

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

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

M2 R01

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

Revise the *2006 Metric 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 1 m back of the beginning extremity of the structure and ending at a station 1 m beyond the ending extremity of the structure.

DEMOLITION OF BUILDINGS AND APPURTENANCES:

(1-1-02) (Rev. 9-19-06)

M2 R10

The Contractor’s attention is directed to the fact that he shall be responsible for removing all buildings, sheds, signs, walls, fences and any other rubble or surface debris within the right of way and/or construction limits whether listed in this special provision or not. Payment at the contract lump sum price for “Clearing and Grubbing” will be full compensation for this work.

Demolish the buildings and appurtenances listed below in accordance with Section 210 of the *2006 Metric Standard Specifications* and the following provisions:

Prior to demolishing any building, comply with the notification requirements of *Title 40 Code of Federal Regulations*, Part 61, Subpart M, which are applicable to asbestos. Give notification to the North Carolina Department of Health and Human Services, Division of Public Health, Health Hazards Control Unit and/or the appropriate county agency when enforcement of the Federal Regulation is performed by the county (Buncombe, Forsyth, Mecklenburg only). Submit a copy of the notification to the Engineer prior to the building demolition.

The Department has performed asbestos assessments and abatement for building items identified below. Copies of this report may be obtained through the Division Right-of-Way Agent. When asbestos is discovered after the opening of bids for the project, the Engineer may have the abatement performed by others or the cost of asbestos removal and disposal will be paid for in accordance with Article 104-7 of the *2006 Metric Standard Specifications*. When directed to perform removal and disposal of asbestos do so in accordance with the requirements of *Title 40 Code of Federal Regulations, NCGS 130A-444-452 and 10A NCAC 41C 0600*.

Comply with all Federal, State and local regulations when performing building demolition and/or asbestos removal and disposal. Any fines resulting from violations of any regulation are the sole responsibility of the Contractor and the Contractor agrees to indemnify and hold harmless the Department against any assessment of such fines.

Prior to removal of any Underground Storage Tank (UST), comply with the notification requirements of the *Title 40 Code of Federal Regulations*, Part 280.71(a). Give notification to the appropriate regional office of the North Carolina Department of Environment, and Natural Resources, Division of Waste Management, UST Section. Submit a copy of the notification to the Engineer prior to the removal of the underground storage tank.

Permanently close UST systems by removal and dispose of in compliance with the regulations set forth in *Title 40, Code of Federal Regulations*, Part 280.71 and *North Carolina Administrative Code Title 15A*, Chapter 2, Subchapter 2N and any applicable local regulations. Assess Underground Storage Tank sites at closure for the presence of contamination as required in *North Carolina Administrative Code Title 15A*, Chapter 2, Subchapter 2N, Section .0803 and as directed by the appropriate Regional Office of the Division of Waste Management. Remove and dispose of UST systems and contents in a safe manner in conformance with requirements of *American Petroleum Institute Bulletin 1604*, Removal and Disposal of Used Underground Petroleum Storage Tanks, Chapters 3 through 6. (Note: As an exception to these requirements, the filling of the tank with water as a means of expelling vapors from the tank as described in section 4.2.6.1 of *American Petroleum Institute Bulletin 1604*, will not be allowed). Where underground storage tanks are indicated below, there will be no direct payment for the closure or assessment, as payment at the contract lump sum price for *Clearing and Grubbing* will be full compensation for all costs of such closure or assessment. When the contract does not indicate the presence of storage tanks and storage tanks are discovered after the opening of bids for the project, the cost of closure, assessment and/or removal will be paid for in accordance with Article 104-7 of the *2006 Metric Standard Specifications*.

Disposition of any contaminated material associated with underground storage tanks will be made as provided in Article 107-26 of the *2006 Metric Standard Specifications*.

Demolition of Buildings and Appurtenances

Parcel #037 – Left of Survey Station 251+05, Survey Line –L-
Approximately 60 square feet Frame Shed

Demolition of Buildings and Appurtenances

Parcel #052 – Right of Survey Station 258+27, Survey Line –L-
One Story Frame Shed approximately 750 square feet

Demolition of Buildings and Appurtenances

Parcel #085 – Left of Survey Station 272+30, Survey Line –L-
Frame Shed approximately 100 square feet

Demolition of Buildings and Appurtenances

Parcel #085 – Left of Survey Station 272+40, Survey Line –L-
Frame Shed approximately 100 square feet

Demolition of Buildings and Appurtenances

Parcel #083 – Left of Survey Station 272+70, Survey Line –L-
One Story Frame Building approximately 250 square feet

Demolition of Buildings and Appurtenances

Parcel #103 – Left of Survey Station 279+60, Survey Line –L-
One Story Frame Garage approximately 600 square feet

Demolition of Buildings and Appurtenances

Parcel #106 – Right of Survey Station 280+32, Survey Line –L-
One Story Frame and Concrete Shed approximately 100 square feet

Demolition of Buildings and Appurtenances

Parcel #109 – Right of Survey Station 281+83, Survey Line –L-
One Story Frame Building / Business approximately 850 square feet

Demolition of Buildings and Appurtenances

Parcel #117 – Right of Survey Station 11+15, Survey Line –Y-18-
One Story Block Building, approximately 75 square feet

Demolition of Buildings and Appurtenances

Parcel #118 – Right of Survey Station 289+26, Survey Line –L-
Open Steel and Frame Shed, approximately 1,500 square feet

Demolition of Buildings and Appurtenances

Parcel #187 – Right of Survey Station 314+20, Survey Line –L-
Frame Storage Shed approximately 300 square feet

Demolition of Buildings and Appurtenances

Parcel #193 – Left of Survey Station 317+45, Survey Line –L-
One Story Block and Frame Building, approximately 1,200 square feet

Demolition of Buildings and Appurtenances

Parcel #214 – Left of Survey Station 334+00, Survey Line –L-
One Story Frame Dwelling, approximately 1,000 square feet

Demolition of Buildings and Appurtenances

Parcel #214 – Left of Survey Station 334+10, Survey Line –L-
One Story Frame Shed approximately 60 square feet

BUILDING AND UNDERGROUND STORAGE TANK REMOVAL:

(1-1-02) (Rev.6-21-05)

M2 R15

The Contractor's attention is directed to the fact that he shall be responsible for removing all buildings, sheds, signs, walls, fences and any other rubble or surface debris within the right of way and/or construction limits whether listed in this special provision or not. Payment at the contract lump sum price for "Clearing and Grubbing" will be full compensation for this work.

Building Removal

Remove the buildings and appurtenances listed below in accordance with Section 215 of the *2006 Metric Standard Specifications* and the following:

Prior to removal of any building, comply with the notification requirements of *Title 40 Code of Federal Regulations*, Part 61, Subpart M, which are applicable to asbestos. Give notification to the North Carolina Department of Health and Human Services, Division of Public Health Epidemiology Branch and/or the appropriate county agency when the county performs enforcement of the Federal Regulation. Submit a copy of the notification to the Engineer prior to the building removal.

The Department has performed asbestos assessments and abatement for building items identified below. Copies of this report may be obtained through the Division Right-of-Way Agent. When asbestos is discovered after the opening of bids for the project, the Engineer may have the abatement performed by others or the cost of asbestos removal and disposal will be paid for in accordance with Article 104-7 of the *2006 Metric Standard Specifications*. When directed to perform removal and disposal of asbestos, do so in accordance with the requirements of *Title 40 Code of Federal Regulations*; comply with all Federal, State and local regulations when performing building removal and/or asbestos removal and disposal. Any fines resulting from violations of any regulation are the sole responsibility of the Contractor and the Contractor agrees to indemnify and hold harmless the Department against any assessment of such fines.

When a building has had or will have asbestos removed and the Contractor elects to remove the building such that it becomes a public area, the Contractor is responsible for any additional costs incurred including final air monitoring.

Underground Storage Tank Removal

Known Underground Storage Tanks (UST's) will be removed by the Department prior to the opening of bids. When UST's are discovered after the opening of bids for the project, the Engineer may have the work performed by others or the cost of assessment, closure, and/or removal will be paid for in accordance with Article 104-7 of the *2006 Standard Specifications*.

When directed to remove UST'S, prior to their removal, comply with the notification requirements of the *Title 40 Code of Federal Regulations*, Part 280.71(a). Give notification to the appropriate regional office of the North Carolina Department of Environment and Natural Resources, Division of Waste Management, UST Section. Submit a copy of the notification to the Engineer prior to the removal of the underground storage tank.

Permanently close UST systems by removal and disposal in compliance with the regulations set forth in *Title 40, Code of Federal Regulations*, Part 280.71 and *North Carolina Administrative Code (NCAC) Title 15A, Chapter 2, Subchapter 2N* and any applicable local regulations. Assess Underground Storage Tank sites at closure for the presence of contamination as required in *NCAC Title 15A, Chapter 2, Subchapter 2N, Section .0803* and as directed by the appropriate Regional Office of the Division of Waste Management. Remove and dispose of UST systems and contents in a safe manner in conformance with requirements of *American Petroleum Institute Bulletin 1604, Removal and Disposal of Used Underground Petroleum Storage Tanks, Chapters 3 through 6*. (Note: As an exception to these requirements, the filling of the tank with water as a means of expelling vapors from the tank as described in Section 4.2.6.1 of *American*

Petroleum Institute Bulletin 1604, will not be allowed. Comply with all Federal, State and local regulations when performing UST removal and contaminated material disposal. Any fines resulting from violations of any regulation are the sole responsibility of the Contractor and the Contractor agrees to indemnify and hold harmless the Department against any assessment of such fines.

Disposal of any contaminated material associated with underground storage tanks will be made as provided in Article 107-26 of the *2006 Metric Standard Specifications*.

Building Removal
Parcel #001 – Left of Survey Station 227+60, Survey Line –L-
1 Story House Trailer, approximately 1,120 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #004 – Left of Survey Station 228+00, Survey Line –L-
1 Story Frame Dwelling, approximately 2,000 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #013 – Right of Survey Station 10+75, Survey Line –Y-2-
1 Story Frame Barn, approximately 2,200 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #017A – Right of Survey Station 236+70, Survey Line –L-
1 Story Metal Business, approximately 5,000 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #022 – Left of Survey Station 11+60, Survey Line –Y-5-
2 Metal Storage Sheds, approximately 1,474 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #029 – Right of Survey Station 246+80, Survey Line –L-
1 Story Frame Shed, approximately 100 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #032 – Right of Survey Station 10+55, Survey Line –Y-6-
Frame Shed, approximately 275 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #089 – Right of Survey Station, 274+80, Survey Line –L-
1 Story Brick Dwelling approximately 4,000 square feet, partially outside right of way and/or construction limits

Building Removal
Parcel #093 – Left of Survey Station 276+10, Survey Line –L-
1 Story Frame Dwelling approximately 2,000 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #099A- -Right of Survey Station 12+35, Survey Line –Y-17-
Two (2) Propane Tanks, 500 gallons each
Building Removal
Parcel #136 – Left of Survey Station 294+60, Survey Line –L-
1 Story Frame and Concrete/Block Building, approximately 400 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #193 – Left of Survey Station 317+90, Survey Line –L-
1 Story Frame Dwelling, (used as business), approximately 1,500 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #194 – Left of Survey Station 318+15, Survey Line –L-
1 Story Frame Business, approximately 1,500 square feet
Building Removal
Parcel #199A – Right of Survey Station 11+40, Survey Line –D-13 Revised
1 Story Frame Business, approximately 2,300 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #200 – Left of Survey Station 324+00, Survey Line –L-
1 Story Frame Dwelling, approximately 2,100 square feet
Building Removal
Parcel #201 – Left of Survey Station 324+35, Survey Line –L-
2 Story Rock and Frame Dwelling with Deck, approximately 2,800 square feet, partially outside right of way and/or construction limits
Building Removal
Parcel #201 – Left of Survey Station 325+03, Survey Line –L-
1 Story Frame Dwelling, approximately 2,000 square feet
Building Removal
Parcel #026 – Left of Survey Station 327+60, Survey Line –L-
1 ½ Story Frame Dwelling, approximately 2,000 square feet

When the description of the work for an item indicates a building partially inside and partially outside of right of way and/or construction area, but does not require the building be cut off, the entire building shall be removed.

