage Facility for Test Equipment**

Provide the field office with a storage facility, separate from the office for storage of test equipment, other than the nuclear gage. Provide a facility that has at least floor space of 64 square feet, is weatherproof, tightly floored and roofed, and has a tamper resistant key operated lock.

### **Miscellaneous Items**

The field office shall also include the following:

1. A certification that the office is free of asbestos and other hazardous materials.
2. A broom, dust pan, mop and bucket, and general cleaning supplies.
3. Provide and maintain an all weather parking area for six vehicles, including graveled access to the paved surface.

### **Measurement and Payment**

Measurement for use of the *Field Office* will be based on the time it is used, expressed in calendar months. The unit bid price shall include furnishing, erecting, maintaining, and removing the field office. Payment will not be made for any month during which the office is furnished for less than 15 calendar days or for any time in excess of the time limit established in the Contract as extended in accordance with the requirements of Section 108-10 of the *Standard Specifications*.

Installation and service fees for the telephone will be paid for by the Department.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Field Office	Month

**STEEL U-CHANNEL POSTS AND STEEL SQUARE TUBE SUPPORTS:**

(7-18-06) (Rev 1-18-11)

SP9 R02

Revise the *2006 Standard Specifications* as follows:

**Page 9-15 Subarticle 903-3(D) delete the last sentence in the first paragraph and add the following:**

Use posts of sufficient length to permit the appropriate sign mounting height. Spliced posts are not permitted on new construction.

**Page 9-16 Subarticle 903-3(G) delete the last sentence in the first paragraph and add the following:**

Use posts of sufficient length to permit the appropriate sign mounting height. Spliced posts are not permitted on new construction.

**Page 9-16 Subarticle 903-3(G), delete the fourth paragraph and add the following:**

Do not weld or cut supports in the field except for the saw cutting of steel square tube material for the frames and cross-braces that may be required for Types D, E, and F signs with two or more supports.

**GALVANIZED HIGH STRENGTH BOLTS, NUTS AND WASHERS:**

(2-17-09) (Rev 5-17-11)

SP10 R02

Revise the *Standard Specifications* as follows:

**Page 10-126, Subarticle 1072-7(F)(3) Change the AASHTO reference to ASTM B695 Class 55.**

**Page 10-247, Table 1092-2, Steel Sign Materials, Change High Strength Bolts, Nuts & Washers ASTM Specifications for Galvanizing to B695 Class 55.**

**Page 10-259, Subarticle 1094-1(A) Breakaway or Simple Steel Beam Sign Supports, replace the third paragraph with the following:**

Fabricate high strength bolts, nuts, and washers required for breakaway supports from steel in accordance with ASTM A325 and galvanize in accordance with ASTM B695 Class 55.

**Page 10-261, Article 1096-2 Steel Overhead Sign Structures, replace the last sentence with the following:**

The galvanizing shall meet ASTM B695 Class 55 for fasteners and ASTM A123 for other structural steel.

**GALVANIZING:**

(8-17-10)

SP10 R03

Revise the *Standard Specifications* as follows:

**Page 10-150, Subarticle 1076-1, Galvanizing,** add a second paragraph as the follows:

Allow the Engineer to obtain samples of molten zinc directly from the galvanizing vat upon request.

**AGGREGATE PRODUCTION:**

(11-20-01)

SP10 R05

Provide aggregate from a producer who uses the current 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 use the program. Participation in the program does not relieve the producer of the responsibility of complying with all requirements of the *2006 Standard Specifications*. Copies of this procedure are available upon request from the Materials and Test Unit.

**CONCRETE BRICK AND BLOCK PRODUCTION:**

(11-20-01)

SP10 R10

Provide concrete brick and block from a producer who uses the current 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 use the program. Participation in the program does not relieve the producer of the responsibility of complying with all requirements of the *2006 Standard Specifications*. Copies of this procedure are available upon request from the Materials and Test Unit.

**VOLUMETRIC CONCRETE BATCHING:**

(5-18-10)

SP10 R13

Revise the *2006 Standard Specifications* as follows:

**Page 10-19, after Article 1000-12,** add the following as a new article:

**1000-13      VOLUMETRIC MIXED CONCRETE**

Upon written request by the contractor, the Department may approve the use of concrete proportioned by volume. The volumetric producer must submit and have approved a process control plan and product quality control plan by the Materials and Tests Unit. If concrete is proportioned by volume, the other requirements of these specifications with the following modifications will apply. Unless otherwise approved by the Department, use of concrete proportioned by volume shall be limited to Class B concrete and a maximum of 30 cubic yards per unit per day.

