PART VII -- INCIDENTAL CONSTRUCTION

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Section 701
Culverts and Storm Drains

701.01 DESCRIPTION. This work consists of furnishing, installing, and cleaning pipe, pipe arch, storm drains and sewers, also referred to as culverts or conduit, in accordance with these specifications and in conformity with lines and grades shown on the plans or established.

701.02 MATERIALS. Materials shall comply with the following Sections and Subsections:

Usable Soil	203.06(a)
Selected Soil	203.06(b)
Plastic Soil Blanket	203.10
Flowable Fill	710
Mortar	702.02
Portland Cement Concrete	901
Stone	1003.03(b)
Recycled Portland Cement Concrete	1003.03(c)
Granular Material	1003.07
Bedding Material	1003.08
Concrete Sewer Pipe	1006.02
Reinforced Concrete Pipe	1006.03
Reinforced Concrete Pipe Arch	1006.04
Gasket Materials	1006.06
Plastic Pipe	1006.07
Split Plastic Coupling Bands	1006.07(d)(4)
Plastic Yard Drain Pipe	1006.09
Bituminous Coated Corrugated Steel Pipe and Pipe Arch	1007.02
Structural Plate for Pipe, Pipe Arch and Arch	1007.04
Corrugated Aluminum Pipe and Pipe Arch	1007.05
Coupling Bands	1007.09
Reinforcing Steel	1009
Geotextile Fabric	1019

(a) Side Drain Pipe or Side Drain Pipe Arch: When the item for Side Drain Pipe or Side Drain Pipe Arch is included in the contract, the contractor has the option of furnishing reinforced concrete pipe or reinforced concrete pipe arch, corrugated metal pipe or corrugated metal pipe arch, or plastic pipe, unless otherwise specified.

(b) Cross Drain Pipe or Cross Drain Pipe Arch: When the item for Cross Drain Pipe or Cross Drain Pipe Arch is included in the contract, the contractor has the option of furnishing reinforced concrete pipe or reinforced concrete pipe arch, corrugated metal pipe or corrugated metal pipe arch, or plastic pipe, unless otherwise specified.

(c) Storm Drain Pipe or Storm Drain Pipe Arch: When the item for Storm Drain Pipe or Storm Drain Pipe Arch is included in the contract, the contractor has the option of furnishing reinforced concrete pipe or reinforced concrete pipe arch, or plastic pipe, unless otherwise specified.

(d) Yard Drain Pipe: When the item for Yard Drain Pipe is included in the contract, the contractor has the option of furnishing concrete sewer pipe, plastic yard drain pipe or plastic pipe in accordance with Section 1006 unless otherwise specified.

(e) Material Type Abbreviations:

(1) Reinforced Concrete Pipe:

RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch

(2) Corrugated Metal Pipe:

CAP	Corrugated Aluminum Pipe
CAPA	Corrugated Aluminum Pipe Arch
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CSP	Corrugated Steel Pipe
CSPA	Corrugated Steel Pipe Arch
BCCSP	Bituminous Coated Corrugated Steel Pipe
BCCSPA	Bituminous Coated Corrugated Steel Pipe Arch

(3) Plastic Pipe:

PP	Plastic Pipe
PVCP	Polyvinyl Chloride Pipe
RPVCP	Ribbed Polyvinyl Chloride Pipe
CPEPDW	Corrugated Polyethylene Pipe Double Wall

(f) Joint Type Abbreviations:

T1	Type 1 Joint
T2	Type 2 Joint
T3	Type 3 Joint

(g) Quality Assurance for Pipe: Manufacturing plants will be periodically inspected for compliance with specified manufacturing methods, and material samples will be randomly obtained for laboratory testing for verification of manufacturing lots. Materials approved at the manufacturing plant will be subject to visual acceptance inspections at the jobsite or point of delivery.

701.03 EXCAVATION. The bottom of the trench shall be excavated to a minimum width of 18 inches (450 mm) on each side for all pipe. Surplus material or excavated material that does not conform to the requirements of Subsection 203.06(a) shall be satisfactorily disposed of in accordance with Subsection 202.02.

701.04 FORMING PIPE BED. When rock is encountered, it shall be removed below grade and replaced with material complying with Subsection 203.06. This replacement material shall be compacted to at least the density of the surrounding soil. The compacted earth cushion shall have a thickness under the pipe of at least 1/2 inch per foot (40 mm/m) of fill height over the top of the pipe with a minimum thickness of 8 inches (200 mm).

When pipe is not laid in a trench, a uniformly firm bed shall be made as specified for the bottom of a trench.

When bedding material is specified, additional excavation shall be performed below established grade and bedding material placed.

When a suitable foundation cannot be obtained, unstable soil below established grade shall be removed and replaced with granular material or bedding material constructed in accordance with Section 726. When stone or recycled portland cement concrete is used as backfill, unstable soil below established grade shall be removed and replaced with bedding material constructed in accordance with Section 726.

701.05 LAYING PIPE. Pipe laying shall begin at the downstream end of the line. The pipe shall be in contact with the foundation throughout its length. Bell or groove ends of pipe and outside circumferential laps of riveted metal pipe shall be placed facing upstream. Riveted seam metal pipe shall be placed with longitudinal laps at sides. Pipes in each continuous line shall have the same wall thickness. Metal pipes provided with lifting lugs shall be handled only by these lugs.

After pipe has been laid and before backfill is placed, the engineer will inspect the pipe for alignment, grade, integrity of joints, and coating damage.

701.06 JOINING PIPE.

(a) Joint Usage:

(1) Type 1 (T1) joints shall be used for side drains under drives and similar installations.

(2) Type 2 (T2) joints shall be used for cross drains under roadways, including turnouts.

(3) Type 3 (T3) joints shall be used for closed storm drain systems, flumes and siphons.

(b) Concrete Pipe: Concrete pipe may be either bell and spigot, or tongue and groove. The method of joining pipe sections shall be such that ends are fully entered and inner surfaces are flush and even.

An approved mechanical pipe puller shall be used for joining pipes over 36 inches (900 mm) in diameter. For pipe 36 inches (900 mm) or less in diameter, any approved method for joining pipe may be used which does not damage the pipe.

Joints shall comply with Subsection 1006.05, and shall be sealed with gasket material installed in accordance with the manufacturer's recommendations.