CONTAMINATED SOIL

The Contractor's attention is directed to the fact that soil containing petroleum hydrocarbon compounds exists within the project area. Soil samples collected indicated that petroleum contaminated soil is present in the right of way on the following parcels:

Parcel 40, Andrew E. Brown Property
Parcel 42, George Daniel Hensley Property
Parcel 99A, Delx, Inc. Property
Parcel 114, Arlene Ray, Inc. Property
Parcel 115, S.C.N. Enterprises Property
Parcel 119, Samuel S. Styles Property
Parcel 134, Keith Presnell Property
Parcel 167, Edd's Independent Station Property
Parcel 194, William Ira Young Property
Parcel 196, Ed Gouge Property

Information relating to this contaminated area, sample locations, and laboratory results are available at the following web address:

www.ncdot.org/doh/preconstruct/ps/contracts/letting.html

Impact to contamination is possible during any earthwork activities on the project. The Contractor should only excavate those soils which the Engineer designates necessary to complete a particular task. The Engineer shall determine if the soil is contaminated based on petroleum odors and unusual soil staining. Contaminated soil not required to be excavated is to remain in place and undisturbed. Undisturbed soil shall remain in place whether contaminated or not. The Contractor shall transport all contaminated soil excavated from the project to an approved disposal facility licensed to accept contaminated soil. In the event that the Contractor needs to stockpile the soil temporarily, the stockpile shall be created within the property boundaries of the source material and in accordance with the Stockpile Detail found on the above referenced website. If the volume of contaminated material exceeds available space on site, the Contractor shall obtain a permit from the NCDENR UST Section for off-site temporary storage. The Engineer shall provide the Geotechnical Engineering Unit copies of the disposal manifests and weigh tickets for review and approval.

Method of Measurement and Payment:

The quantity of contaminated soil excavated, hauled, and disposed of shall be the actual number of metric tons of material, which has been acceptably excavated, transported and weighed with certified scales. The quantity of excavated contaminated soil, measured as provided above, shall be paid for at the contract unit price per metric ton for "Excavation, Hauling, and Disposal of Contaminated Soil".

The above price and payment shall be full compensation for all work covered by this section, including, but not limited to, excavation, loading, transportation, weighing, laboratory testing, disposal, equipment, decontamination of equipment, labor, and personal protective equipment.

Payment shall be made under:

Pay Item	Pay Unit
Excavation, Hauling, and Disposal of Contaminated Soil	Metric Ton

EMBANKMENTS:

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

M2 R18

Revise the *2006 Metric Standard Specifications* as follows:

Page 2-17, 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 300 mm 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 2-18, 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.

TEMPORARY DETOURS:

(7-1-95) (Rev 4-15-08)

M2 R30 A

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

After the detours have served their purpose, remove the portions deemed unsuitable for use as a permanent part of the project as directed by the Engineer. Salvage and stockpile the aggregate base course removed from the detours at locations within the right of way, as directed by the Engineer, for removal by State Forces. Place pavement and earth material removed from the detour in embankments or dispose of in waste areas furnished by the Contractor.

Aggregate base course and earth material that is removed will be measured and will be paid for at the contract unit price per cubic yard for *Unclassified Excavation*. Pavement that is removed will be measured and will be paid for at the contract unit price per square yard for *Removal of*

Existing Pavement. Pipe culverts removed from the detours remain the property of the Contractor. Pipe culverts that are removed will be measured and will be paid for at the contract unit price per linear foot for *Pipe Removal*. Payment for the construction of the detours will be made at the contract unit prices for the various items involved.

Such prices and payments will be full compensation for constructing the detours and for the work of removing, salvaging, and stockpiling aggregate base course; removing pipe culverts; and for placing earth material and pavement in embankments or disposing of earth material and pavement in waste areas.

AGGREGATE SUBGRADE:

(9-18-07) (Rev 3-16-10)

M2 R35

Description

Construct aggregate subgrades in accordance with the contract or as directed by the Engineer. Undercut as needed in cut areas. Install fabric for soil stabilization and place Class IV Subgrade Stabilization at locations shown on the plans.

Materials

Refer to Division 10 of the *Metric Standard Specifications*.

Item	Section
Select Material, Class IV	1016
Fabric for Soil Stabilization, Type 4	1056

Use Class IV Select Material for Class IV Subgrade Stabilization. If Class IV Subgrade Stabilization does not meet the requirements of Article 1010-2 of the *Metric Standard Specifications*, the Engineer may consider the material reasonably acceptable in accordance with Article 105-3 of the *Metric Standard Specifications*.

Construction Methods

When shallow undercut is required to construct aggregate subgrades, undercut 150 mm to 600 mm as shown on the plans or as directed by the Engineer. Perform undercut excavation in accordance with Section 225 of the *Metric Standard Specifications*. Install fabric for soil stabilization in accordance with Article 270-3 of the *Metric Standard Specifications*. Place Class IV Subgrade Stabilization (standard size no. ABC) by end dumping ABC on the fabric. Do not operate heavy equipment on the fabric until it is covered with Class IV Subgrade Stabilization. Compact ABC to 92% of AASHTO T180 as modified by the Department or to the highest density that can be reasonably obtained.

Maintain Class IV Subgrade Stabilization in an acceptable condition and minimize the use of heavy equipment on ABC in order to avoid damaging aggregate subgrades. Provide and maintain drainage ditches and drains as required to prevent entrapping water in aggregate subgrades.

Measurement and Payment

Shallow Undercut will be measured and paid for in cubic meters. Shallow undercut will be measured in accordance with Article 225-7 of the *Metric Standard Specifications*. The contract unit price for *Shallow Undercut* will be full compensation for excavating, hauling and disposing of materials to construct aggregate subgrades.

Class IV Subgrade Stabilization will be measured and paid for in metric tons. Class IV Subgrade Stabilization will be measured by weighing material in trucks in accordance with Article 106-7 of the *Metric Standard Specifications*. The contract unit price for *Class IV Subgrade Stabilization* will be full compensation for furnishing, hauling, handling, placing, compacting and maintaining ABC.

Fabric for Soil Stabilization will be measured and paid for in accordance with Article 270-4 of the *Metric Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
Shallow Undercut	Cubic Meter
Class IV Subgrade Stabilization	Metric Ton

FALSE SUMPS:

(7-1-95)

M2 R40

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

Payment for the work of construction of the false sumps will be made at the contract unit price per cubic meter for *Unclassified Excavation* or *Borrow Excavation* depending on the source of material, or included in *Grading-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, 17th 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.

Design and perform rock blasting such that no flyrock occurs. If flyrock occurs, 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.

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^{0.5} or m/kg^{0.5})
D = Distance to subject structure (ft or m)
W_{max} = 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 $\frac{1}{2}$ to $\frac{3}{4}$ 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)

M2 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 Metric Standard Specifications* except as follows:

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

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

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

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 Metric Standard Specifications*.

REINFORCED SOIL SLOPES:

(SPECIAL)

DESCRIPTION

A reinforced soil slope consists of select material and geogrid reinforcements in the reinforced zone with erosion control mat facing and is typically constructed in accordance with the Reinforced Soil Slope (RSS) Details Drawing. Construct reinforced soil slopes (RSS) in accordance with the contract. RSS are required to reinforce embankments and stabilize slopes at locations shown on the plans and as directed.

MATERIALS

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Select Material	1016
Anchor Pins	1056
Wire Staples	1060-8(D)

Unless required otherwise on the plans, use Class I, II or III Select Material in the reinforced zone for RSS flatter than 1.5:1 (H:V). For RSS steeper than 1.5:1 (H:V), use Class I Select Material in the reinforced zone that meets Article 560-2 of the *Standard Specifications* except for select material that meets AASHTO M 145 for soil classifications A-4 and A-5. Do not use A-4 or A-5 soil or Class II or III Select Material for RSS steeper than 1.5:1 (H:V).

Use erosion control mat facing on slope faces of RSS in accordance with the *Permanent Soil Reinforcement Mat* provision.

Identify, store and handle geogrids in accordance with ASTM D4873. Geogrids with defects, flaws, deterioration or damage will be rejected. Do not unwrap geogrids until just before installation. Do not leave geogrids exposed for more than 7 days before covering with select material.

Use primary geogrids that have been evaluated by the National Transportation Product Evaluation Program (NTPEP). A Type 1 Certified Mill Test Report in accordance with Article 106-3 of the *Standard Specifications* is required for geogrids. Define “minimum average roll value” (MARV) in accordance with ASTM D4439. Provide certifications with MARV for geogrid properties. For testing geogrids, define a “lot” as a single day’s production.

Use geogrids shown on the plans or an approved equal. Define “machine direction” (MD) and “cross-machine direction” (CD) in accordance with ASTM D4439. Use secondary geogrids with a roll width of at least 1.25 meters.

CONSTRUCTION METHODS

Before starting RSS construction, a preconstruction meeting may be required to discuss the construction and inspection of the RSS. Schedule this meeting after all material certifications have been accepted. The Resident or District Engineer, Roadway Construction Engineer, Geotechnical Operations Engineer and Contractor will attend this preconstruction meeting.

Control drainage during construction in the vicinity of RSS. Direct run off away from RSS, select material and backfill. Contain and maintain select material and backfill and protect material from erosion.

Clear and grub RSS sites in accordance with Section 200 of the *Standard Specifications*. Excavate as necessary for RSS as shown on the plans. A horizontal clearance of at least 300 mm is required between the ends of geogrids and limits of select material as shown on the plans. When excavating existing slopes, bench slopes in accordance with Subarticle 235-4(A) of the *Standard Specifications*. Notify the Engineer when excavation is complete. Obtain approval of the excavation dimensions and in-situ material before placing the first primary geogrid layer.

Construct RSS with dimensions shown on the plans. Contact the Engineer when unanticipated obstructions such as foundations, guardrail, pavements, pipes, inlets or utilities will interfere with geogrids. If necessary, the top geogrid layer may be lowered up to 225 mm to avoid obstructions. Extend geogrids to slope faces. Install primary and secondary geogrids with the orientations, dimensions and number of layers shown on the plans. Place geogrids within 50 mm of locations shown on the plans and in slight tension free of kinks, folds, wrinkles or creases. Hold geogrids in place with wire staples or anchor pins until covered.

Install primary geogrids with the MD perpendicular to the embankment centerline. The MD is the direction of the length or long dimension of the roll. Unless shown otherwise on the plans, do not splice or overlap primary geogrids in the MD so that splices or overlaps are parallel to the toe of slope. Unless shown otherwise on the plans and except for clearances at the ends of primary geogrids, completely cover select material at each primary geogrid layer with primary geogrids so that geogrids are adjacent to each other in the CD, i.e., perpendicular to the MD. The CD is the direction of the width or short dimension of the roll.

Install secondary geogrids with MD parallel to the toe of RSS. Secondary geogrids should be continuous for each secondary geogrid layer. However, if secondary geogrid roll length is too short, overlap ends of secondary geogrid rolls at least 300 mm in the MD. Overlap geogrids in the direction that select material will be placed to prevent lifting the edge of the top geogrid.