**(A) Materials**

Use materials that meet the requirements for the respective items in the *Standard Specifications* except that they will be measured by a calibrated volume-weight relationship.

Storage facilities for all material shall be designed to permit the Department to make necessary inspections prior to the batching operations. The facilities shall also permit identification of approved material at all times, and shall be designed to avoid mixing with or contaminating by unapproved material. Coarse and fine aggregate shall be furnished and handled so variations in the moisture content affecting the uniform consistency of the concrete will be avoided.

Moisture content of the coarse and fine aggregate will be made available onsite for the Engineer's review for each load. The frequency of moisture testing will be dependent on certain variables such as weather, season and source; however, moisture tests should be performed at least once at the beginning of the work day for each source material. Additional daily moisture tests for the coarse and fine aggregate shall be performed if requested by the Engineer.

Unused materials should be emptied from hopper daily. Concrete should not be mixed with materials that have been left in the hopper overnight.

**(B) Equipment**

Provide volumetric mixers with rating plates indicating that the performance of the mixer is in accordance with the Volumetric Mixer Manufacturer Bureau or equivalent. Mixers must comply with ASTM C685. Unless otherwise specified, all mixing operations must be in strict accordance with the manufacturer's recommended procedures. Such procedures shall be provided to the Department for review upon request.

The volumetric mixer shall be capable of carrying sufficient unmixed dry bulk cement, pozzolan (if required), fine aggregate, coarse aggregate, admixtures and water, in separate compartments and accurately proportioning the specified mix. Each batching or mixing unit (or both) shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator.

The concrete mixing device shall be an auger-type continuous mixer used in conjunction with volumetric proportioning. The mixer shall produce concrete, uniform in color and appearance, with homogeneous distribution of the material throughout the mixture. Mixing time necessary to produce uniform concrete shall be established by the contractor and shall comply with other requirements of these specifications. Only equipment found acceptable in every respect and capable of producing uniform results will be permitted.

Each volumetric mixer shall be equipped with an onboard ticketing system that will electronically produce a record of all material used and their respective weights and the total volume of concrete placed. Alternate methods of recordation may be used if approved by the Engineer. Tickets should also identify the following information, at minimum:

- Contractor Name
- Contractor Phone Number
- NCDOT Project No. and TIP No.
- Date
- Truck No.
- Ticket No.
- Time Start/End of Pour
- Mix ID & Description (Strength)
- Aggregate Moisture Before Mixing

**(C) Proportioning Devices**

Volume proportioning devices, such as counters, calibrated gate openings or flow meters, shall be easily accessible for controlling and determining the quantities of the ingredients discharged. All indicating devices that affect the accuracy of proportioning and mixing of concrete shall be in full view of and near enough to be read by the operator and Engineer while concrete is being produced. In operation, the entire measuring and dispensing mechanism shall produce the specified proportions of each ingredient.

The volumetric mixer shall provide positive control of the flow of water and admixtures into the mixing chamber. Water flow shall be indicated by a flow meter and be readily adjustable to provide for slump control and/or minor variations in aggregate moisture. The mixer shall be capable of continuously circulating or mechanically agitating the admixtures.

Liquid admixtures shall be dispensed through a controlled, calibrated flow meter. A positive means to observe the continuous flow of material shall be provided. If an admixture requires diluting, the admixture shall be diluted and thoroughly mixed prior to introducing the admixture into the dispenser. When admixtures are diluted, the ratio of dilution and the mixing shall be approved by and performed in the presence of the Department.

The volumetric mixer shall be capable of measurement of cement, pozzolan (if required), liquids and aggregate being introduced into the mix.