Types 2 and 3 joints shall be wrapped with geotextile fabric for a minimum of 12 inches (300 mm) on each side of joint for pipe 36 inches (900 mm) or less in diameter and a minimum of 18 inches (450 mm) on each side of the joint for pipe greater than 36 inches (900 mm) in diameter. Ends of the fabric shall be lapped at least 10 inches (250 mm). The edges and ends of fabric shall be suitably secured for the entire circumference of the pipe.

(c) Metal Pipe: Metal pipe shall be firmly joined by coupling bands. Bands shall be centered over the joint.

For Type 1 joints, approved gasket material shall be placed in one corrugation recess on each side of the joint at the coupling band and on each band connection in such manner to prevent leakage.

When Type 2 or 3 joints are specified, joining of metal pipe sections shall conform to the following provisions:

(1) General: Band joints shall be sealed with gasket material. Gasket material shall be placed in accordance with the plan details. The joint shall be wrapped with geotextile fabric for a minimum of 12 inches (300 mm) on each side of the connecting band for pipe diameters 36 inches (900 mm) or less and a minimum of 18 inches (450 mm) on each side of the connecting band for pipe diameters greater than 36 inches (900 mm). Ends of fabric shall be lapped at least 10 inches (250 mm). The edges and ends of fabric shall be suitably secured for the entire circumference of the pipe.

(2) Circular Section: Connecting bands shall be of an approved design and shall be installed in accordance with plan details.

(3) Arch Section: Connecting bands shall be a minimum of 12 inches (300 mm) wide for pipe arch less than 36 inches (900 mm) round equivalent diameter, and a minimum of 21 inches (525 mm) wide for 36 inches (900 mm) round equivalent diameter pipe arch and greater. Bands shall be connected at the ends by approved angle or strap connections. Connecting bands used for 36 inches (900 mm) round equivalent diameter pipe arch and above shall be 2-piece bands.

(d) Plastic Pipe: Joints for plastic pipe shall be either bell and spigot or split coupling bands.

Types 2 and 3 joints shall be wrapped with geotextile fabric for a minimum of 12 inches (300 mm) on each side of the joint for pipes 36 inches (900 mm) or less in diameter and for a minimum of 18 inches (450 mm) on each side of the joint for pipes greater than 36 inches (900 mm) in diameter. The ends of the fabric shall be lapped at least 10 inches (250 mm). The edges and ends of the fabric shall be suitably secured for the entire circumference of the pipe.

(1) Bell and Spigot Type Joint System: The method of joining pipe sections shall be such that ends are fully entered and inner surfaces are reasonably flush and even.

An approved mechanical pipe puller shall be used for joining pipes over 36 inches (900 mm) in diameter. For pipe 36 inches (900 mm) or less in diameter, any approved method for joining pipe may be used which does not damage the pipe.

Joints shall be approved and shall be sealed with a gasket system utilizing gasket material complying with Subsection 1006.06(a).

(2) Split Coupling Type Joint System: Split coupling bands shall comply with all dimensional and material requirements of Subsection 1006.07. The bands shall be centered over the joint. The split coupling band shall be secured to the pipe with a minimum of five stainless steel or other approved corrosion resistant bands.

Joints shall be approved and shall be sealed with gasket material. Gasket material shall be placed in the first two corrugation recesses on each side of the pipe connections. Gasket material shall also be placed on each band connection to prevent leakage. When flexible plastic gasket material is used it shall be a minimum of 1/2 inch (13 mm) in size. The bands shall be tightened to create overlap of the band and shall adequately compress the gasket material.

(e) Connections: Approved connections shall be used when joining new pipes to existing pipes. When concrete collars are required in order to

extend the ends of existing pipes that have been damaged or to join different types or sizes of pipes, the concrete collars shall be constructed in accordance with plan details, the applicable requirements of Section 901, and as directed.

701.07 RELAYING PIPE. If specified or directed, existing pipes shall be removed and suitable sections relaid as specified for new pipes.

701.08 BACKFILLING.

(a) General: Prior to backfilling, pipes found to be damaged or out of alignment or grade shall be removed and reinstalled, or replaced.

Type A backfill material shall be stone, recycled portland cement concrete, or flowable fill.

Type B backfill material shall be stone, recycled portland cement concrete, flowable fill, selected soils, or granular material.

When Type A backfill material is used, geotextile fabric shall be placed in accordance with plan details prior to placing backfill material. Care shall be taken to prevent damage to geotextile fabric during placement of backfill material.

Adjacent rolls of fabric shall be overlapped or sewn. When rolls are overlapped, the overlap shall be a minimum of 18 inches (450 mm), including the ends of the rolls. The top layer of the fabric shall be parallel with adjacent rolls and in the direction of backfill materials placement. When rolls are sewn, the contractor shall join adjacent rolls by sewing with polyester, or Kevlar thread. Field sewing shall employ the "J" seam or "Butterfly" seam with the two pieces of geotextile fabric mated together, turned in order to sew through 4 layers of fabric and sewn with 2 rows of Type 401, two-threaded locking chain stitch. Factory seams other than specified shall be submitted to the Materials and Testing Section for approval.

Damaged fabric shall be either removed and replaced with new fabric or covered with a second layer of fabric extending 2 feet (0.6 m) in each direction from the damaged area.

(b) Backfill Applications:

(1) Paved Areas: Cross drains and side drains in paved areas subject to traffic loads such as roadway travel lanes, shoulders, and turnouts shall be backfilled with Type A material. Type B backfill material shall be used in all other paved areas including driveways, detour roads and similar installations. Selected soils will not be allowed as backfill material. Placement and compaction shall be as specified in Heading (c) below.

(2) Nonpaved Areas: Pipe backfill material, except for plastic pipe, shall be Type B backfill material placed by approved methods and compacted

to the density of surrounding soil. Plastic pipe shall be backfilled with granular material or Type A backfill Material.

(c) Placement and Compaction: When corrugated metal pipe is used, the backfill material shall be tested and shall have a resistivity greater than 1500 ohm-cm and a pH greater than 5 when tested in accordance with DOTD TR 429 and DOTD TR 430 respectively.

If the top of pipe is even with or below the top of the trench, backfill material shall be brought up evenly on both sides of pipe for its full length to an elevation of 12 inches (300 mm) above the top of pipe [or to subgrade if less than 12 inches (300 mm)] or to natural ground elevation, whichever is greater.