Place select material in the reinforced zone in 200 to 250 mm thick lifts. Compact embankments in accordance with Subarticle 235-4(C) of the *Standard Specifications*. For RSS steeper than 1.5:1 (H:V), compact slope faces with an approved method. Do not displace or damage geogrids when placing and compacting material. Do not operate heavy equipment on geogrids until they are covered with at least 150 mm of select material. To prevent damaging geogrids, minimize turning and avoid sudden braking and sharp turns with compaction equipment. Replace any damaged geogrids to the satisfaction of the Engineer. Construct remaining portions of embankments behind RSS in accordance with Section 235 of the *Standard Specifications*.

Define “slope plating material” as material that meets Article 560-2 of the *Standard Specifications*. Plate slope faces of RSS with at least 150 mm of slope plating material except when select material in the reinforced zone is slope plating material. When this occurs, no plating is necessary.

Install erosion control mat facing in accordance with the *Permanent Soil Reinforcement Mat* provision to minimize sloughing of RSS until vegetation is established. Seed slope faces and install erosion control mat facing as soon as possible to prevent erosion damage to slope faces of RSS. If damage occurs, repair RSS at no additional cost to the Department.

MEASUREMENT AND PAYMENT

Reinforced Soil Slopes will be measured and paid in square yards. RSS will be measured along the slope faces of RSS before installing erosion control mat facing and no additional payment will be made for overlapping geogrids. The contract unit price for *Reinforced Soil Slopes* will be full compensation for furnishing, transporting and placing geogrids and select material, plating slope faces, compacting material and providing any labor, tools, equipment and materials to complete the work except for erosion control mat facing. The contract unit price for *Reinforced Soil Slopes* will also be full compensation for excavating existing slopes to install RSS.

Erosion control mat facing will be measured and paid in accordance with the *Permanent Soil Reinforcement Mat* provision.

Payment will be made under:

Pay Item	Pay Unit
Reinforced Soil Slopes	Square Meters

SELECT GRANULAR MATERIAL:
(3-16-10)

M2 R80

Revise the *2006 Metric Standard Specifications* as follows:

Page 2-23, 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.

Materials

Refer to Division 10 of the *Metric Standard Specifications*.

Item	Section
Select Material, Class II	1016
Select Material, Class III	1016

265-2 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 1 m above fabric and water level.

265-3 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 *Metric Standard Specifications* and no payment for *Select Granular Material* will be made.

Select Granular Material will be measured and paid for in cubic meters. When *Undercut Excavation* is in accordance with Section 226 (Comprehensive Grading) of the *Metric 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 *Metric Standard Specifications* or by weighing material in trucks in accordance with Article 106-7 of the *Metric Standard Specifications* as determined by the Engineer. When select granular material is weighed in trucks, a unit weight of 21.2 kN/m³ will be used to convert the weight of select granular material to cubic meters. At the Engineer’s discretion, truck measurement in accordance with Article 230-5 of the *Metric 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 Meter
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FLOWABLE FILL:
(9-17-02) (Rev 8-21-07)

M3 R30

Description

This work consists of all work necessary to place flowable fill in accordance with these provisions, the plans, and as directed.

Materials

Provide flowable fill material in accordance with Article 340-2 of the *2006 Metric Standard Specifications*.

Construction Methods

Discharge flowable fill material directly from the truck into the space to be filled, or by other approved methods. The mix may be placed full depth or in lifts as site conditions dictate. The Contractor shall provide a method to plug the ends of the existing pipe in order to contain the flowable fill.

Measurement and Payment

At locations where flowable fill is called for on the plans and a pay item for flowable fill is included in the contract, *flowable fill* will be measured in cubic meters and paid for as the actual number of cubic meters that have been satisfactorily placed and accepted. Such price and payment will be full compensation for all work covered by this provision including but not limited to the mix design, furnishing, hauling, placing and containing the flowable fill.

Payment will be made under:

Pay Item	Pay Unit
Flowable Fill	Cubic Meter

PIPE ALTERNATES:
 (7-18-06) (Rev 4-17-07)

M3 R36

Description

The Contractor may substitute Aluminized Corrugated Steel Pipe, Type IR or HDPE Pipe, Type S or Type D up to 1219 mm in diameter in lieu of concrete pipe in accordance with the following requirements.

Material

Item	Section
HDPE Pipe, Type S or D	1032-10
Aluminized Corrugated Steel Pipe, Type IR	1032-3(A)(7)

Aluminized Corrugated Steel Pipe will not be permitted in counties listed in Article 310-2 of the *2006 Metric Standard Specifications*.

Construction Methods

Aluminized Corrugated Steel Pipe Culverts and HDPE Pipe Culverts shall be installed in accordance with the requirements of Section 300 of the *2006 Metric Standard Specifications* for Method A, except that the minimum cover shall be at least 300 mm. Aluminized Corrugated Steel Pipe Culvert and HDPE Pipe Culvert will not be permitted for use under travelways, including curb and gutter.

Measurement and Payment

_____ mm Aluminized Corrugated Steel Pipe Culvert to be paid for will be the actual number of linear meters installed and accepted. Measurement will be in accordance with Section 310-6 of the *2006 Metric Standard Specifications*.

_____ mm HDPE Pipe Culvert to be paid for will be the actual number of linear meters installed and accepted. Measurement will be in accordance with Section 310-6 of the *2006 Metric Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
_____ mm Aluminized Corrugated Steel Pipe Culverts, _____ mm Thick	Linear Meter
_____ mm HDPE Pipe Culverts	Linear Meter

PIPE INSTALLATION:

(10-20-09)(Rev 01-18-11)

M3 R40A

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

Replace Section 300 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:

Item	Section
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 450 mm.

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 0.3 m a pay adjustment will be made as follows:

$$\text{Pay Adjustment (per linear meter)} = [(APE - AAE) \pm 0.3 \text{ meter}] (0.15 \times \text{CUP})$$

Where:

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

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

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

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 1050 mm in diameter and larger, wrap filter fabric around all pipe joints. Extend fabric at least 300 mm 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 1500 mm 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 150 mm, 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 150 mm 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 1 m 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 2.5 mm or deflections greater than 7.5 percent. Repair or replace pipes with cracks greater than 0.25 mm, 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 meters 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 as the actual number of metric 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 in square meters. 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:

Pay Item	Pay Unit
Foundation Conditioning Material, Minor Structures	Metric Ton
Foundation Conditioning Fabric	Square Meter

mm WELDED STEEL PIPE LINER:

Description

Furnish, haul and install all pipe, fittings, couplings and other material; grout; construct joint connections; and clean out the existing pipe for the Welded Steel Pipe Liner inside the existing corrugated steel pipe as shown in the plans.

Materials

Refer to Division 10:

Item	Section
Welded Steel Pipe	Article 1032-8

Construction Methods

Install the pipe in accordance with the detail in the plans and as directed by the Engineer.

Measurement and Payment

Pipe liner will be measured and paid for as the actual number of linear meters of pipe liner that has been incorporated into the completed and accepted work.

Measurement of pipe liner will be made by counting the number of joints used and multiplying by the length of the joint to obtain the number of linear meters of pipe liner installed and accepted. Measurements of partial joints are made along the longest length of the partial joint to the nearest 0.1 of a meter.

No separate measurement or payment will be made for grout as the cost of such shall be incidental to the welded steel pipe liner.

Payment will be made under:

Pay Item	Pay Unit
___mm Welded Steel Pipe Liner	Linear Meter

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

M5 R03

Revise the *2006 Metric Standard Specifications* as follows:

Page 5-9, 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)

M5 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 *2006 Metric 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 3-15-11)

M6 R01

Revise the *2006 Metric Standard Specifications* as follows:

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

Page 6-10, 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 6-10, Subarticle 609-5(C)(2), Quality Control Minimum Sampling and Testing Schedule, delete first paragraph 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 metric 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 6-10, Subarticle 609-5(C)(2)(c) Maximum Specific Gravity, add after (AASHTO T 209):

or ASTM D 2041

Page 6-11, 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.

Page 6-11, 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 6-12, Subarticle 609-5(C)(3) Control Charts, fourth paragraph on this page, delete the last sentence and replace with the following:

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

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.

Subarticle 609-5(C)(4) Control Limits, replace the first paragraph and the CONTROL LIMITS Table on page 6-13 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 6-13, Subarticle 609-5(C)(5) Warning Bands, delete this subarticle in its entirety.

Pages 6-13 through 6-15, Subarticle 609-5(C)(6) Corrective Actions, delete the word "warning" and replace with the words "moving average".

Page 6-13, 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 6-14, Subarticle 609-5(C)(6) Corrective Actions, second paragraph, delete 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.

Fifth 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 6-14, Subarticle 609-5(C)(6) Corrective Actions, eighth 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 6-14, delete the last paragraph and the first paragraphs on Page 6-15, 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 6-15, Second full 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 6-16, Subarticle 609-5(D)(1) General, delete the last 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 6-18, 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 6-18, Subarticle 609-5(D)(5) Limited Production Procedure, delete the last 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 6-20, 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 6-23 through Page 6-24, 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 6-28, 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 _{ini}	N _{des}		VMA % Min.	VTM %	VFA Min. - Max.	%G _{mm} @ N _{ini}
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

	Design Parameter	Design Criteria
All Mix Types	1. Dust to Binder Ratio ($P_{0.075} / P_{be}$)	0.6 – 1.4
	2. Retained Tensile Strength (TSR) (AASHTO T283 Modified)	85% Min. (d)

- Notes:
- (a) Based on 20 year design traffic.
 - (b) When Recycled Mixes are used, select the binder grade to be added in accordance with Subarticle 610-3(A). Payment for Binder Grade for recycled mixes shall be based solely on the grade for the specified mix type as shown in the above table.
 - (c) Volumetric Properties based on specimens compacted to N_{des} as modified by the Department.
 - (d) 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.
 - (e) Mix Design Criteria for Type S 4.75A may be modified subject to the approval of the Engineer.

Page 6-28, 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 50mm.
 - (2) Category 2 RAP has been processed to a maximum size of 25 mm by either crushing and or screening to reduce variability in the gradations.
 - (3) Category 3 RAP has been processed to a maximum size of 25 mm, fractionating the RAP into 2 or more sized stockpiles.
 - (4) Payment for binder grade shall be based solely on Table 610-2.

Page 6-29, 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	2°C	2°C
ACIC, Type I 19.0B, C, D	2°C	2°C
ACSC, Type S 4.75A, SF 9.5A, S 9.5B	4°C	10°C*
ACSC, Type S 9.5C, S 12.5C	7°C	10°C
ACSC, Type S 9.5D, S 12.5D	10°C	10°C

* 2°C if surface is soil or aggregate base for secondary road construction.

Page 6-36, Article 610-8 SPREADING AND FINISHING, third full paragraph, replace the first sentence with the following:

Use the 9 m 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 7.3 m* 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 6-37, Article 610-8 SPREADING AND FINISHING, delete the fourth paragraph on page 6-37 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 facilities. Where required above, utilize the MTV when placing all full width travel lanes, collector lanes, ramps, and loops.

Page 6-41, Article 610-13 DENSITY ACCEPTANCE, delete the second full 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.

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 6-42, 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 6-43, Article 620-4 MEASUREMENT AND PAYMENT, modify as follows:

Second paragraph, delete the first sentence and replace with the following:

Where recycled plant mix is being produced, the grade of asphalt binder shall be paid for based on the grade for the specified mix type as shown in Table 610-2.

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.

Add the following pay item:

Pay Item	Pay Unit
Asphalt Binder for Plant Mix, Grade PG 70-28	Metric Ton

Page 6-49, Article 650-5 CONSTRUCTION REQUIREMENTS delete the seventh paragraph on page 6-49 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 facilities. Where required above, utilize the MTV when placing all full width travel lanes, collector lanes, ramps, and loops.