**(D) Calibration**

Volume-weight relationships will be based on calibration. The proportioning devices shall be calibrated by the contractor prior to the start of each NCDOT job, and subsequently at intervals recommended by the equipment manufacturer. Calibrations

will be performed in the presence of the Department and subject to approval from the Department. Calibration of the cement and aggregate proportioning devices shall be accomplished by weighing (determining the mass of) each component. Calibration of the admixture and water proportioning devices shall be accomplished by weight (mass) or volume. Tolerances in proportioning the individual components will be as follows:

**TABLE 1000-4  
VOLUMETRIC MIXED CONCRETE CALIBRATION  
PROPORTION TOLERANCES**

Item	Tolerance
Cement, Weight (Mass) percent	0 to +4
Fine Aggregate, Weight (Mass) percent	± 2
Coarse Aggregate, Weight (Mass) percent	± 2
Admixtures, Weight (Mass) or Volume percent	± 3
Water, Weight (Mass) or Volume percent	± 1

Each volumetric mixer must be accompanied at all times by completed calibration worksheets and they shall be made available to the Department upon request.

**(E) Verification of Yield**

Verification of the proportioning devices may be required at any time by the Department. Verification shall be accomplished by proportioning the rock and sand based on the cement meter count for each concrete mobile mixer. Once the count (revolutions) for 94 pounds of cement has been determined then delivery of the correct amount of rock and sand can be verified.

**(F) Uniformity**

When concrete is produced, have present during all batching operations a Certified Concrete Batch Technician. During batching and placement, the sole duty of this employee is to supervise the production and control of the concrete, perform moisture tests, adjust mix proportions of aggregates for free moisture, complete and sign approved delivery tickets, and assure quality control of the batching.

Two samples of sufficient size to make the required tests will be taken after discharge of approximately 15 and 85 percent of the load. Each of the 2 samples of concrete will be separately tested for the properties listed in Table 1000-3. Tests will be conducted in accordance with the test procedures specified in Table 1000-3 or procedures established by the Materials and Tests Unit. The Engineer may recheck mixer performance at any time when in his opinion satisfactory mixing is not being accomplished.

**PORTLAND CEMENT CONCRETE (Alkali-Silica Reaction):**

(2-20-07)

SP10 R16

Revise the 2006 *Standard Specifications* as follows:

**Article 1024-1(A)**, replace the 2nd paragraph with the following:

Certain combinations of cement and aggregate exhibit an adverse alkali-silica reaction. The alkalinity of any cement, expressed as sodium-oxide equivalent, shall not exceed 1.0 percent. For mix designs that contain non-reactive aggregates and cement with an alkali content less than 0.6%, straight cement or a combination of cement and fly ash, cement and ground granulated blast furnace slag or cement and microsilica may be used. The pozzolan quantity shall not exceed the amount shown in Table 1024-1. For mixes that contain cement with an alkali content between 0.6% and 1.0%, and for mixes that contain a reactive aggregate documented by the Department, regardless of the alkali content of the cement, use a pozzolan in the amount shown in Table 1024-1.

Obtain the list of reactive aggregates documented by the Department at:<http://www.ncdot.org/doh/operations/materials/pdf/quarryasrprob.pdf>

<b>Table 1024-1</b>	
<b>Pozzolans for Use in Portland Cement Concrete</b>	
<i>Pozzolan</i>	<i>Rate</i>
Class F Fly Ash	20% by weight of required cement content, with 1.2 lbs Class F fly ash per lb of cement replaced
Ground Granulated Blast Furnace Slag	35%-50% by weight of required cement content with 1 lb slag per lb of cement replaced
Microsilica	4%-8% by weight of required cement content, with 1 lb microsilica per lb of cement replaced

**WATER FOR CONCRETE:**

(10-19-10)

SP10 R17

Revise the *Standard Specifications for Roads and Structures* as follows:

**Page 10-63, Article 1024-4**, replace article with the following:

**1024-4 WATER**

Ensure that water used to condition, wash, or as an integral part of materials is clear and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substance. It shall not be salty or brackish. Water used in the production of concrete or grout shall be from wells or public water systems which are suitable for drinking and must meet the criteria listed in Table 1024-1.

Test all water from wells and public water supplies from all out of state locations and in the following counties: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrell,

and Washington unless the Engineer waives the testing requirements. Water from a municipal water supply in all other NC counties may be accepted by the Engineer without testing.