When the top of the pipe is above the top of the trench, backfill material shall be brought up evenly on both sides of pipe for its full length to 12 inches (300 mm) above the top of pipe or to subgrade if less than 12 inches (300 mm). Material in the trench and above the top of the trench for a distance on each side of the pipe equal to the horizontal outside diameter for corrugated metal or plastic pipe and 18 inches (450 mm) for concrete pipe, and to 12 inches (300 mm) above the top of pipe or to subgrade if less than 12 inches (300 mm) shall be backfill material.

The embankment shall be constructed to a minimum of 24 inches (600 mm) over the pipe before heavy construction equipment is allowed to cross the installation. Where practical, installations with less than 24 inches (600 mm) of cover over the top of the pipe shall be constructed after heavy hauling is completed over the pipe location. After completion of hauling operations, the contractor shall remove excess cover material. Pipe damaged by hauling and backfilling operations shall be removed and reinstalled, or replaced, at no direct pay.

(1) Backfill Methods:

a. General: Compaction by flooding will not be allowed.

b. Selected Soils: Backfill shall be placed at or near optimum moisture content determined in accordance with DOTD TR 415 or TR 418 in layers not exceeding 8 inches (200 mm) compacted thickness. Backfill material shall be thoroughly compacted under the haunches of the pipe. Each layer shall be compacted by approved methods to at least 95 percent of maximum dry density prior to placement of a subsequent layer.

c. Granular Material: Backfill shall be placed at or near optimum moisture content determined in accordance with DOTD TR 415 or TR 418. Backfill material shall be thoroughly compacted under the haunches of the pipe and then compacted in layers not exceeding 12 inches (300 mm) compacted thickness. Each layer shall be compacted by approved methods to

at least 95 percent of maximum dry density prior to placement of a subsequent layer. Exposed slopes at the pipe ends shall be covered by at least 12 inches (300 mm) compacted thickness of plastic soil blanket.

d. Flowable Fill: Flowable fill shall be in accordance with Section 710.

e. Stone or Recycled Portland Cement Concrete: Backfill shall be placed at or near optimum moisture content determined in accordance with DOTD TR 415 or TR 418. Backfill material shall be thoroughly compacted under the pipe haunches and then compacted in layers not exceeding 8 inches (200 mm) compacted thickness. With approval of the engineer, layer thickness may be increased to 12 inches (300 mm) with verification of satisfactory installation and performance. Each layer shall be compacted by approved methods to at least 95 percent of maximum dry density prior to placement of a subsequent layer. The contractor shall control placement operations so as not to damage protective coatings on metal pipes. The contractor shall repair damaged coatings at no additional pay.

(2) Density Requirements: Maximum dry density will be determined in accordance with DOTD TR 415 or TR 418 and in-place density determined in accordance with DOTD TR 401.

701.09 INSPECTION OF PIPES. After completion of embankment and prior to roadway surfacing, the engineer shall inspect pipes for proper alignment and integrity of joints. Any misaligned pipe or defective joints shall be corrected by the contractor at no direct pay.

(a) Plastic Pipe: Installed plastic pipe shall be tested to ensure that vertical deflections do not exceed 5.0 percent. Maximum allowable deflections shall be governed by the mandrel requirements stated herein.

Deflection tests shall be performed no sooner than 30 calendar days after installation and compaction of backfill. The pipe shall be cleaned and inspected for offsets and obstructions prior to testing.

For pipe 36 inches (900 mm) and less in diameter, a mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. The mandrel shall be approved by the engineer prior to use. Use of an unapproved mandrel or a mandrel altered or modified after approval will invalidate the test. If the mandrel fails to pass, the pipe is overdeflected.

Unless otherwise permitted, overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled, but shall be removed and replaced with new pipe. Any pipe subjected to any method or

process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be removed and replaced with new pipe.

The mandrel shall be a rigid, nonadjustable, odd-numbered legged (minimum 9 legs) mandrel having a length not less than its nominal diameter or 24 inches (600 mm), whichever is less. The minimum diameter at any point shall be 5.0 percent less than the base inside diameter of the pipe being tested. The mandrel shall be fabricated of steel, aluminum or other approved material fitted with pulling rings at each end. The nominal pipe size and outside diameter of the mandrel shall be stamped or engraved on some segment other than a runner. A suitable carrying case shall be furnished.

For pipe larger than 36 inches (900 mm) in diameter, deflection shall be determined by a method approved by the engineer. If a mandrel is selected, the minimum diameter, length, and other requirements shall conform to the above requirements.

Mandrel testing shall be conducted by the contractor in the presence of the engineer. Mandrel testing shall be at no direct pay.

(b) Metal Pipe: If the inside diameter of metal pipe or rise dimension of metal pipe arch deflects more than 5.0 percent from original dimensions, they shall be removed and reinstalled, unless they do not rebound or are damaged. Pipe or pipe arch which are damaged or do not rebound shall be removed and replaced at no direct pay. Measurement of deflection will be made by the engineer away from rerolled ends.

701.10 CLEANING PIPES.

(a) Existing Pipes: Pipes designated to be cleaned shall be cleaned of soil, debris and other materials to the invert of the pipe. Designated pipes shall be cleaned by approved methods that will not damage the pipes. Any damage caused by the contractor's operations shall be satisfactorily repaired at no direct pay.

Removed soil, debris and other materials shall be disposed of in accordance with Subsection 202.02 or as otherwise approved in writing.

(b) Contractor Installed Pipes: Prior to final acceptance, pipes shall be cleaned of all debris and soil to the invert of the pipe at no direct pay.

Removed soil, debris and other materials shall be disposed of in accordance with Subsection 202.02 or as otherwise approved in writing.

701.11 STUBBING AND PLUGGING PIPES. When it is required that pipes be plugged, such plugs shall be constructed of Class R concrete complying with Section 901. Thickness of plug and method of construction shall be as directed.

When new pipes are to be stubbed into new or existing pipes or other structures, the connection shall be made with approved mortar complying with Subsection 702.02.

701.12 MEASUREMENT. Pipe, both new and relaid, will be measured in linear feet (lin m) as follows unless stated otherwise.

(a) Pipe not confined by fixed structures will be measured by the number of joints at the nominal length of each joint.

(b) Pipe confined by fixed structures will be measured along the pipe between the termini of pipe in structure walls.