Page 6-57, TABLE 660-1 MATERIAL APPLICATION RATES AND TEMPERATURES, add the following:

Type of Coat	Grade of Asphalt	Asphalt Rate L/M ²	Application Temperature °C	Aggregate Size	Aggregate Rate KG./ M ² Total
Sand Seal	CRS-2 or CRS-2P	1.00-1.36	66-79	Blotting Sand	6-8

Page 6-62, 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 6-63, 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 6-63, 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 6-65, Subarticle 661-2(E), Asphalt Binder For Plant Mix, Grade PG 70-28, rename as 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. Where PG 76-22 is being used in the production of Ultra-thin, the grade of asphalt binder to be paid for will be PG 70-28, unless otherwise approved.

Page 6-65, 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 6-66, Article 661-2(G) Composition of Mix, replace Table 661-4 and associated notes with the following:

TABLE 661-4 – MIXTURE DESIGN CRITERIA

Gradation Design Criteria (% Passing by Weight)				
Standard Sieves		12.7 mm Type A	9.5 mm Type B	6.4 mm 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

Mix Design Criteria				
	12.7 mm Type A	9.5 mm Type B	6.4 mm 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, Kg/M ²	49	38	27	
Approximate Application Depth, mm	19.0	15.9	12.5	
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 6-66, 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 6-68, 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 10°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 16°F or higher and the air temperature in the shade away from artificial heat is 16°F or higher.

Page 10-33, Subarticle 1012-1(A) General, add the following at the end of the last paragraph, last sentence:

or ultra-thin bonded wearing course.

Page 10-34, Table 1012-1, delete the entries for OGAFc and add new entries for OGAFc and a row for UBWC with entries:

Mix Type	Coarse Aggregate Angularity ^(b) 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
OGAFc	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 10-34, 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 10-35, Subarticle 1012-1(F) Reclaimed Asphalt Shingle Material (RAS), insert the following immediately following the first paragraph:

(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 pass a 12.5 mm sieve 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.

RAS contamination including but not limited to excessive dirt, debris, clean stone, concrete will not be allowed.

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.

**NEW SOURCE RAS GRADATION and BINDER TOLERANCES
(Apply Tolerances to Mix Design Data)**

0-6% RAS

P_b %	±1.6%
Sieve Size (mm)	Tolerance
9.5	±1
4.75	±5
2.36	±4
1.18	±4
0.300	±4
0.150	±4
0.075	±2.0

Page 10-35 through 10-37, Subarticle 1012-1(G), delete this 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 50 mm 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 25 mm 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 25 mm sieve. The coarse RAP stockpile shall only contain material retained on a 9.5 mm screen, unless otherwise approved. The fine RAP stockpile shall only contain material passing the 9.5 mm screen, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 9.5 mm 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 metric 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)

P_b %	±0.3%
Sieve Size (mm)	Percent Passing
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 50 mm 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 ⁺ -30 % RAP			30 ⁺ % RAP				
	Sieve (mm)	Base	Inter.	Surf.	Base	Inter.	Surf.	Base	Inter.	Surf.	
P _b %		± 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:

(1-18-11) (Rev 2-15-11)

M6 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 Metric Standard Specifications* as follows:

Page 6-7, 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 6-7, 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 6-10, 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 6-11, 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 13,600 metric 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 the *Hot-Mix Asphalt QMS Manual* procedures for TSR testing on that JMF. This request shall be submitted in writing and include all Material and Tests Unit Form 612s performed on the specific JMF.

Page 6-22, 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 6-23, 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 6-26, 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 6-26, 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 107°C to 135°C.

ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES:

(11-21-00)

M6 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	4.3%
Asphalt Concrete Intermediate Course	Type I 19.0	4.7%
Asphalt Concrete Surface Course	Type S 4.75A	7.0%
Asphalt Concrete Surface Course	Type SF 9.5A	6.5%
Asphalt Concrete Surface Course	Type S 9.5	6.0%
Asphalt Concrete Surface Course	Type S 12.5	5.5%

The actual asphalt binder content will be established during construction by the Engineer within the limits established in the *2006 Metric Standard Specifications*.

ASPHALT PLANT MIXTURES:

(7-1-95)

M6 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)

M6 R25

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

The base price index for asphalt binder for plant mix is \$ **559.23** per metric ton.

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

FINAL SURFACE TESTING - ASPHALT PAVEMENTS (Rideability):

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

M6 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:

Pay Adjustment Schedule for Cumulative Straightedge Index (CSI) (Obtained by adding SE Index of up to 25 consecutive 100 foot test sections)				
*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.

ROCK 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 II Rip Rap	Section 1042
Filter Fabric for Drainage, Type 2	Section 1056

Construction Methods

Rock 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

Rip Rap, Class II 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 energy dissipator basin.

MASONRY DRAINAGE STRUCTURES:

(10-16-07)

M8 R01

Revise the *2006 Standard Specifications* as follows:

Page 8-25, 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 3 meters, payment will be made at 1.3 times the contract unit price per linear meter for *Masonry Drainage Structure*.

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

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

M8 R02

Revise the *2006 Metric Standard Specifications* as follows:

Division 2 Earthwork

Page 2-12, Subarticle 230-1(D), add the words: *The Contractor specifically waives* as the first words of the sentence.

Page 2-13, 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 8-8, 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 8-8, Article 802-2, General Requirements, 7th 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.

CONCRETE TRANSITIONAL SECTIONS FOR CATCH BASINS AND DROP INLETS:

(1-20-09)

M8R03

Revise the *Metric Standard Specifications* as follows:

Page 8-26, Article 840-4 Measurement and Payment, delete the eighth full paragraph and replace with the following:

No separate payment will be made for Concrete Aprons as shown in Standard Drawings 840.17, 840.18, 840.19, 840.26, 840.27 and 840.28 and will be incidental to the other work in this section.

Page 8-31, Article 852-4 Measurement and Payment, add the following as the fourth paragraph.

Concrete Transitional Section for Catch Basin will be measured and paid for in units of each.

Concrete Transitional Section for Drop Inlet will be measured and paid for in units of each.

Payment will be made under:

Pay Item	Pay Unit
Concrete Transitional Section for Catch Basin	Each
Concrete Transitional Section for Drop Inlet	Each

Revise the *Metric Roadway Standard Drawings* as follows:

On page 852.04, change Pay Limits for Concrete Apron for Drop Inlets in two places on the drawing to *Pay Limits for Concrete Transitional Section for Drop Inlet*.

On page 852.05, change Concrete Apron for Catch Basin on the drawing to *Concrete Transitional Section for Catch Basin*.

On page 852.06, change Pay Limits for Concrete Apron for Drop Inlets in two places on the drawing to *Pay Limits for Concrete Transitional Section for Drop Inlet*.

SUBSURFACE DRAINAGE:
(7-20-10)

M8 R05

Revise the *2006 Metric Standard Specifications* as follows:

Page 8-11, Delete Section 815 SUBSURFACE DRAINAGE and replace it with the following:

**SECTION 815
SUBSURFACE DRAINAGE**

815-1 Description

Construct subsurface drains, underdrains, blind drains and other types of drains in accordance with the contract or as directed by the Engineer. Install markers to locate concrete pads for drains as shown on the plans. This provision does not apply to shoulder drains.

815-2 Materials

Refer to Division 10 of the *Standard Specifications*.

Item	Section
Portland Cement Concrete, Class B	1000
Select Material, Class V	1016
Subsurface Drainage Materials	1044
Filter Fabric for Subsurface Drains, Type 1	1056
Steel Markers	1072-4
Steel Marker Paint	1080-14
Pavement Marker Paint	1087

Use Class B Concrete for concrete pads and Class V Select Material for subdrain coarse aggregate. Provide subdrain coarse aggregate for subsurface drains and subdrain fine aggregate for underdrains and blind drains.

815-3 Construction Methods

Do not leave filter fabrics uncovered for more than 7 days. Excavate trenches as necessary in accordance with the contract or as directed by the Engineer. For subsurface drains, line trench with filter fabric and overlap fabric ends a minimum of 150 mm on top of subdrain coarse aggregate.

Install blind drains at a depth of 1.2 to 1.8 meters below subgrade elevation. Install subdrain pipes for subsurface drains and underdrains at a depth of 1.2 to 1.8 meters below subgrade elevation unless the subgrade will be proof rolled. For subsurface drains and underdrains in subgrades that will be proof rolled, install subdrain pipes at a depth of 1.8 meters below subgrade elevation. Firmly connect subdrain pipes together as needed. Place perforated subdrain pipes with perforations down except for pipes in dry materials, in which case turn perforations up or use non-perforated pipes. For concrete pipes in dry materials, construct mortar joints in accordance with Subarticle 300-6(A) of the *Standard Specifications*.

Place subdrain aggregate beneath, around and over subdrain pipes such that pipes are covered by at least 150 mm of aggregate unless shown otherwise on the plans. Do not displace or damage subdrain pipes while placing and compacting subdrain aggregate. Lightly compact backfill material such that settlement is minimized.

Use solvent cement for connecting polyvinyl chloride (PVC) 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. Construct concrete pads and provide an Ordinary Surface Finish in accordance with Subarticle 825-6(B) of the *Standard Specifications*. Furnish and install steel and pavement markers at concrete pads as shown on the plans.

Allow drains to function for up to 30 days or a sufficient time as determined by the Engineer before undercutting, proof rolling or constructing embankments over drains.

815-4 Measurement and Payment

Subdrain Excavation will be measured and paid for in cubic meters. Excavation will be measured based on the trench width shown on the plans or as directed by the Engineer and the actual trench depth as determined by the Engineer. The contract unit price for *Subdrain Excavation* will be full compensation for excavating trenches and backfilling above subdrain aggregate.

Filter Fabric for Subsurface Drains will be measured and paid for in square meters. Filter fabric in a trench will be measured in place based on the subdrain aggregate width shown on the plans or as directed by the Engineer and the actual aggregate depth as determined by the Engineer. No additional payment will be made for overlapping fabric. The contract unit price for *Filter Fabric for Subsurface Drains* will be full compensation for supplying, transporting and installing filter fabric.

Subdrain Fine Aggregate and *Subdrain Coarse Aggregate* will be measured and paid for in cubic meters. Subdrain aggregate in a trench will be measured in place based on the aggregate width shown on the plans or as directed by the Engineer and the actual aggregate depth as determined by the Engineer. When subdrain aggregate is not placed in a trench, aggregate will be measured in place based on the aggregate dimensions shown on the plans or as determined by the Engineer. The contract unit prices for *Subdrain Fine Aggregate* and *Subdrain Coarse Aggregate* will be full compensation for furnishing, hauling, handling, placing, compacting and maintaining subdrain aggregate.

 mm *Perforated Subdrain Pipe* and mm *Outlet Pipe* will be measured and paid for in linear feet. Pipes will be measured in place as the pipe length, including fittings, to the nearest 0.1 meters with no deduction for fittings. The contract unit prices for mm *Perforated Subdrain Pipe* and mm *Outlet Pipe* will be full compensation for supplying, transporting and installing pipes, fittings and rodent screens and making joint connections.

Subdrain Pipe Outlets will be measured and paid for in units of each. Outlets will be measured as the number of concrete pads or connections to existing drainage structures. The contract unit price for *Subdrain Pipe Outlets* will be full compensation for concrete pads including furnishing concrete, constructing pads and providing and placing markers and connecting pipes to existing drainage structures including cutting into structures, removing existing paved ditches and grouting around connections.

Payment will be made under:

Pay Item	Pay Unit
Subdrain Excavation	Cubic Meter
Filter Fabric for Subsurface Drains	Square Meter
Subdrain Fine Aggregate	Cubic Meter
Subdrain Coarse Aggregate	Cubic Meter
__ mm Perforated Subdrain Pipe	Linear Meter
__ mm Outlet Pipe	Linear Meter
Subdrain Pipe Outlets	Each

ENDWALLS:

(5-20-08)

M8 R25

Revise the *Standard Specifications* as follows:

Page 8-23, Article 838-4 Replace the 1st and 2nd paragraph with the following:

Endwalls will be measured and paid for in cubic meters 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 meters 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.