**TABLE 1024-1  
ACCEPTANCE CRITERIA FOR WATER  
USED IN THE PRODUCTION OF CONCRETE**

<b>Requirement</b>	<b>Limit</b>	<b>Test Method</b>
Compressive Strength, minimum percent of control at 3 and 7 days	90 percent	NCDOT Modified / AASHTO T106
Time of set, deviation from control	From 1:00 hr. earlier to 1:30 hr. later	NCDOT Modified / AASHTO T131
pH	4.5 to 8.5	NCDOT Modified / AASHTO T26
Chloride Ion Content, Max.	250 ppm	ASTM D512
Total Solids Content (Residue), Max.	1000 ppm	NCDOT Modified / Standard Methods for Examination of Water and Wastewater
Resistivity, Min.	0.500 kohm-cm	NCDOT Modified / ASTM D1125
Sulfate as SO <sub>4</sub> , Max.	1500 ppm	NCDOT Modified / ASTM D516
Presence of Sugar	None	NCDOT Procedure
Dissolved Organic Matter	None	NCDOT Modified / AASHTO T26

**Page 10-65, Article 1026-4, replace article with the following:**

#### **1026-4 WATER**

All water used for curing concrete shall meet the requirements of Article 1024-4 and Table 1024-1. Water from wells, streams, ponds, or public water systems may be used.

#### **CULVERT PIPE:**

(1-19-10)

SP10 R32

Revise the *Standard Specifications for Roads and Structures* as follows:

**Page 10-67, Article 1032-1, replace (A), (B), (C), (D), (E) and (F) with the following:**

- (A) Coated corrugated metal culvert pipe and pipe arches.
- (B) Coated corrugated metal end sections, coupling band, and other accessories
- (C) Corrugated aluminum alloy structural plate pipe and pipe arches
- (D) Corrugated aluminum alloy end sections, coupling band, and other accessories
- (E) Welded steel pipe



**Page 10-69, Subarticle 1032-3(A)(5) Coating Repair, replace with the following:**

Repair shall be in accordance with Section 1076-6 of the *Standard Specifications*.

**Subarticle 1032-3(A)(7) Aluminized Pipe, replace with the following:**

Aluminized pipe shall meet all requirements herein, except that the pipe and coupling bands shall be fabricated from aluminum coated steel sheet meeting the requirements of AASHTO M274.

**Page 10-71, Article 1032-4 Coated Culvert Pipe, replace (A), (1), (2), (3), (4), (B), (C), (D), (E), (F) and (G) with the following:****(A) Coatings for Steel Culvert Pipe or Pipe Arch**

The below coating requirements apply for steel culvert pipe, pipe arch, end sections, tees, elbows, and eccentric reducers.

- (1) Steel Culvert pipe shall have an aluminized coating, meeting the requirement of AASHTO M274
- (2) When shown on the plans or as approved by the Engineer, a polymeric coating meeting the requirements of AASHTO M246 for Type B coating may be substituted for aluminized coating.

**(B) Acceptance**

Acceptance of coated steel culvert pipe, and its accessories will be based on, but not limited to, visual inspections, classification requirements, check samples taken from material delivered to the project, and conformance to the annual Brand Registration.

**Page 10-73, Article 1032-5, sixth paragraph, third sentence, remove the word "spelter"****Page 10-74, 1032-7 Vitrified Clay Culvert Pipe, delete section in its entirety.****Page 10-75, Article 1032-8 Welded Steel Pipe, change title to WELDED STEEL PIPE FOR DRAINAGE****Subarticle 1032-9(B) Plain Concrete Culvert Pipe, delete section in its entirety.**

**Page 10-77, Article 1032-10 Corrugated Polyethylene Culvert Pipe, change title to CORRUGATED POLYETHYLENE (HDPE) CULVERT PIPE**

**Add the following: Article 1032-11 Polyvinyl Chloride (PVC) Pipe**

Polyvinyl Chloride pipe shall conform to AASHTO M 304 or ASTM 949. When rubber gaskets are to be installed in the pipe joint, the gasket shall be the sole element relied on to maintain a tight joint. Test pipe joints at the plant hydrostatically using test methods in ASTM D 3212. Soil tight joints shall be watertight to 13.8 kPa. Watertight joints shall be watertight to 34.5 kPa unless a higher pressure rating is specified in the plans.

**GLASS BEADS:**

(7-18-06)(Rev 10-19-10)

SP10 R35

Revise the *2006 Standard Specifications* as follows:

**Page 10-223, 1087-4(A) Composition, add the following as the fourth paragraph:**

Glass beads shall have no more than 75 parts per million of arsenic as determined by the United States Environmental Protection Agency Method 6010B in conjunction with the United States Environmental Protection Agency Method 3052 modified.