(c) Pipe confined by a fixed structure on one end and unconfined at the other end will be measured along the pipe from the terminus of pipe in the structure wall to the unconfined end of pipe.

(d) Fabricating of pipe tees, elbows and other fittings will be measured per each fitting. The length of pipe in such fittings will be included in the pay length measurement of pipes of which they form a part.

(e) Excavation required for installation of pipes will not be measured for payment, except as otherwise specified in Subsection 203.14.

(f) Furnishing and placing backfill material for pipes will not be measured for payment. Backfill material needed to complete backfill above natural ground and around pipes that extend above natural ground will be measured and payment will be made under applicable earthwork items. When specified, flowable fill will be measured and paid for in accordance with Section 710.

(g) Plugging and stubbing of pipes will not be measured for payment.

(h) Cleaning existing pipes will be measured by the length of pipe cleaned and accepted.

(i) Concrete collars will be measured per each.

701.13 PAYMENT.

(a) Payment for pipe will be made at the contract unit price per linear foot (lin m) of the types and sizes specified.

When plastic pipe is specified on the plans or elected to be used by the contractor, payment will be made at the contract unit price per linear foot (lin m) of the types and sizes specified in accordance with the payment schedule of Table 701-1.

Table 701-1
Payment Schedule for Plastic Pipe

Percent Payment	Stage of Completeness
75	After placement and backfill has been completed
25	After the pipe has met vertical deflection requirements in accordance with Subsection 701.09(a)

(b) Payment for fabricating pipe tees, elbows and other fittings will be made at the contract unit price per each fitting.

(c) When unstable conditions are encountered, the additional excavation will not be measured for payment; however, the additional materials furnished and placed for the pipe foundation will be measured and paid for as follows:

(1) Granular Materials: Payment will be made under the embankment item. The net section volume of the materials will be multiplied by 3 to determine the pay volume. When the contract does not include a pay item for embankment, payment will be made in accordance with Subsection 104.02.

(2) Bedding Material: Measurement and payment will be made in accordance with Section 726. When the contract does not include a pay item for bedding material, payment will be made in accordance with Subsection 104.02.

(d) Payment for cleaning existing pipes will be made at the contract unit price per linear foot (lin m).

(e) Payment for concrete collars will be made at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
701-01	Cross Drain Pipe (Size & Type)	Linear Foot (Lin m)
701-02	Cross Drain Pipe Arch (Size & Type)	Linear Foot (Lin m)
701-03	Storm Drain Pipe (Size & Type)	Linear Foot (Lin m)
701-04	Storm Drain Pipe Arch (Size & Type)	Linear Foot (Lin m)
701-05	Side Drain Pipe (Size)	Linear Foot (Lin m)
701-06	Side Drain Pipe Arch (Size)	Linear Foot (Lin m)
701-07	Yard Drain Pipe (Size)	Linear Foot (Lin m)
701-08	Relaying Pipe	Linear Foot (Lin m)
701-09	Fabricating Pipe Fittings	Each
701-10	Reinforced Concrete Pipe (Extension)	Linear Foot (Lin m)
701-11	Reinforced Concrete Pipe Arch (Extension)	Linear Foot (Lin m)
701-12	Corrugated Metal Pipe (Extension)	Linear Foot (Lin m)
701-13	Corrugated Metal Pipe Arch (Extension)	Linear Foot (Lin m)
701-14	Cleaning Existing Pipes	Linear Foot (Lin m)
701-15	Concrete Collar	Each
701-16	Plastic Pipe (Extension)	Linear Foot (Lin m)

Section 702
Manholes, Junction Boxes, Catch Basins, and End Treatments

702.01 DESCRIPTION. This work consists of the construction, installation, and adjustment of manholes, junction boxes, catch basins, culvert end treatments and safety ends in accordance with these specifications, and in conformity with lines and grades shown on the plans or established.

702.02 MATERIALS. Materials shall comply with the following Sections and Subsections:

Cast-in-Place Concrete (Class M)	901
Portland Cement	1001.01
Mortar Sand	1003.02(a)
Sewer Brick	1004.01
Asphaltic Varnish	1008.03
Reinforcing Steel	1009.01
Precast Reinforced Concrete Drainage Units	1016
Frames, Grates and Covers for Manholes, Catch Basins and Junction Boxes	1018.04
Geotextile Fabric	1019

The contractor may furnish structures of either cast-in-place concrete or precast concrete units.

Mortar shall consist of one part portland cement, two parts mortar sand, and water as required for proper consistency. Mortar shall be used within 30 minutes after mixing.

702.03 QUALITY ASSURANCE. Manufacturing plants will be inspected periodically for compliance with specified manufacturing methods. Material samples will be randomly obtained for laboratory testing for verification of manufacturing lots.

Materials will be subject to inspection at any time during the work.

702.04 CONSTRUCTION REQUIREMENTS. All cast-in-place structures shall be constructed in dry or dewatered areas, unless otherwise directed. Logs, stumps and other undesirable material shall be removed.

(a) Manholes, Junction Boxes, and Catch Basins: Concrete construction shall conform to Section 805. Joints shall be full mortar joints not more than 1/2 inch (13 mm) wide. When specified, outside faces of structures shall be plastered with 1/2 inch (13 mm) thick cement-sand mortar. Exposed surfaces of concrete and masonry shall be cured in accordance with Subsection 805.10 for at least 48 hours.

Precast concrete units shall be cast with the specified number and size of pipe openings required for the drainage system; however, if additional pipe is required during construction for which no openings have been provided, the contractor may make such openings provided any damaged units are replaced or satisfactorily repaired. Precast units shall be set to established grade within ±1/2 inch (±13 mm). Joints for sectional precast units shall be sealed with flexible plastic gasket material complying with Subsection 1006.06(b) installed as to form a watertight seal. The joints of precast units shall be wrapped with geotextile fabric a minimum of 18 inches (450 mm) on each side of the joint. Ends of the fabric shall be lapped at least 10 inches (250 mm). The edges and ends of the cloth shall be suitably secured.

Metal frames shall be set in a full mortar bed. Conduit sections shall be flush on the inside of structure wall and project outside sufficiently for proper connection with the next conduit section. Masonry shall fit neatly and tightly around conduit.

When grade adjustments of existing structures are specified, frames, covers and gratings shall be removed and walls reconstructed as required. Cleaned frames shall be reset at required elevation. Metal parts shall be thoroughly cleaned and placed in good repair. In lieu of adjusting structures, the contractor may adjust structures by means of approved metal adjustment rings.