CONVERT EXISTING DROP INLET TO JUNCTION BOX WITH MANHOLE COVER:

(1-1-02) (Rev. 7-18-06)

M8 R50

At the proper phase of construction, convert the existing drop inlet at locations indicated in the plans or where directed, to junction box with manhole cover in accordance with the details in the plans and the applicable requirements of Sections 840 and 859 of the *2006 Metric Standard Specifications*.

Convert Existing Drop Inlet to Junction Box with Manhole Cover will be measured and paid for as each, completed and accepted. Such price and payment is considered full compensation for all equipment, materials, labor, tools, and incidentals necessary to complete each conversion satisfactorily.

Payment will be made under:

Pay Item	Pay Unit
Convert Existing Drop Inlet to Junction Box with Manhole Cover	Each

FRAME WITH GRATE (Driveway Drop Inlet):

(3-21-00) (Rev.7-18-06)

SPI 8-35(Rev.)

Description

Provide grates for driveway drop inlets that are fabricated steel or cast iron. Provide grates that are of a design and weight that is recommended by the manufacturer as being adequate for HS-20 loadings. Furnish a manufacturer's certification stating that the grates and frame furnished on the project have been designed and manufactured to be adequate for an HS-20 loading. Provide grates with a minimum clear waterway opening of 1058 cm² per 1 meter length of grate.

If the frame and grate is made from fabricated steel, the requirements of Article 1074-9 of the *2006 Standard Specifications* will be applicable. If the grate and frame is made from iron castings, the requirements of Article 1074-7 of the *2006 Standard Specifications* will be applicable.

Measurement and Payment

Frame with Grate, Driveway Drop Inlet will be measured and paid for as the actual number of linear meters that have been incorporated into the completed and accepted work. Such price and payment will be full compensation for furnishing the grates and frame, and all labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Frame with Grate, Driveway Drop Inlet	Linear Meter

GUARDRAIL ANCHOR UNITS, TYPE M-350:

(4-20-04)

M8 R60

Description

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

Materials

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

The guardrail anchor unit (SRT-350) as manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

The guardrail anchor unit (FLEAT) as manufactured by:

Road Systems, Inc.
3616 Old Howard County Airport
Big Springs, Texas 79720
Telephone: 915-263-2435

The guardrail anchor unit (REGENT) as manufactured by:

Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601-2076
Telephone: 888-32-ENERGY

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 Metric 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 Metric 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 shall be 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 Metric 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 Article 862-6 of the *2006 Metric Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
Guardrail Anchor Units, Type M-350	Each

GUARDRAIL ANCHOR UNITS, TYPE 350:

(4-20-04)

M8 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 Metric Standard Specifications*, and at locations shown in the plans.

Materials

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

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

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 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 Metric 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 Metric 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 Metric Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
Guardrail Anchor Units, Type 350	Each

STEEL PIPE HANDRAIL:

Description

Furnish and install steel pipe handrail at the location shown in the plans, in accordance with the detail in the plans and as directed by the Engineer.

Measurement and Payment

Steel pipe handrail will be measured and paid for as the actual number of linear meters of steel pipe handrail measured along the top of the handrail to the nearest 0.1 of a meter. Such price and payment shall be full compensation for fabricating, furnishing, installing, painting and all incidentals necessary to satisfactorily install the handrail.

Payment will be made under:

Pay Item	Pay Unit
Steel Pipe Handrail	Linear Meter

FENCE:

(3-6-06)

M8 R86

Revise the *2006 Metric Standard Specifications* as follows:

Page 8-44, Subarticle 866-3(A), second sentence,

Add *existing fencing* after stumps

PREFORMED SCOUR HOLE WITH LEVEL SPREADER APRON:

(10-15-02) (Rev 6-17-08)

M8 R105

Description

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

Materials

Item	Section
Plain Rip Rap	1042
Filter Fabric	1056

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

<i>Property</i>	<i>Test Method</i>	<i>Value Unit</i>
Light Penetration	ASTM D6567	15 %
Thickness	ASTM D6525	13 mm
Mass Per Unit Area	ASTM D6566	0.339 kg/m ²
Tensile Strength	ASTM D6818	572 kg/m
Elongation (Maximum)	ASTM D6818	49 %
Resiliency	ASTM D6524	> 70 %
UV Stability*	ASTM D4355	≥80 %
Porosity (Permanent Net)	Calculated	≥85 %
Minimum Filament	Measured	0.76 mm
Maximum Permissible Shear Stress (Vegetated)	Performance Test	≥ 39.1 kg/m ²
Maximum Allowable Velocity	Performance Test	≥ 4.9 m/s

*ASTM D1682 Tensile Strength and % strength retention of material after 1000 hours of exposure.

Submit a certification from the manufacturer showing:

- (A) the chemical and physical properties of the mat used, and
- (B) conformance of the mat with this specification

Soil Preparation

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

Measurement and Payment

Preformed Scour Holes with Level Spreader Aprons will be measured and paid as the actual number that has been incorporated into the completed and accepted work. Such price and payment will be full compensation for all work covered by this provision.

Payment will be made under:

Pay Item	Pay Unit
Preformed Scour Hole with Level Spreader Aprons	Each

DETECTABLE WARNINGS FOR PROPOSED WHEELCHAIR RAMPS;

(6-15-10)

M8 R126

Description

Construct detectable warnings consisting of integrated raised truncated domes on proposed concrete wheelchair ramps in accordance with the *2006 Standard Specifications*, plan details, the requirements of the *28 CFR Part 36 ADA Standards for Accessible Design* and this provision.

Materials

Detectable warning for proposed wheelchair ramps shall consist of integrated raised truncated domes. The description, size and spacing shall conform to Section 848 of the *Standard Specifications*.

Use material for detectable warning systems as shown herein. Material and coating specifications must be stated in the Manufacturers Type 3 Certification and all Detectable Warning systems must be on the NCDOT Approved Product List for Wheelchair Ramps.

Install detectable warnings created from one of the following materials: precast concrete blocks or bricks, clay paving brick, gray or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile. Only one material type for detectable warning will be permitted per project, unless otherwise approved by the Engineer.

- (A) Detectable Warnings shall consist of a base with integrated raised truncated domes, and when constructed of precast concrete they shall conform to the material requirements of Article 848-2 of the *Standard Specifications*.**
- (B) Detectable Warnings shall consist of a base with integrated raised truncated domes, and may be comprised of other materials including but not limited to clay paving brick, gray iron or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile, which are cast into the concrete of the wheelchair ramps. The material shall have an integral color throughout the thickness of the material. The detectable warning shall include fasteners or anchors for attachment in the concrete and shall be furnished as a system from the manufacturer.**

Prior to installation, the Contractor shall submit to the Engineer assembling instructions from the manufacturer for each type of system used in accordance with Article 105-2 of the *Standard Specifications*. The system shall be furnished as a kit containing all consumable materials and consumable tools, required for the application. They shall be capable of being affixed to or anchored in the concrete ramp, including green concrete (concrete that has set but not appreciably hardened). The system shall be solvent free and contain no volatile organic compounds (VOC). The static coefficient of friction shall be 0.8 or greater when measured on top of the truncated domes and when measured between the domes in accordance with ASTM C 1028 (dry and wet). The system shall be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to degradation by motor fuels, lubricants and antifreeze.

- (C) When steel or gray iron or ductile iron casting products are provided, only products that meet the requirements of Article 106-1(B) of the *Standard Specifications* may be used. Submit to the Engineer a Type 6 Certification, catalog cuts and installation procedures at least 30 days prior to installation for all.

Construction Methods

- (A) Prior to placing detectable warnings in proposed concrete ramps, adjust the existing subgrade to the proper grade and in accordance with Article 848-3 of the *Standard Specifications*.
- (B) Install all detectable warning in proposed concrete ramps in accordance with the manufacturer's recommendations.

Measurement and Payment

Detectable Warnings installed for construction of proposed wheelchair ramps will not be paid for separately. Such payment will be included in the price bid for *Concrete Wheelchair Ramps*.

STREET SIGNS AND MARKERS AND ROUTE MARKERS:

(7-1-95)

M9 R01

Move any existing street signs, markers, and route markers out of the construction limits of the project and install the street signs and markers and route markers so that they will be visible to the traveling public if there is sufficient right of way for these signs and markers outside of the construction limits.

Near the completion of the project and when so directed by the Engineer, move the signs and markers and install them in their proper location in regard to the finished pavement of the project.

Stockpile any signs or markers that cannot be relocated due to lack of right of way, or any signs and markers that will no longer be applicable after the construction of the project, at locations directed by the Engineer for removal by others.

The Contractor shall be responsible to the owners for any damage to any street signs and markers or route markers during the above described operations.

No direct payment will be made for relocating, reinstalling, and/or stockpiling the street signs and markers and route markers as such work shall be considered incidental to other work being paid for by the various items in the contract.

STEEL U-CHANNEL POSTS AND STEEL SQUARE TUBE SUPPORTS:

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

M9 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.

HIGH STRENGTH CONCRETE FOR DRIVEWAYS:

(11-21-00) (7-18-06)

M10 R01

Use high early strength concrete for all driveways shown in the plans and as directed by the Engineer. Provide high early strength concrete that meets the requirements of Article 1000-6 of the *2006 Metric Standard Specifications*.

Measurement and payment will be in accordance with Section 848 of the *2006 Metric Standard Specifications*.

GALVANIZED HIGH STRENGTH BOLTS, NUTS AND WASHERS:

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

M10 R02

Revise the *Metric Standard Specifications* as follows:

Page 10-101, Subarticle 1072-7(F)(3) Change the AASHTO reference to ASTM B695 Class 55.

Page 10-201, Table 1092-2, Steel Sign Materials, Change High Strength Bolts, Nuts & Washers ASTM Specifications for Galvanizing to B695 Class 55.

Page 10-211, Subarticle 1094-1(A) Breakaway or Simple Steel Beam Sign Supports, replace the first full 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 10-212, 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)

M10 R03

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-121, 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)

M10 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 Metric Standard Specifications*. Copies of this procedure are available upon request from the Materials and Test Unit.

CONCRETE BRICK AND BLOCK PRODUCTION:

(11-20-01)

M10 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 Metric Standard Specifications*. Copies of this procedure are available upon request from the Materials and Test Unit.