**Page 10-223, 1087-4(C) Gradation & Roundness, delete the last paragraph and replace the second sentence of the first paragraph with the following:**

All Drop-On and Intermixed Glass Beads shall be tested in accordance with ASTM D1155.

**Page 10-226, 1087-8 Material Certification, add the following below the first sentence:**

Glass Beads (for paint, thermoplastic and polyurea) – Type 3 Material Certification for no more than 75 parts per million of arsenic

**ENGINEERING FABRICS:**

(7-18-06) (Rev 10-19-10)

SP10 R40

Revise the *Standard Specifications* as follows:

**Page 10-99, Delete Section 1056 ENGINEERING FABRICS and replace it with the following:**

**SECTION 1056  
ENGINEERING FABRICS**

**1056-1 General**

Use engineering fabrics that meet the requirements of Article 4.1 of AASHTO M288 and have been evaluated by National Transportation Product Evaluation Program (NTPEP). When required, sew fabrics together in accordance with Article X1.1.4 of AASHTO M288. Provide sewn seams with seam strengths meeting the required strengths for the engineering fabric type and class specified.

Load, transport, unload and store fabrics such that they are kept clean and free of damage. Label, ship and store fabrics in accordance with Section 7 of AASHTO M288. Fabrics with defects, flaws, deterioration or damage will be rejected. Do not unwrap fabrics until just before installation. With the exception of fabrics for temporary silt fences and mechanically stabilized earth (MSE) wall faces, do not leave fabrics exposed for more than 7 days before covering fabrics with material.

When required, use pins a minimum of 3/16" in diameter and 18" long with a point at one end and a head at the other end that will retain a steel washer with a minimum outside diameter of 1.5". When wire staples are required, provide staples in accordance with Subarticle 1060-8(D) of the *Standard Specifications*.

### **1056-2 Fabric Properties**

Provide Type 1 Certified Mill Test Report, Type 2 Typical Certified Mill Test Report or Type 4 Certified Test Report in accordance with Article 106-3 of the *Standard Specifications*. Furnish certifications with minimum average roll values (MARV) as defined by ASTM D4439 for all fabric properties with the exception of elongation. For testing fabrics, a lot is defined as a single day's production.

Provide engineering fabric types and classes in accordance with the contract. Machine direction (MD) and cross-machine direction (CD) are as defined by ASTM D4439. Use woven or nonwoven fabrics with properties meeting the requirements of Table 1056-1.

**TABLE 1056-1  
FABRIC PROPERTY REQUIREMENTS**

Property	ASTM Test Method	Requirements (MARV <sup>1</sup> )				
		Type 1	Type 2	Type 3 <sup>2</sup>	Type 4	Type 5 <sup>3</sup>
<i>Typical Application</i>		<i>Shoulder Drains</i>	<i>Under Riprap</i>	<i>Temporary Silt Fence</i>	<i>Soil Stabilization</i>	<i>Temporary MSE Walls</i>
Elongation (MD & CD)	D4632	≥ 50 %	≥ 50 %	≤ 25 %	< 50 %	< 50 %
Grab Strength (MD & CD)	D4632	90 lbs	205 lbs	100 lbs	180 lbs	---
Tear Strength (MD & CD)	D4533	40 lbs	80 lbs	---	70 lbs	---
Puncture Strength	D6241	220 lbs	440 lbs	---	370 lbs	---
Wide Width Tensile Strength @ Ultimate (MD & CD)	D4595	---	---	---	---	2400 lbs/ft (unless required otherwise in the contract)
Permittivity	D4491	0.20 sec <sup>-1</sup>	0.20 sec <sup>-1</sup>	0.05 sec <sup>-1</sup>	0.05 sec <sup>-1</sup>	0.20 sec <sup>-1</sup>
Apparent Opening Size <sup>4</sup>	D4751	#60	#60	#30	#40	#30
Ultraviolet Stability (retained strength) <sup>5</sup>	D4355	50 %	50 %	70 %	50 %	50%

<sup>1</sup>MARV does not apply to elongation

<sup>2</sup>Minimum roll width of 36" required

<sup>3</sup>Minimum roll width of 13 ft required

<sup>4</sup>US Sieve No. per AASHTO M92

<sup>5</sup>After 500 hours of exposure

### **PRECAST DRAINAGE STRUCTURES - MACRO-SYNTHETIC FIBERS**

(7-15-08)(Rev 11-18-08)

SP10 R42

#### **Description**

Substitute as an option, macro-synthetic fibers in lieu of 4" x 4" W1.4 x W1.4 welded wire fabric reinforcement for selected precast concrete products in accordance with the following requirements.