New structures shall be cleaned of silt, debris or other foreign matter, and nongalvanized metal parts of new or adjusted structures shall be coated with asphaltic varnish meeting the requirements of Subsection 1008.03 or a jet black metal work paint satisfactory to the engineer.

The structure shall be backfilled in accordance with Subsection 701.08(c)(1).

Excavated material not satisfactory for backfill and surplus material shall be disposed of in accordance with Subsection 202.02.

(b) Culvert End Treatments: Culvert end treatments to control erosion at the ends of cross drains and side drains shall be constructed in accordance with these specifications, the plans, and as directed. Designs other than those shown on the plans shall be submitted for approval.

(1) Concrete Toe Wall Placement: Cast-in-place toe walls shall conform to Subsection 805.03 and plan details.

(2) Geotextile Fabric Placement: Geotextile fabric shall be placed in accordance with Subsection 712.03.

(3) Sacked Concrete (Wet-Batched) Placement:

a. Revetment: Wet-batched sacked concrete revetments shall conform to the requirements of Section 712. Placement of sacked concrete shall begin at the toe of the revetment and progress to the end of the pipe. The compressive strength shall comply with the requirements of Section 901 for Class R concrete.

b. Toewall: Sacks shall be stacked as indicated on the plans.

(4) Sacked Concrete (Dry-Batched) Placement:

a. Revetment: Dry-batched sacked concrete revetments shall conform to the requirements of Section 712. Placement shall begin at the toe of the revetment and progress to the end of the pipe. The supplier of the dry batched revetment shall submit a certificate of compliance with each shipment showing the proportions of cement and sand (or other approved aggregates used). The contents of the package shall be mixed with water by the contractor as required to produce a slump of 2 to 5 inches (50 to 125 mm). The compressive strength shall comply with the requirements of Section 901 for Class R concrete.

b. Toewall: Sacks shall be stacked as indicated on the plans.

(5) Stone Placement: Stone revetment shall conform to the requirements of Section 712.

(c) Culvert Safety Ends: Safety ends shall be furnished and installed on cross drains and side drains in accordance with these specifications, the plans and as directed. Designs other than those given on the plans shall be submitted for approval.

(1) Reinforcing steel shall be fabricated and placed in accordance with Section 806.

(2) Cast-in-place or precast concrete shall comply with Section 805.

(3) Pipe runners shall be bolted in place as shown on the plans. Bolts shall either be cast into the plastic concrete or placed in approximately 1-inch (25 mm) diameter holes and epoxied in place using an approved anchor system listed in QPL 32 or 52 as directed.

702.05 MEASUREMENT. New and adjusted junction boxes, manholes, catch basins, culvert end treatments and safety ends will be measured per each.

Excavation and backfill required for installation of these units will not be measured for payment.

702.06 PAYMENT. Payment for new and adjusted junction boxes, manholes, catch basins, culvert end treatments and safety ends will be made at the contract unit price per each which shall include all materials, tools, equipment, labor and incidentals necessary to complete the work.

The concrete in cast-in-place manholes, junction boxes, catch basins, and culvert end treatments and safety ends will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-6 and Note 1 therein. Acceptance for each precast concrete manhole, junction box, and catch basin lot will be in accordance with the requirements of Standard Plan PC-01. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
702-01	Junction Boxes	Each
702-02	Manholes	Each
702-03	Catch Basins	Each
702-04	Adjusting _____	Each
702-05	Cross Drain End Treatment (Type)	Each
702-06	Side Drain End Treatment (Type)	Each
702-07	Cross Drain Safety End (Type)	Each
702-08	Side Drain Safety End (Type)	Each

Section 703
Underdrain Systems

703.01 DESCRIPTION. This work consists of constructing pipe underdrain systems in accordance with these specifications and in conformity with lines and grades shown on the plans or established.

703.02 MATERIALS. Materials shall comply with the following Sections and Subsections:

Asphaltic Concrete	502
Portland Cement Concrete (Class M)	901
Aggregate Backfill (Size 3)(Crushed or Uncrushed)	1003.05
Granular Material (Backfill)	1003.07
Perforated and Nonperforated Underdrain Plastic Pipe	1006.08
Perforated Bituminous Coated Corrugated Steel Pipe	1007.03
Perforated Corrugated Aluminum Pipe	1007.06
Reinforcing Steel	1009.01
Precast Concrete Headwalls	1016.03
Hardware Cloth Screen	1018.21
Geotextile Fabric	1019.01
Geocomposite Drains	1019.02

When an item for "Shoulder Outlet Underdrains" is included in the contract, plastic pipe shall be furnished.

When an item for "Perforated Pipe Underdrains" is included in the contract, the contractor will be permitted to furnish any of the perforated plastic pipe types, unless otherwise specified.

When an item for "Nonperforated Pipe Underdrains" is included in the contract, the contractor will be permitted to furnish any of the nonperforated plastic pipe types, unless otherwise specified.

At the Department's discretion, plants will be inspected periodically for compliance with specified manufacturing methods. Material samples will be obtained for laboratory testing for acceptance of manufacturing lots.

703.03 CONSTRUCTION REQUIREMENTS.

(a) Plastic Pipe Shoulder Underdrains: Installation of plastic pipe underdrains, aggregate backfill and replacement of shoulder base and

surfacing shall follow immediately behind trenching operations. When traffic is permitted on the roadway, operations shall be conducted so that no trench will be open at the end of the day. Operations shall be performed in such a manner that existing pavement, shoulder surfacing and base course outside the limits of underdrain trenches are not damaged.

(1) Trenching: When existing surfaced shoulders are not to be overlaid with asphaltic concrete under the contract, existing shoulder surfacing shall be cut full depth along the edges of the proposed trench prior to beginning trenching operations. Excess excavated materials may be spread on embankment slopes when permitted. The contractor shall dispose of removed materials considered unacceptable for spreading on slopes in accordance with Subsection 202.02.

(2) Geotextile Fabric: Completed trenches for perforated plastic pipe shall be lined with geotextile fabric. Adjoining sheets of fabric shall be spliced by lapping a minimum of 18 inches (450 mm) and satisfactorily securing; or by use of sewn or heat-bonded splices. A sufficient width of fabric shall be placed in the trench to permit the cloth to lap over the top of the trench for the full width of trench. Care shall be taken during placement of geotextile fabric, pipe and backfill to avoid damaging geotextile fabric. The contractor shall satisfactorily repair or replace any damaged geotextile fabric at no direct pay.