VOLUMETRIC CONCRETE BATCHING:

(5-18-10)

M10 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 22.94 cubic meters 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 42.64 kilograms 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)

M10 R16

Revise the *2006 Metric 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/quarrysrprob.pdf>

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

WATER FOR CONCRETE:

(10-19-10)

M10 R17

Revise the 2006 *Metric Standard Specifications for Roads and Structures* as follows:

Page 10-51, 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**

Requirement	Limit	Test Method
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 ₄ , Max.	1500 ppm	NCDOT Modified / ASTM D516
Presence of Sugar	None	NCDOT Procedure
Dissolved Organic Matter	None	NCDOT Modified / AASHTO T26

Page 10-53, 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)

M10R32

Revise the *Metric 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)

M10 R35

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-181, 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 10-182, 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 10-184, 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)

M10 R40

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-78, 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 5 mm in diameter and 450 mm 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 38 mm. When wire staples are required, provide staples in accordance with Subarticle 1060-8(D) of the *2006 Metric 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 *2006 Metric Standard Specifications*. Furnish certifications with minimum average roll values (MARV) as defined by ASTM D4439 for all fabric properties with the exception of elongation and apparent opening size (AOS). 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 ¹)				
		Type 1	Type 2	Type 3 ²	Type 4	Type 5 ³
<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	400 N	900 N	445 N	800 N	---
Tear Strength (MD & CD)	D4533	180 N	350 N	---	300 N	---
Puncture Strength	D6241	900 N	1925 N	---	1650 N	---
Wide Width Tensile Strength @ Ultimate (MD & CD)	D4595	---	---	---	---	35 kN/m (unless required otherwise in the contract)
Permittivity	D4491	0.20 sec ⁻¹	0.20 sec ⁻¹	0.05 sec ⁻¹	0.05 sec ⁻¹	0.20 sec ⁻¹
Apparent Opening Size (AOS) ⁴	D4751	0.25 mm	0.25 mm	0.60 mm	0.43 mm	0.60 mm
Ultraviolet Stability (retained strength) ⁵	D4355	50 %	50 %	70 %	50 %	50%

¹MARV does not apply to elongation and AOS

²Minimum roll width of 900 mm required

³Minimum roll width of 4 m required unless otherwise approved

⁴Maximum average roll value

⁵After 500 hours of exposure

PRECAST DRAINAGE STRUCTURES - MACRO-SYNTHETIC FIBERS

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

SP 10 R42

Description

Substitute as an option, macro-synthetic fibers in lieu of 100 mm x 100 mm W1.4 x W1.4 welded wire fabric reinforcement for selected precast concrete products in accordance with the following requirements.

Materials

Item	Section
Portland Cement Concrete	1077-5

- (A) Substitute macro-synthetic fibers only for steel reinforcement with an area of steel of 254 mm²/m or less in the following items:
- (1) **Precast Drainage Structure** units in accordance with the requirements of *Standard Drawing 840.45*.
 - (2) **Precast Manhole 1.2 Meter' 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 alkalis present in cement paste and/or the substances present in air-entraining and chemical admixtures.
- (2) Fiber length - no less than 38 mm.
- (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 2812 kg/cm² when tested in accordance with ASTM D 3822.

- (5) Macro-synthetic fibers - minimum modulus of elasticity of 28,123 kg/cm² 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 2.97 kg/m³. 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, ± 1.5% tolerance.
- (3) Fiber reinforced concrete - develop a minimum compressive strength 2.97 kg/m³ 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)

M10 R43

Page 10-114, 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. 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.

PAIN SAMPLING AND TESTING:

(8-15-06)

M10 R45

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-155, 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.

PORTABLE CONCRETE BARRIER

(2-20-07)

M10 R50

The *2006 Metric Standard Specifications* is revised as follows:

Page 10-200, Article 1090-1(A) General, add the following after the first sentence:

The requirement for approved galvanized connectors will be waived if the barrier remains the property of the Contractor.

CHANNELIZING DEVICES (Drums):

7-20-10

M10 R60

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-192, 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 10-192, 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 150mm to 200 mm wide band Type III–High Intensity Microprismatic Retroreflective Sheeting or better that meets the requirement of Section 1093 for each band. Do not exceed 50 mm for any non-reflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 150 mm 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 10-193, 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 10-193, 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 150mm to 200 mm wide band Type III–High Intensity Microprismatic Retroreflective Sheeting or better that meets the requirement of Section 1093 for each band. Do not exceed 50 mm for any non-reflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 150 mm 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.

TEMPORARY SHORING:

(2-20-07) (Rev 9-25-07)

M11 R02

Description

Design and construct temporary shoring in accordance with the contract. Temporary shoring includes standard shoring, temporary mechanically stabilized earth (MSE) walls and non-anchored temporary shoring. Trench boxes are not considered temporary shoring. "Standard shoring" refers to *standard temporary shoring* and *standard temporary MSE walls*. Notes on plans may restrict the use of one or both types of standard shoring. Notes on plans may also require or prohibit temporary MSE walls.

Unless noted otherwise on the plans, temporary shoring is required as shown on the plans and to maintain traffic. Temporary shoring to maintain traffic is defined as shoring necessary to provide lateral support to the side of an excavation or embankment parallel to an open travelway when a theoretical 2:1 (H:V) slope from the bottom of the excavation or embankment intersects the existing ground line closer than 1.5 m from the edge of pavement of the open travelway.

This provision is not applicable to anchored temporary shoring or the installation of pipes, drop inlets and utilities unless noted otherwise on the plans. Provide all shoring submittals before beginning work.

Materials**(A) Certifications, Storage and Handling**

Provide Type 7 Contractor's Certifications in accordance with Article 106-3 of the *2006 Metric Standard Specifications* for all shoring materials used with the exception of reinforcing fabrics and geogrids. Furnish Type 2 Typical Certified Mill Test Reports in accordance with Article 106-3 of the *2006 Metric Standard Specifications* for all seam strengths and reinforcing fabric and geogrid properties. Provide minimum average roll values (MARV) in accordance with ASTM D4759 for test reports. For testing reinforcing fabric and geogrids, a lot is defined as a single day's production.

Load, transport, unload and store shoring materials such that they are kept clean and free of damage. Identify, store and handle all geogrids and geotextile fabrics in accordance with ASTM D4873. Geogrids and fabrics with defects, flaws, deterioration or damage will be rejected. Do not leave fabrics or geogrids uncovered for more than 7 days.

(B) Shoring Backfill

Use shoring backfill for the construction of all temporary shoring including backfilling behind non-anchored temporary shoring and in the reinforced zone for temporary MSE walls. Unless backfilling around culverts, use shoring backfill that meets the requirements of Class II Type I, Class III, Class V or Class VI select material in accordance with Section 1016 of the *2006 Metric Standard Specifications* or AASHTO M145 for soil classification A-2-4 with a maximum plasticity index (PI) of 6. For backfilling around culverts, use shoring backfill as defined herein except for A-2-4 soil.

(C) Non-anchored Temporary Shoring

Use steel shapes, plates and piles that meet the requirements of ASTM A36 and steel sheet piles that meet the requirements of Article 1084-2 of the *2006 Metric Standard Specifications*. Use timber lagging with a minimum allowable bending stress of 6.9 MPa that meets the requirements of Article 1082-1 of the *2006 Metric Standard Specifications*. For standard temporary shoring, use pile sections and lengths and lagging sizes as shown on the plans.

(D) Temporary MSE Walls

Use welded wire reinforcement forms, facings, mesh and mats that meet the requirements of AASHTO M55 or M221. Use connector bars and wires for welded wire wall components and support struts that meet the requirements of AASHTO M32. For standard temporary MSE walls, use wire gauges, strut sizes and welded wire components as shown on the plans.

(1) Geotextile Fabrics

Use geotextile fabrics that meet the requirements of Article 1056-1 of the *2006 Metric Standard Specifications*.

(a) Reinforcing Fabric

The reinforcement direction (RD) is defined as the direction perpendicular to the wall face and the cross-reinforcement direction (CRD) is defined as the direction parallel to the wall face.

Use woven polyester or polypropylene fabric that meets the following properties:

Property	Test Method	Requirement (MARV)
Wide Width Tensile Strength @ Ultimate (RD)	ASTM D4595	Varies – 35 kN/m min
Wide Width Tensile Strength @ Ultimate (CRD)	ASTM D4595	18 kN/m min
Trapezoidal Tear Strength	ASTM D4533	0.44 kN min
CBR Puncture Strength	ASTM D6241	2.67 kN min
UV Resistance after 500 hrs	ASTM D4355	70 %
Apparent Opening Size (AOS), US Sieve	ASTM D4751	0.212 mm min – 0.850 mm max
Permittivity	ASTM D4491	0.20 sec ⁻¹

For standard temporary MSE walls (temporary fabric wall) use reinforcing fabric wide width tensile strengths and lengths in the RD as shown on the plans.

(b) Retention Fabric

Retain shoring backfill at the face of temporary MSE walls with retention fabric. Use fabric that meets the requirements of Class 3 and the UV resistance, AOS and permittivity for separation geotextile in accordance with AASHTO M288.

(2) SierraScape Temporary Wall

Use uniaxial (UX) geogrids composed of high-density polyethylene (HDPE) manufactured by Tensar Earth Technologies. Test geogrids in accordance with ASTM D6637. Use connection rods manufactured by Tensar Earth Technologies to transfer the load between the facings and geogrids.

For standard temporary MSE walls (SierraScape temporary wall) use geogrid types and lengths as shown on the plans.

(3) Terratrel Temporary Wall

Use ribbed reinforcing steel strips manufactured by The Reinforced Earth Company that meet the requirements of ASTM A572, Grade 450. Use connector rods that meet the requirements of AASHTO M31, Grade 415 and hair pin connectors that meet the requirements of ASTM A1011, Grade 345. Use bolts, nuts and washers that meet the requirements of AASHTO M164.

For standard temporary MSE walls (Terratrel temporary wall) use ribbed steel strip size and lengths, rod lengths and diameters, hairpin connectors, bolts, nuts and washers as shown on the plans.

Embedment

“Embedment” is defined as the depth of shoring below the bottom of the excavation or the grade in front of the shoring. For cantilever shoring, embedment is the depth of the piling below the grade in front of the shoring. For temporary MSE walls, embedment is the difference between the grade elevation in front of the wall and the elevation of the bottom of the reinforced zone.

Portable Concrete Barriers

Provide portable concrete barriers in accordance with the plans and if shoring is located within the clear zone as defined in the *AASHTO Roadside Design Guide*. Use NCDOT portable concrete barriers (PCBs) in accordance with Roadway Metric Standard Drawing No. 1170.01 and Section 1170 of the *2006 Metric Standard Specifications*. Use Oregon Tall F-Shape Concrete Barriers in accordance with detail drawing and special provision obtained from:

<http://www.ncdot.org/doh/preconstruct/wztc/DesRes/English/DesResEng.html>

The clear distance is defined as the horizontal distance from the back face of the barrier to the edge of pavement and the minimum required clear distance is shown on the traffic control plans. At the Contractor's option or if the minimum required clear distance is not available, set an unanchored PCB against the traffic side of the shoring and design shoring for traffic impact or use the "surcharge case with traffic impact" for the standard temporary shoring. An anchored PCB or Oregon barrier is required for barriers above and behind temporary MSE walls.

Contractor Designed Shoring

"Contractor designed shoring" is defined as non-anchored temporary shoring or temporary MSE walls designed by the Contractor. Unless prohibited or required, Contractor designed shoring is optional. Contractor designed shoring is required when notes on plans prohibit the use of standard shoring. Non-anchored Contractor designed shoring is prohibited when notes on plans require the use of temporary MSE walls and Contractor designed temporary MSE walls are prohibited when notes on plans prohibit the use of temporary MSE walls.

Before beginning design, survey the shoring location to determine existing elevations and actual design heights. Submit design calculations and drawings including typical sections for review and acceptance showing details of the proposed design and construction sequence in accordance with Article 105-2 of the *2006 Metric Standard Specifications*. Have shoring designed, detailed and sealed by a Professional Engineer registered in the State of North Carolina. Submit 3 hard copies of design calculations and 10 hard copies of drawings and an electronic copy (pdf or jpeg format on CD or DVD) of both the calculations and drawings.

Design non-anchored temporary shoring in accordance with the *AASHTO Guide Design Specifications for Bridge Temporary Works* and temporary MSE walls in accordance with the *AASHTO Allowable Stress Design Standard Specifications for Highway Bridges*. Use the following soil parameters for shoring backfill in the reinforced zone.