**Materials**

<b>Item</b>	<b>Section</b>
Portland Cement Concrete	1077-5

(A) Substitute macro-synthetic fibers only for steel reinforcement with an area of steel of 0.12 in<sup>2</sup>/ft or less in the following items:

- (1) **Precast Drainage Structure** units in accordance with the requirements of *Standard Drawing 840.45*.
- (2) **Precast Manhole 4.0' Riser Sections** in accordance with the requirements of *Standard Drawing 840.52*.

All other requirements, including reinforcement for these precast concrete items will remain the same.

(B) **Submittal** Submit to the Department for approval by the precast producer and fiber manufacturer, independently performed test results certifying the macro-synthetic fibers and the precast concrete products meet the requirements listed herein:

(C) **Macro-Synthetic Fibers**

- (1) Manufacture from virgin polyolefins (polypropylene and polyethylene) and comply with ASTM C 1116.4.1.3.

*Fibers manufactured from materials other than polyolefins* Submit test results certifying resistance to long-term deterioration when in contact with the moisture and alkalies present in cement paste and/or the substances present in air-entraining and chemical admixtures.

- (2) Fiber length - no less than 1-1/2 inch.
- (3) Macro-synthetic fibers - aspect ratio (length divided by the equivalent diameter of the fiber) between 45 and 150.
- (4) Macro-synthetic fibers - Minimum tensile strength of 40 ksi when tested in accordance with ASTM D 3822.
- (5) Macro-synthetic fibers - minimum modulus of elasticity of 400 ksi when tested in accordance with ASTM D 3822.

**(D) Fiber Reinforced Concrete**

- (1) Approved structural fibers may be used as a replacement of steel reinforcement in allowable structures of NCDOT Standards 840.45 and 840.52. The dosage rate, in pounds of fibers per cubic yard, shall be as per recommended by the fiber manufacturer to provide a minimum average residual strength (in accordance with ASTM C 1399) of concrete of no less than that of the concrete with the steel reinforcement that is being replaced, but no less than 5 lbs. per cubic yard. Submit the recommendations of the manufacturer that correlate the toughness of steel-reinforced concrete with that of the recommended dosage rate for the fiber-reinforced concrete.
- (2) Fiber reinforced concrete - 4.5% air content,  $\pm$  1.5% tolerance.
- (3) Fiber reinforced concrete - develop a minimum compressive strength 4000 psi in 28 days.
- (4) Workability of the concrete mix - determine in accordance with ASTM C995. The flow time - not be less than 7 seconds or greater than 25 seconds.
- (5) Assure the fibers are well dispersed and prevent fiber balling during production. After introduction of all other ingredients, add the plastic concrete and mix the plastic concrete for at least 4 minutes or for 50 revolutions at standard mixing speed.

**Measurement and Payment**

No separate payment will be made for substitution of macro-fiber synthetic reinforcement for the steel reinforcing. The price bid for the precast units will be full compensation for furnishing and incorporating the macro-fiber synthetic reinforcement.

**QUALIFICATION OF WELDS AND PROCEDURES:**

(7-21-09)

SP10 R43

**Page 10-143, Subarticle 1072-20(D) Qualification of Welds and Procedures**, replace the third sentence of the first paragraph with the following:

For all prequalified field welds, submit Welding Procedure Specifications (WPS) for each joint configuration for approval at least 30 days prior to performing any welding. In lieu of this, use the WPS provided and preapproved by the Department. These preapproved WPS are available from the Materials and Tests Unit or at:

[http://www.ncdot.org/doh/operations/materials/structural/appr\\_proc.html](http://www.ncdot.org/doh/operations/materials/structural/appr_proc.html). Use non-prequalified welds only if approved by the Engineer. Submit WPS for all non-prequalified welds to the Engineer for approval. At no cost to the Department, demonstrate their adequacy in accordance with the requirements of the Bridge Welding Code.