(3) Plastic Pipe Installation: Plastic pipe underdrain shall be placed in the trench immediately adjacent to the pavement or shoulder edge as shown on the plans. Fittings and materials necessary to make splices of the plastic pipe underdrain and to make connections of the plastic pipe underdrain to the nonperforated outlet pipe shall be from the same manufacturer as the pipe. Fittings shall be designed to prevent soil or aggregate intrusion into the underdrain or outlet piping. When the underdrain is terminated without an outlet, a fitting or other approved method shall be provided to prevent soil or aggregate intrusion into the end of the underdrain.

(4) Aggregate Backfill: After pipe installation, the trench shall be backfilled in a manner that will not displace or damage the pipe. Aggregate backfill for perforated pipe shall be uniformly compacted with approved vibratory equipment to the satisfaction of the engineer, after which geotextile fabric shall be lapped over the full width of the trench and secured by an approved method. Aggregate backfill shall be placed in lifts no greater than 10 inches (250 mm) uncompacted thickness. The backfilled and compacted trench shall be left in a condition ready to receive surfacing.

(5) Replacement of Base Course and Surfacing: Asphaltic concrete shall be used for replacement of removed shoulder base course and

surfacing as shown on the plans and shall be constructed in accordance with Section 510.

(b) Shoulder Outlet Underdrain: Installation of the nonperforated plastic pipe, backfill, and replacement of shoulder base and surfacing shall follow immediately behind trenching operations. When traffic is permitted on the roadway, operations shall be conducted so that no trench will be open at the end of the day. Operations shall be performed in such a manner that the existing pavement, shoulder surfacing and base course outside the limits of the trenches are not damaged.

(1) Trenching: When existing surfaced shoulders are not to be overlaid with asphaltic concrete under the contract, existing shoulder surfacing shall be cut full depth along the edges of the proposed trench prior to beginning trenching operations. Excess excavated materials may be spread on embankment slopes when permitted. The contractor shall dispose of removed materials considered unacceptable for spreading on slopes outside the right-of-way in accordance with Section 202.02.

(2) Nonperforated Plastic Pipe Installation: Nonperforated plastic pipe shall be placed in the trench and connected to plastic pipe in accordance with manufacturer's recommendations. The pipe shall comply with the requirements of Subsection 1006.08(b).

(3) Backfill: After pipe installation, the trench shall be backfilled in a manner that will not displace or damage the pipe. Backfill material shall be excavated trench material that meets the requirements for granular material. When additional material is required, the contractor shall provide granular material at no direct pay. The backfill material shall be placed in lifts no greater than 6 inches (150 mm) of uncompacted material. Backfill material shall be uniformly compacted by approved methods to the satisfaction of the engineer. The backfilled and compacted trench shall be left in a condition ready to receive surfacing.

(4) Replacement of Base Course and Surfacing: Asphaltic concrete shall be used for replacement of removed shoulder base course and surfacing as shown on the plans and shall be constructed in accordance with Section 510.

(5) Headwalls: Portland cement concrete headwalls for non-perforated pipe shall be cast-in-place or precast constructed in accordance with Section 702. Each outlet pipe shall be furnished with a rodent screen as shown on the plans.

(c) Perforated or Nonperforated Pipe Underdrain: Perforated or nonperforated pipe underdrain shall be used as shown on the plans to drain

wet areas. Installation of the underdrains and backfill shall follow immediately behind trenching operations.

(1) Trenching: Trenches shall be excavated to the specified dimensions and grade or as directed. When specified, a minimum 3 inches (75 mm) bedding layer of specified material shall be placed and compacted in the bottom of the trench for its full width and length. The contractor shall dispose of excess excavated material in accordance with Subsection 202.02.

(2) Underdrain Pipe: Underdrain pipe shall be embedded firmly in the bedding material and shall be joined securely with appropriate coupling fittings or bands. When specified, perforated pipe shall be wrapped with geotextile fabric in accordance with plan details or as directed. Upgrade ends of pipe shall be capped to prevent soil intrusion.

(3) Backfill: Specified backfill shall be placed as shown on the plans or as directed.

(d) Geocomposite Wall Drains: Geocomposite wall drains shall be placed against the structure as shown on the plans before structural backfilling. The drains shall be placed such that drainage of the backfill is accomplished without soil intrusion into the drainage product core or outlet piping. The backfill shall be placed and compacted in accordance with Section 802 in a manner that will not displace or damage the geocomposite wall drain.

Fittings and material necessary to make splices and to make connections of the drainage product core to outlet piping shall be from the same manufacturer. When the sides of the product are terminated, the fabric shall be folded under to prevent soil intrusion into the end of the drainage product. The fabric shall overlap a minimum of 6 inches (150 mm) at all seams.

703.04 MEASUREMENT.

(a) Shoulder Underdrains:

(1) Shoulder Underdrains: Shoulder underdrains will be measured by the linear foot (lin m) along the pavement or shoulder edge. Required excavation, geotextile fabric, restoration of shoulder base course and surfacing, and disposal of excavated materials will not be measured for payment.

(2) Shoulder Outlet Underdrains: Shoulder outlet underdrains will be measured per each outlet underdrain installation. Required excavation, plastic pipe and fittings, backfill, replacement of shoulder base course and surfacing, concrete headwalls, rodent screens, and disposal of excavated materials will not be measured for payment.

(b) Perforated or Nonperforated Pipe Underdrains: Perforated and nonperforated pipe underdrains will be measured by the linear foot (lin m) of underdrain pipe. Required excavation, bedding, backfill and geotextile fabric will not be measured for payment.

(c) Geocomposite Wall Drains: Geocomposite wall drains will be measured by the square yard (sq m) of geocomposite wall drain.

703.05 PAYMENT. Payment for underdrains will be made at the contract unit prices. Pay adjustments for portland cement concrete of Section 901 will not apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
703-01	Shoulder Underdrains	Linear Foot (Lin m)
703-02	Shoulder Outlet Underdrains	Each
703-03	Perforated Pipe Underdrains	Linear Foot (Lin m)
703-04	Nonperforated Pipe Underdrains	Linear Foot (Lin m)
703-05	Geocomposite Wall Drains	Square Yard (Sq m)

Section 704
Guard Rail

704.01 DESCRIPTION. This work consists of furnishing and constructing beam type highway guard rail in accordance with these specifications, plan details, the manufacturer's recommended procedures and other requirements as directed by the engineer.