Total Unit Weight = 18.8 kN/m³
Friction Angle = 30 degrees
Cohesion = 0 kPa

Design temporary shoring in accordance with the in-situ assumed soil parameters shown on the plans. Design shoring for a 3-year design service life and a traffic surcharge equal to 11.5 kPa. This surcharge is not applicable for construction traffic. If a construction surcharge will be present within a horizontal distance equal to the height of the shoring, design the shoring for the required construction surcharge. If the edge of pavement or a structure to be protected is within a horizontal distance equal to the height of the shoring, design shoring for a maximum deflection of 75 mm. Otherwise, design shoring for a maximum deflection of 150 mm.

For non-anchored temporary shoring, the top of shoring elevation is defined as the elevation where the grade intersects the back face of the shoring. For traffic impact, apply 29.2 kN/m to the shoring 450 mm above the top of shoring elevation. When designing for traffic impact, extend shoring at least 800 mm above the top of shoring elevation. Otherwise, extend shoring at least 150 mm above the top of shoring elevation.

Standard Shoring

Unless notes on plans prohibit the use of one or both types of standard shoring, standard shoring is optional. Submit a “Standard Temporary MSE Wall Selection Form” for each standard temporary MSE wall location and a “Standard Temporary Shoring Selection Form” for up to three standard temporary shoring locations. Submit selection forms at least 14 days before beginning shoring construction. Obtain standard shoring selection forms from:

<http://www.ncdot.org/doh/preconstruct/highway/geotech/formdet/>

(A) Standard Temporary Shoring

Determine the shoring height, traffic impact, groundwater condition and slope or surcharge case for each standard temporary shoring location. Determine the minimum required extension, embedment and sheet pile section modulus or H pile section from the plans for each location.

(B) Standard Temporary MSE Walls

Choose a standard temporary MSE wall from the multiple temporary MSE wall options shown in the plans. Do not use more than one option per wall location.

Step bottom of reinforced zone in increments equal to vertical reinforcement spacing for the wall option chosen. Determine the wall height and slope or surcharge case for each section of standard temporary MSE wall. With the exception of either the first or last section of wall, use horizontal section lengths in increments equal to the following for the wall option chosen.

Standard Temporary MSE Wall Option	Increment
Temporary Fabric Wall	2.7 m min (varies)
Hilfiker Temporary Wall	3.0 m min (varies)
SierraScape Temporary Wall	5.7 m
Retained Earth Temporary Wall	7.3 m
Terratrel Temporary Wall	6.0 m

Determine the appropriate facings and/or forms and reinforcement length, spacing, strength, type, density and/or size from the plans for each wall section.

Construction Methods

When using an anchored PCB, anchor the barrier in accordance with Roadway Metric Standard Drawing 1170.01 and Section 1170 of the *2006 Metric Standard Specifications*. Control drainage during construction in the vicinity of temporary shoring. Collect and direct run off away from temporary MSE walls, shoring and shoring backfill.

(A) Non-anchored Temporary Shoring

Install and interlock sheet piling or install piles as shown on the plans or accepted submittals with a tolerance of 42 mm per meter from vertical. Contact the Engineer if the design embedment is not achieved. If piles are placed in drilled holes, perform pile excavation to the required elevations and backfill excavations with concrete and lean sand grout.

Remove grout as necessary to install timber lagging. Install timber lagging with a minimum bearing distance of 75 mm on each pile flange. Backfill voids behind lagging with shoring backfill.

Perform welding in accordance with the accepted submittals and Article 1072-20 of the *2006 Metric Standard Specifications*.

(1) Pile Excavation

Excavate a hole with a diameter that will result in at least 75 mm of clearance around the entire pile. Use equipment of adequate capacity and capable of drilling through soil and non-soil including rock, boulders, debris, man-made objects and any other materials encountered. Blasting is not permitted to advance excavations. Blasting for core removal is permitted only when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the *2006 Metric Standard Specifications*. Drilling spoils consist of all excavated material including water removed from excavations by either pumping or drilling tools.

If unstable, caving or sloughing soils are encountered, stabilize excavations with clean watertight steel casing. Steel casings may be either sectional type or one continuous corrugated or non-corrugated piece. Provide casings of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of 6 mm.

Before placing concrete, check the water inflow rate in the excavation after any pumps have been removed. If the inflow rate is less than 150 mm per half hour, remove any water and free fall the concrete into the excavation. Ensure that concrete flows completely around the pile. If the water inflow rate is greater than 150 mm per half hour, propose and obtain approval of the concrete placement procedure before placing concrete.

Center the pile in the excavation and fill the excavation with Class A concrete in accordance with Section 1000 of the *2006 Metric Standard Specifications* except as modified herein. Provide concrete with a slump of 150 to 200 mm. Use an approved high-range water reducer to achieve this slump. Place concrete in a continuous manner to the bottom of shoring or the elevations shown on the accepted submittals. Fill the remainder of the excavation with a lean sand grout and remove all casings.

(B) Temporary MSE Walls

The Engineer may require a wall preconstruction meeting to discuss the construction and inspection of the temporary MSE walls. If required, conduct the meeting with the Site Superintendent, the Resident or Bridge Maintenance Engineer, the Bridge Construction Engineer and the Geotechnical Operations Engineer before beginning wall construction.

Perform all necessary clearing and grubbing in accordance with Section 200 of the *2006 Metric Standard Specifications*. Excavate as necessary as shown on the plans or accepted submittals. Notify the Engineer when foundation excavation is complete. Do not place shoring backfill or first reinforcement layer until obtaining approval of the excavation depth and foundation material.

If applicable, install foundations located within the reinforced zone in accordance with the plans or accepted submittals.

Erect and maintain facings and forms as shown on the plans or accepted submittals. Stagger vertical joints of facings and forms to create a running bond when possible unless shown otherwise on the plans or accepted submittals.

Place facings and forms as near to vertical as possible with no negative batter. Construct temporary MSE walls with a vertical and horizontal tolerance of 75 mm when measured with a 3 m straight edge and an overall vertical plumbness (batter) and horizontal alignment of less than 150 mm.

Place reinforcement at locations and elevations shown on the plans or accepted submittals and in slight tension free of kinks, folds, wrinkles or creases. Repair or replace any damaged reinforcement. Contact the Engineer when existing or future structures such as foundations, pavements, pipes, inlets or utilities will interfere with reinforcement. To avoid structures, deflect, skew and modify reinforcement.

Do not splice reinforcement in the reinforcement direction (RD), i.e., parallel to the wall face. Seams are allowed in the cross-reinforcement direction (CRD). Bond or sew adjacent reinforcing fabric together or overlap fabric a minimum of 450 mm with seams oriented perpendicular to the wall face.

Place shoring backfill in 200 to 250 mm thick lifts and compact in accordance with Subarticle 235-4(C) of the *2006 Metric Standard Specifications*. Use only hand operated compaction equipment within 1 m of the wall face. Do not damage reinforcement when placing and compacting shoring backfill. End dumping directly on the reinforcement is not permitted. Do not operate heavy equipment on reinforcement until it is covered with at least 250 mm of shoring backfill. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet.

Cover reinforcing and retention fabric with at least 75 mm of shoring backfill. Place top reinforcement layer between 100 to 600 mm below top of wall as shown on the plans or accepted submittals.

Bench temporary MSE walls into the sides of excavations where applicable. If the top of wall is within 1.5 m of finished grade, remove top form or facing and incorporate the top reinforcement layer into the fill when placing fill in front of the wall. Temporary MSE walls remain in place permanently unless required otherwise.

Measurement and Payment

Temporary Shoring will be measured and paid for at the contract unit price per square meter of exposed face area at locations shown on the plans or required by the Engineer. For temporary MSE walls, the wall height will be measured as the difference between the top and bottom of wall and does not include the embedded portions of the wall or any pavement thickness above the wall. For all other temporary shoring, the shoring height will be measured as the difference between the top and bottom of shoring elevation. The bottom of shoring elevation is defined as where the grade intersects the front face of the shoring. The top of shoring elevation is defined as where the grade intersects the back face of the shoring. No payment will be made for any extension of shoring above the top of shoring or any embedment below the bottom of shoring. Such price and payment will be full compensation for furnishing all labor, tools, equipment, materials and all incidentals necessary to design and install the temporary shoring and complete the work as described in this provision.

No payment will be made for temporary shoring not shown on the plans or required by the Engineer including shoring for OSHA reasons or the Contractor's convenience. No value engineering proposals will be accepted based solely on revising or eliminating the shoring locations shown on the plans or the estimated quantities shown in the bid item sheets as a result of actual field measurements or site conditions.

No additional payment will be made for anchoring PCBs or providing Oregon barriers in lieu of unanchored PCBs. Additional costs for anchoring PCBs or providing Oregon barriers will be considered incidental to *Temporary Shoring*.

Payment will be made under:

Pay Item	Pay Unit
Temporary Shoring	Square Meter

ANCHORED TEMPORARY SHORING: (SPECIAL)

Description

Anchored temporary shoring consists of sheet piling or H piles with timber lagging anchored with ground or helical anchors. At the Contractor's option, use anchored temporary shoring in lieu of temporary shoring. Design and construct anchored temporary shoring based on actual

elevations and dimensions in accordance with the contract and accepted submittals. For this provision, “anchored shoring” refers to anchored temporary shoring and “Anchored Shoring Contractor” refers to the contractor installing the anchors. Use an Anchored Shoring Contractor prequalified by the NCDOT Contractual Services Unit for anchored retaining walls work (work code 3020).

Materials

Provide Type 7 Contractor’s Certifications in accordance with Article 106-3 of the *Standard Specifications* for anchored shoring materials. Store steel materials on blocking a minimum of 12” (300 mm) above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store anchored shoring materials such that they are kept clean and free of damage. Damaged or bent materials will be rejected.

Use steel piles meeting the requirements of Section 1084 of the *Standard Specifications*. For steel shapes and plates not addressed below, use steel materials meeting the requirements of ASTM A36. Use timber lagging with a minimum allowable bending stress of 1000 psi (6.9 MPa) that meets the requirements of Article 1082-1 of the *Standard Specifications*.

(A) Ground Anchors

A ground anchor consists of a grouted steel bar or strands with miscellaneous elements. Use high-strength steel bars meeting the requirements of AASHTO M275 or seven-wire strands meeting the requirements of ASTM A886 or Article 1070-5 of the *Standard Specifications*. Splice bars in accordance with Article 1070-10 of the *Standard Specifications*. Do not splice strands.

Provide bondbreakers, spacers and centralizers meeting the requirements of Section 6.3.5 of the *AASHTO LRFD Bridge Construction Specifications*. Use grout in accordance with the contract.

(B) Helical Anchors

A helical anchor consists of a lead section with a central steel shaft and at least one helix steel plate followed by extensions with only central shafts (no helixes). Use helical anchors with an ICC Evaluation Service, Inc. (ICC-ES) report. Helical anchors without an ICC-ES report may be approved at the discretion of the Engineer. Provide couplers, thread bar adapters and bolts for connecting helical anchors together and to piling in accordance with the anchor manufacturer’s recommendations.

(C) Anchorages

Anchorage consist of steel bearing plates with washers and hex nuts for bars or steel wedge plates and wedges for strands. Provide bearing plates meeting the requirements of Section 6.3.3 of the *AASHTO LRFD Bridge Construction Specifications* and washers, hex nuts, wedge plates and wedges in accordance with the anchor manufacturer’s recommendations.

(D) Shoring Backfill

Use shoring backfill meeting the requirements of Class II Type I, Class III, Class V or Class VI Select Material in accordance with Section 1016 of the *Standard Specifications* or AASHTO M145 for soil classification A-2-4 with a maximum plasticity index (PI) of 6.

Design

Before beginning design, survey Contractor designed shoring locations to determine existing elevations and actual design heights. Design anchored shoring in accordance with the plans and the *FHWA Geotechnical Engineering Circular No. 4 "Ground Anchors and Anchored Systems"* (Publication No. FHWA-IF-99-015). Do not embed anchored shoring below bottom of excavation or the grade in front of shoring. Backfill voids and fill sections behind lagging and piling with shoring backfill.