**PAINT SAMPLING AND TESTING:**

(8-15-06)

SP10 R45

Revise the *2006 Standard Specifications* as follows:

**Page 10-190, Article 1080-4,** Delete the first paragraph and replace with the following:

All paint will be sampled, either at the point of manufacture or at the point of destination. Inspection and sampling will be performed at the point of manufacture wherever possible. The Contractor shall not begin painting until the analysis of the paint has been performed, and the paint has been accepted.

**CHANNELIZING DEVICES (Drums):**

7-20-10

SP10 R60

Revise the *2006 Standard Specifications* as follows:

**Page 10-236, Subarticle 1089-5(A) Drums (1) General,** replace the paragraph with the following:

(1) General

Provide drums composed of a body, alternating orange and white 4 band pattern of Type III-High Intensity Microprismatic Sheeting and ballasts that have been evaluated by NTPEP.

The following guidelines will be used during the transition from drums with the standard 5 band engineer's grade sheeting to the new 4 band configuration.

(a) All **new** drums purchased **after July 20, 2010** shall have the new sheeting and 4 band configuration.

(b) Existing 5 band drums with engineer's grade sheeting (both new and used devices in existing inventories) will be allowed for use on all on-going construction projects until project completion and will also be allowed for use on other projects until a sunset date has been established.

(c) Intermixing of "old drums" and "new drums" on the same project is acceptable during the transition.

(d) 4 band drums with engineer's grade sheeting will not be allowed at anytime.

**Page 10-236, Subarticle 1089-5(A) Drums (3) Retroreflective Stripes,** replace the paragraph with the following:

(3) Retroreflective Bands

Provide a minimum of 4 retroreflective bands- 2 orange and 2 white alternating horizontal circumferential bands. The top band shall always be orange. Use a 6" to 8"

wide band Type III–High Intensity Microprismatic Retroreflective Sheeting or better that meets the requirement of Section 1093 for each band. Do not exceed 2” for any non-reflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 6-inch band. Apply the retroreflective sheeting directly to the drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugations areas. No damage to the reflective sheeting should result from stacking and unstacking the drums, or vehicle impact.

**Page 10-237, Subarticle 1089-5(B) Skinny-Drums (1) General**, replace the paragraph with the following:

(1) General

All existing skinny-drums that do not have Type III-High Intensity Microprismatic Sheeting as a minimum will have the same transition requirements as drums as stated above. All **new** skinny-drums purchased **after July 20, 2010** shall have Type III–High Intensity Microprismatic Sheeting as the minimum. Type IV and higher grade sheeting is acceptable for use on both new and used devices.

Provide skinny-drums composed of a body, reflective bands, and ballasts that have been evaluated by NTPEP.

**Page 10-237, Subarticle 1089-5(B) Skinny Drums (3) Retroreflective Stripes**, replace the paragraph with the following:

(3) Retroreflective Bands

Provide a minimum of 4 retroreflective bands- 2 orange and 2 white alternating horizontal circumferential bands for each skinny-drum. The top band shall always be orange. Use a 6” to 8” wide band Type III–High Intensity Microprismatic Retroreflective Sheeting or better that meets the requirement of Section 1093 for each band. Do not exceed 2” for any non-reflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 6-inch band. Apply the retroreflective sheeting directly to the skinny-drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugations areas. No damage to the reflective sheeting should result from stacking and unstacking the skinny-drums, or vehicle impact.



**WORK ZONE TRAFFIC CONTROL:**

(8-16-11)

SP11 R20

**Revise the 2006 Standard Specifications as follows:**

**Page 11-3, Article 1101-12 Traffic Control Supervision**, in addition to the stated requirements, add the following:

Provide the service of at least one qualified Work Zone Supervisor. The Work Zone Supervisor shall have the overall responsibility for the proper implementation of the traffic management plan, as well as ensuring all employees working inside the NCDOT Right of Way have received the proper training appropriate to the job decisions each individual is required to make.

The work zone supervisor is not required to be on site at all times but must be available to address concerns of the Engineer. The name and contact information of the work zone supervisor shall be provided to the Engineer prior to or at the preconstruction conference.

Qualification of Work Zone Supervisors shall be done by an NCDOT approved training agency or other approved training provider. For a complete listing of these, see the Work Zone Traffic Control's webpage, <http://www.ncdot.gov/doh/preconstruct/wztc/>.