704.02 MATERIALS. Materials shall comply with the following Section and Subsections.

Cast-in-Place Concrete (Class M)	901
Reinforcing Steel	1009
Metal Beam Guard Rail	1010.08
Posts and Spacer Blocks	1010.09
Hardware	1010.10
Wire Rope and Fittings	1010.11

Welding shall comply with Section 815.

704.03 GENERAL CONSTRUCTION REQUIREMENTS.

(a) Posts: Posts shall be aligned and set plumb. When driving of posts is permitted, the manner of driving shall not damage posts. Post holes shall be backfilled with acceptable material placed and compacted as directed. When posts are to be placed within existing surfaced areas, surface material shall be replaced in kind or with Class M concrete.

(b) Rail Elements: Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts, except adjustment bolts, shall be drawn tight. Bolts shall be of sufficient length to extend beyond nuts. Holes for special details may be field drilled or punched when approved. Damaged galvanized surfaces and drilled holes shall be repaired in accordance with Subsection 811.12.

(c) Anchor Blocks: Reinforced concrete blocks for anchoring guard rail to existing bridge ends shall meet the requirements of Sections 805 and 806. Concrete shall be Class M complying with Section 901. Required removal of portions of existing bridge railings and drilling of holes into existing railings shall be performed in such manner that will not damage the railings that are to remain. The contractor shall satisfactorily repair damage

to the existing bridge due to operations at no additional cost to the Department. Removed materials shall be disposed of in accordance with Subsection 202.02.

(d) Guard Rail End Treatments: All guard rail end treatments must have been successfully crash tested and shall comply with the crash test requirements of the National Cooperative Highway Research Program (NCHRP) Report 350. End treatment systems not in compliance with this requirement will not be allowed on any federal or state funded projects.

The Bridge Design Engineer has pre-approved a list of end treatment systems for selection by the contractor. The contractor shall provide the project engineer with a copy of the most recent working drawing/shop drawing of the selected guard rail end treatment system prior to installation. The drawings shall provide the details of all components of the guard rail end treatment system and shall state that all details are in compliance with the NCHRP Report 350 requirements as approved by the FHWA.

The contractor may select any end treatment, which meets the above criteria, but shall not use a combination of such end treatments on the same project. The contractor shall submit to the Bridge Design Section the system name, the manufacturer of the end treatment system, and the necessary documentation to substantiate that the end treatment is in compliance with the NCHRP 350 requirement.

The contractor shall install all components of the guard rail end treatment system such as posts, blocks, and hardware in accordance with the drawings and the manufacturer's recommendations. Under no circumstances shall any component of the guard rail end treatment system be modified without written approval.

All end treatments shall be furnished with a retroreflective sheeting at the terminal end as shown in the plans.

When necessary, the guard rail length may be adjusted to provide the same "length of need" as specified in the plans. This adjustment shall be made at no additional cost to the Department.

704.04 MEASUREMENT. Quantities of guard rail, anchor sections, end treatments, and transitions for payment will be the design quantities as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made.

Design quantities of single faced guard rail are based on plan length along the face of rail between end posts, exclusive of openings, and plan length of end sections. Design quantities of double faced guard rail are based on plan

length between end posts along centerline of posts, exclusive of openings, and plan length of end sections. Design quantities of trailing end and breakaway cable terminal (BCT) anchor sections are based on plan length along the face of rail.

Guard rail anchor blocks and end treatments will be measured per each unit furnished and installed.

704.05 PAYMENT. Payment for guard rail, anchor sections, anchor blocks, end treatments, and transitions will be made at the contract unit prices which include drilling of holes in existing concrete for reinforcing steel dowels, concrete and reinforcing steel. Payment adjustments for portland cement concrete of Section 901 will not apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
704-01	Guard Rail	Linear Foot (Lin m)
704-02	Guard Rail (Double Faced)	Linear Foot (Lin m)
704-03	Blocked Out Guard Rail	Linear Foot (Lin m)
704-04	Blocked Out Guard Rail (Double Faced)	Linear Foot (Lin m)
704-05	Guard Rail Anchor Sections (BCT)	Linear Foot (Lin m)
704-06	Guard Rail Anchor Sections (Trailing End)	Linear Foot (Lin m)
704-07	Guard Rail Bridge Attachments	Linear Foot (Lin m)
704-08	Guard Rail Transitions	Linear Foot (Lin m)
704-09	Guard Rail Anchor Sections (Turndown)	Linear Foot (Lin m)
704-10	Guard Rail Anchor Blocks	Each
704-11	Guard Rail End Treatment (Type)	Each

Section 705
Fences

705.01 DESCRIPTION. This work consists of constructing fences and gates in accordance with these specifications and in conformity with lines and grades shown on the plans or established by the engineer.

705.02 MATERIALS. Materials shall comply with the following Section and Subsections:

Portland Cement Concrete (Class R)	901
Barbed Wire	1010.01
Woven Wire	1010.02
Posts and Braces for Field and Line Type Fence	1010.03
Staples and Nails	1010.04
Metal Fasteners for Steel Posts	1010.05
Gates for Field and Line Type Fence	1010.06
Chain Link Fence, Gates and Appurtenances	1010.07
Timber Preservatives	1014.03
Ground Rod Assemblies	1018.05

The same type chain link fencing shall be used throughout the project. The same type, shape and treatment of posts shall be used throughout a section of fence.

705.03 GENERAL CONSTRUCTION REQUIREMENTS. Clearing and grubbing for fence installation shall conform to Section 201.

The contractor's operations shall be confined to the area adjacent to right-of-way lines and within the right-of-way.

Where breaks in a run of fencing are required, and at intersections with existing fences, appropriate adjustment in post spacing shall be made for the type closure indicated.

Wood posts shall be placed with small end up. When posts, braces or anchors are to be embedded in concrete, the contractor shall install temporary braces as required to hold posts in proper position until concrete has set sufficiently to hold posts. No material shall be installed on posts or strain placed on bracing set in concrete for 72 hours after concrete has been placed.