Provide portable concrete barriers in accordance with the contract for barriers for temporary shoring. The top of shoring elevation is defined as the elevation where the grade intersects the back face of the anchored shoring. For traffic impact, apply 2 kips/ft (29.2 kN/m) to the anchored shoring 18" (450 mm) above the top of shoring elevation. When designing for traffic impact, extend anchored shoring at least 32" (800 mm) above the top of shoring elevation. Otherwise, extend anchored shoring at least 6" (150 mm) above the top of shoring elevation.

Design anchored shoring for a 3-year design service life and a traffic surcharge equal to 240 psf (11.5 kPa). This surcharge is not applicable for construction traffic. If a construction surcharge will be present within a horizontal distance equal to the height of the shoring, design the anchored shoring for the required construction surcharge.

Do not extend anchors beyond right-of-way or easement lines. Extend the unbonded length for ground anchors or the shallowest helix for helical anchors at least 5 ft (1.5 m) behind the critical failure surface. If existing or future obstructions such as foundations, guardrail posts, pavements, pipes, inlets or utilities will interfere with anchors, maintain a minimum clearance of 6" (150 mm) between the obstruction and the anchors.

Determine anchor loads for ground and helical anchors in accordance with Geotechnical Engineering Circular No. 4. Size anchors such that design loads do not exceed 60% of bar, strand or central shaft tensile strengths. Also, size anchors such that maximum test loads do not exceed 80% of bar, strand or central shaft tensile strengths and lock-off loads do not exceed 70% of tensile strengths.

Submit anchored shoring designs including unit grout/ground bond strengths and lock-off loads for ground anchors and installation torque requirements for helical anchors for review and acceptance in accordance with Article 105-2 of the *Standard Specifications*. Submit working drawings showing plan views, shoring profiles with anchor locations and typical sections with anchor, piling and shoring details. If necessary, include details on working drawings for obstructions interfering with anchors or extending through shoring. Also, submit a sequence and

step-by-step description of anchored shoring construction including details of piling installation, excavations and temporary support of excavations and anchor installation and testing. Submit design calculations for each anchored shoring section with different surcharge loads, shoring geometry or material parameters. A minimum of one analysis is required for each shoring section with different anchor lengths. Submit 3 hard copies of design calculations and 10 hard copies of drawings and an electronic copy (PDF on CD or DVD) of both the calculations and drawings. Have anchored shoring designed, detailed and sealed by a Professional Engineer registered in North Carolina.

Construction Methods

When using an anchored NCDOT portable concrete barrier (PCB), anchor the barrier in accordance with Roadway Standard Drawing 1170.01 and Section 1170 of the *Standard Specifications*. Control drainage during construction in the vicinity of anchored shoring. Direct run off away from anchored shoring and areas above and behind shoring.

Before starting anchored shoring construction, conduct a preconstruction meeting to discuss the construction, inspection and testing of the anchored shoring. Schedule this meeting after all anchored shoring submittals have been accepted. The Resident or Bridge Maintenance Engineer, Bridge Construction Engineer, Geotechnical Operations Engineer, Contractor and Anchored Shoring Contractor Superintendent and Project Manager will attend this preconstruction meeting.

Notify the Engineer before blasting in the vicinity of anchored shoring. Perform blasting in accordance with the contract. Install foundations located behind anchored shoring and within a horizontal distance equal to the longest anchor length before beginning anchored shoring construction.

Install piling with a tolerance of 1/2 inch per foot (42 mm per meter) from vertical and in accordance with the accepted submittals and this provision. Contact the Engineer if the design pile embedment is not achieved. If piles are placed in drilled holes, perform pile excavation to the required elevations and backfill excavations with concrete and lean sand grout.

Construct anchored shoring from the top down by excavating material in front of shoring in accordance with the accepted submittals. Remove grout as necessary to install timber lagging and ensure at least 3" (75 mm) of contact in the horizontal direction between the lagging and pile flanges. Do not excavate the next lift until the timber lagging for the preceding lift is installed and the preceding row of anchors are accepted by the Engineer.

Perform any welding in accordance with Article 1072-20 of the *Standard Specifications* and the accepted submittals.

(A) Pile Excavation

Excavate holes with diameters that result in at least 3" (75 mm) of clearance all around piles. Use equipment of adequate capacity and capable of drilling through soil and non-soil including rock, boulders, debris, man-made objects and any other materials

encountered. Blasting is not permitted to advance excavations. Blasting for core removal is permitted only when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the *Standard Specifications*. Drilling spoils consist of all excavated material including water removed from excavations by either pumping or drilling tools.

If unstable, caving or sloughing soils are encountered, stabilize excavations with clean watertight steel casing. Steel casings may be either sectional type or one continuous corrugated or non-corrugated piece. Provide casings of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth and backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of 1/4 inch (6 mm).

Before placing concrete, check the water inflow rate in the excavation after any pumps have been removed. If the inflow rate is less than 6" (150 mm) per half hour, remove any water and free fall the concrete into the excavation. Ensure that concrete flows completely around the pile. If the water inflow rate is greater than 6" (150 mm) per half hour, propose and obtain approval of the concrete placement procedure before placing concrete.

Center the pile in the excavation and fill the excavation with Class A Concrete in accordance with Section 1000 of the *Standard Specifications* except as modified herein. Provide concrete with a slump of 6 to 8 inches (150 to 200 mm). Use an approved high-range water reducer to achieve this slump. Place concrete in a continuous manner to the bottom of shoring or the elevations shown on the accepted submittals. Fill the remainder of the excavation with a lean sand grout and remove all casings.

(B) Anchor Fabrication and Installation

Fabricate and install ground anchors in accordance with the accepted submittals, Sections 6.4 and 6.5 of the *AASHTO LRFD Bridge Construction Specifications* and the following requirements unless otherwise approved.

- Materials in accordance with this provision are required instead of materials conforming to Sections 6.4 and 6.5.3 of the AASHTO LRFD Specifications
- Encapsulation-protected ground anchors in accordance with Section 6.4.1.2 of the AASHTO LRFD specifications are not required
- Corrosion protection for unbonded lengths of ground anchors and anchorage covers are not required

Install helical anchors in accordance with the accepted submittals and the anchor manufacturer's instructions. Measure the torque during installation and do not exceed the torsion strength rating of the helical anchors. Satisfy the minimum installation torque and length requirements before terminating anchor installation. When replacing helical anchors, embed the last helix of the replacement anchor at least 3 helix plate diameters past where the first helix of the previous anchor was located.

(C) Anchor Testing

Proof test and lock-off all anchors in accordance with the accepted submittals and Section 6.5.5 of the *AASHTO LRFD Bridge Construction Specifications* with the exception of the acceptance criteria in Section 6.5.5.5. For the AASHTO LRFD specifications, “ground anchor” refers to a ground or helical anchor and “tendon” refers to a bar or strand for a ground anchor and a central shaft for a helical anchor.

(D) Anchor Acceptance

Anchor acceptance is based on the following criteria.

- (1) For ground and helical anchors, total movement is less than 0.04” (1 mm) between the 1 and 10 minute readings or less than 0.08” (2 mm) between the 6 and 60 minute readings.
- (2) For ground anchors, total movement at maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

(E) Anchor Test Results

Submit 2 original hard copies of anchor test records including movement versus load plots for each load increment within 24 hours of completing each row of anchors. The Engineer will review the test records to determine if the anchors are acceptable.

If the Engineer determines an anchor is unacceptable, revise the anchored shoring design and/or installation methods. Submit a revised anchored shoring design for review and acceptance and provide an acceptable anchor with the revised design and/or installation methods at no additional cost to the Department. If required, replace the anchor and/or provide additional anchors with the revised design and/or installation methods at no additional cost to the Department.

After completing anchor testing for each anchored shoring, submit electronic copies (PDF on CD or DVD) of all corresponding test records.

Measurement and Payment

If the Contractor elects to use anchored temporary shoring in lieu of temporary shoring, the anchored shoring will be paid for at the contract unit price for *Temporary Shoring*. Anchored temporary shoring will be measured as the exposed face area with the shoring height equal to the difference between the top and bottom of shoring elevation. The top of shoring elevation is defined as where the grade intersects the back face of the anchored shoring. The bottom of shoring elevation is defined as where the grade intersects the front face of the anchored shoring. No payment will be made for portions of anchored temporary shoring below bottom of shoring elevations or any extension of anchored shoring above top of shoring.

The contract unit price for *Temporary Shoring* will be full compensation for design, submittals, furnishing labor, tools, equipment and shoring materials, excavating, welding, installing piles and anchors, grouting, testing anchors and providing timber lagging, backfill and any incidentals necessary to design and construct anchored shoring in accordance with this provision.

CHANGEABLE MESSAGE SIGNS

(11-21-06)

M11 R11

Revise the *2006 Metric Standard Specifications* as follows:

Page 11-7, Article 1120-3, Replace the 3rd sentence with the following:

Sign operator will adjust flash rate so that no more than two messages will be displayed and be legible to a driver when approaching the sign at the posted speed.

FLAGGERS:

(2-15-11)

M11 R20

Revise the *2006 Metric Standard Specifications* as follows:

Page 11-10, Article 1150-3 Construction Methods, replace the article with the following:

Provide the service of properly equipped and qualified flaggers (see *Roadway Standard Drawing* 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/stopping site 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)

M12 R01

Revise the *2006 Metric 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 12-4, 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 12-6, 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 12-7, 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 12-8, 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 12-8, 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 12-11, 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 12-11, 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).

EXCAVATION, TRENCHING, PIPE LAYING AND BACKFILLING FOR UTILITIES:

(2-17-09)

M15 R01

Revise the *2006 Metric Standard Specifications* as follows:

Page 15-4, Article 1505-4 Repair of Pavements, Sidewalks and Driveways, first paragraph, add at the end of the first sentence

in accordance with Section 848

Page 15-5, Article 1505-6

Second paragraph,

Delete (E) *Repair of Sidewalks and Driveways* in its entirety

Add as the eighth paragraph:

 mm Concrete Sidewalk and mm Concrete Driveways will be measured and paid for in accordance with Article 848-4.

FIELD OFFICE (Lump Sum):

(6-1-07)

SPI 8-1

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 shall 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 shall 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 constructed of plywood, masonite, gypsum board, or other suitable materials. Have the exterior walls, ceiling, and floor insulated.

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

Number**Item**

- | | |
|---|--|
| 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 at least 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 chairs 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 extinguisher 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 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 64 square feet of floor space, 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

Payment at the contract lump sum bid price for *Field Office* will be full compensation for all work covered by this provision including but not limited to furnishing, erecting, maintaining, and removing the field office as outlined in this provision.

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

Payment will be made under:

Pay Item	Pay Unit
Field Office	Lump Sum

PERMANENT SEEDING AND MULCHING:

(7-1-95)

M16 R01

The Department desires that permanent seeding and mulching be established on this project as soon as practical after slopes or portions of slopes have been graded. As an incentive to obtain an early stand of vegetation on this project, the Contractor's attention is called to the following:

For all permanent seeding and mulching that is satisfactorily completed in accordance with the requirements of Section 1660, Seeding and Mulching, and within the following percentages of elapsed contract times, an additional payment will be made to the Contractor as an incentive additive. The incentive additive will be determined by multiplying the number of acres of seeding and mulching satisfactorily completed times the contract unit bid price per acre for Seeding and Mulching times the appropriate percentage additive.

Percentage of Elapsed Contract Time	Percentage Additive
0% - 30%	30%
30.01% - 50%	15%

Percentage of elapsed contract time is defined as the number of calendar days from the date of availability of the contract to the date the permanent seeding and mulching is acceptably completed divided by the total original contract time.