**Page 11-13, Article 1150-3 Construction Methods**, replace the article with the following:

Provide the service of properly equipped and qualified flaggers (see *Roadway Standard Drawings* No. 1150.01) at locations and times for such period as necessary for the control and protection of vehicular and pedestrian traffic. Anyone who controls traffic is required to be qualified. Qualification consists of each flagger receiving proper training in the set-up and techniques of safely and competently performing a flagging operation. Qualification of flaggers is to be done at an NCDOT approved training agency. For a complete listing of these, see the Work Zone Traffic Control's webpage, <http://www.ncdot.gov/doh/preconstruct/wztc/>.

Prior to beginning work on the project, a Qualification Statement that all flaggers used on the project have been properly trained through an NCDOT approved training resource shall be provided to the Engineer.

Flagging operations are not allowed for the convenience of the Contractor's operations. However, if safety issues exist (i.e. sight or stopping sight distance), the Engineer may approve the use of flagging operations. Use flagging methods that comply with the guidelines in the MUTCD.

**PAVEMENT MARKING LINES:**

(11-21-06) (Rev. 08-17-10)

SP12 R01

Revise the *2006 Standard Specifications* as follows:

**Page 12-2, 1205-3(D) Time Limitations for Replacement**, add the following at the beginning of the chart:

Facility Type	Marking Type	Replacement Deadline
Full-control-of-access multi-lane roadway (4 or more total lanes) and ramps, including Interstates	All markings including symbols	By the end of each workday's operation if the lane is opened to traffic

**Page 12-5, 1205-3 (H) Observation Period**, delete 1205-3 (H) and replace with the following:

Maintain responsibility for debonding and color of the pavement markings during a 12 month observation period beginning upon final acceptance of the project as defined under Article 105-17. Guarantee the markings under the payment and performance bond in accordance with Article 105-17.

During the 12 month observation period, provide pavement marking material that shows no signs of failure due to blistering, chipping, bleeding, discoloration, smearing or spreading under heat or poor adhesion to the pavement materials. Pavement markings that debond due to snowplowing will not be considered a failed marking. Replace, at no additional expense to the Department, any pavement markings that do not perform satisfactorily under traffic during the 12 month observation period.

**Page 12-8, 1205-4 (C) Application**, delete the last two sentences of the second paragraph and replace with the following:

Produce in place markings with minimum retroreflective values shown below, as obtained with a LTL 2000 Retroreflectometer or Department approved mobile retroreflectometer. Retroreflective measurements will be taken within 30 days after final placement of the pavement marking.

**Page 12-9, 1205-4 (D) Observation Period**, delete the entire section and replace with the following:

In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for minimum retroreflective values for a 30-day period beginning upon the Engineer's acceptance of all markings on the project. Guarantee retroreflective values of the markings during the 30-day period under the payment and performance bond in accordance with Article 105-17.

**Page 12-9, 1205-5 (B) Application**, delete the second sentence of the fourth paragraph and replace with the following:

Produce in place markings with minimum retroreflective values shown below, as obtained with a LTL 2000 Retroreflectometer or Department approved mobile retroreflectometer. Retroreflective measurements will be taken within 30 days after final placement of the pavement marking.

**Page 12-10, 1205-5 (C) Observation Period**, delete this entire section and replace with the following:

Maintain responsibility for minimum retroreflective values for a 30-day period beginning upon satisfactory final placement of all markings on the project. Guarantee retroreflective values of the markings during the 30-day period under the payment and performance bond in accordance with Article 105-17.

**Page 12-14, Article 1205-9, Maintenance**, delete Article 1205-9 and replace with the following:

Replace pavement markings that prematurely deteriorate, fail to adhere to the pavement, lack reflectorization, or are otherwise unsatisfactory during the life of the project or during the 12 month observation period as determined by the Engineer at no cost to the Department.

Upon notification from the Engineer, winterize the project by placing an initial or additional application of paint pavement marking lines in accordance with Article 1205-8. Payment for *Paint Pavement Marking Lines* required to winterize the project will be made in accordance with Article 1205-10 except that no payment will be made on resurfacing projects where paving is completed more than 30 days prior to the written notification by the Department that winterization is required.

**Page 12-14, Article 1205-10, Measurement and Payment**, add the following after the first sentence of the first paragraph:

In addition, *Paint Pavement Marking Lines* will be paid per linear foot for each 15 mil application placed in accordance with Subarticle 1205-8(C).