Tops of posts shall be set to required grade and alignment. Cutting of wood post tops will be allowed only when approved. Cut ends shall be treated with 2 applications of the same type preservative used for post treatment. Wire shall be stretched taut.

Ground rods shall be installed along each segment of new or rebuilt fence, regardless of type fence post used, at maximum 500-foot (150 m) intervals. Ground rods and connections shall conform to plan details.

705.04 REBUILT FENCE. When specified, the contractor shall take down, move back and rebuild existing fence. Fence shall be rebuilt in the same manner as specified for new fence. Rebuilt ornamental fence, picket fence or other special type fence shall be equal in all respects to existing fence.

705.05 GATES. Gates of a different design from that shown on the plans may be furnished with prior approval. Gates shall be of rigid construction, and after erection shall not show sag or warp.

705.06 CHAIN LINK FENCE AND GATES.

(a) Concrete Post Anchorage: Posts shall be anchored in Class R concrete footings. Portable mixing of concrete in accordance with Subsection 901.10(g) will be permitted for small quantities of concrete.

Tops of footings shall extend slightly above ground and shall be steel troweled to a smooth finish sloped to drain away from posts. Posts, braces and other units shall be centered in footings.

Concrete operations shall be in accordance with Section 901. The contractor shall consolidate concrete by tamping or vibrating. Excess excavation from footings shall be disposed of satisfactorily.

(b) Fence Erection: Pull posts shall be placed not more than 200 feet (60 m) apart in straight runs and at each vertical angle greater than 20 degrees. Corner posts shall be placed at each horizontal angle greater than 20 degrees. Corner and pull posts shall have a horizontal brace and tie rod on each side of posts. The horizontal brace and tie rod shall be connected to adjacent line posts.

Posts shall be permanently positioned, anchorages firmly set, and top rail or tension wires satisfactorily secured to posts before fabric is placed. Ends of fabric shall be secured by stretcher bars threaded through loops of fabric and secured to posts by clamps with bolts and nuts.

Fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. Degree of

tensioning shall be commensurate with air temperatures at time of installation to prevent undue sagging or tensioning of fabric due to changing temperatures. Fabric shall be fastened to line posts at approximately equal spaces and to top rail (or top tension wire) and bottom tension wire with tie wires or bands as specified.

(c) Gate Erection: Gate installation shall include gate frames, stretcher bars, filler fabric, latches, stops, locking device, padlocks, hinges, gate posts with braces, tie rods, turnbuckles, caps and other fittings as specified or required for complete installation.

Clamps for attaching hardware shall be tightened. Bottom of gates shall clear the ground at least 3 inches (75 mm) at all points in its swing. The contractor shall grade the area if necessary to meet this requirement. Stops with latches or other approved means for holding the gate open shall be provided, placed to prevent damage to gate or fence by overswing. Unless otherwise directed, stops shall be provided at the centerline of fence to arrest the swing of a closed gate.

(d) Repair of Protective Coatings: After completion of fence and gate installation, any damaged protective coatings shall be satisfactorily repaired in accordance with Subsection 811.12.

705.07 MEASUREMENT.

(a) New Fence and Gates: New fence will be measured by the linear foot (lin m) between outside of end posts for each continuous run of fence, exclusive of gates. Gates for new fence will be measured per each for single swinging gates, and per double gate for double swinging gates.

(b) Rebuilt Fence: Rebuilt fence will be measured by the linear foot (lin m) between outside of end posts for each continuous run of fence, including gates.

(c) Intersecting Fences: Sections of new fence required for connections of existing intersecting fences to new or rebuilt fence will be included in the measurement of the new or rebuilt fence.

(d) Ground Rod: Ground rod placement will not be measured for payment.

705.08 PAYMENT.

Payment for fence and gates will be made at the contract unit prices. Payment adjustments for portland cement concrete of Section 901 will not apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
705-01	Barbed Wire Fence	Linear Foot (Lin m)
705-02	Combination Mesh and Barbed Wire Fence	Linear Foot (Lin m)
705-03	Single Swinging Walk Gates	Each
705-04	Single Swinging Driveway Gates	Each
705-05	Double Swinging Driveway Gates	Double Gate
705-06	Chain Link Fence (__-Foot (m) Height)	Linear Foot (Lin m)
705-07	__-Foot (m) Single Gates for Chain Link Fence (__-Foot (m) Height)	Each
705-08	__-Foot (m) Double Gates for Chain Link Fence (__-Foot (m) Height)	Double Gate
705-09	Rebuilt Fence	Linear Foot (Lin m)

Section 706
Concrete Walks, Drives and Incidental Paving

706.01 DESCRIPTION. This work consists of furnishing and constructing portland cement concrete walks, handicapped curb ramps, drives and incidental paving slabs in accordance with these specifications and in conformity with lines, grades and dimensions shown on the plans or established.

706.02 MATERIALS. Materials shall comply with the following Section or Subsections.

Portland Cement Concrete (Class M)	901
Joint Filler	1005.01(c)
Reinforcing Steel	1009.01
Curing Materials	1011.01

706.03 CONSTRUCTION REQUIREMENTS.

(a) Excavation: Excavation shall be made to required depth and width. The top of the subgrade shall be shaped and compacted to a firm, even surface conforming to the section shown on the plans. Unsuitable material shall be removed and disposed of in accordance with Subsection 202.02 and replaced with approved material at no direct pay.

(b) Forms: Forms shall be of wood or metal and shall extend the full depth of concrete. Forms shall be straight, clean and of sufficient strength to resist the pressure of concrete. Bracing of forms shall be such that forms remain in horizontal and vertical alignment until their removal.

Concrete may be placed by slip-form methods. Slip-formed concrete shall be placed with an approved machine designed to spread, vibrate, consolidate and finish concrete in one pass of the machine in such manner that minimum hand finishing is necessary. Sliding forms shall be rigidly held together to prevent spreading of forms. After the passing of the side forms there shall be no noticeable slumping of concrete.

(c) Subgrade: The subgrade shall be thoroughly moistened immediately prior to placing concrete.

(d) Placing and Finishing: Concrete shall be placed on the subgrade, struck off to required thickness and tamped sufficiently to bring the mortar to the surface. The surface shall be finished with a wood float or steel trowel

followed by brushing to a slightly rough finish. Joints and edges shall be rounded with an edging tool having a 1/4-inch (6 mm) radius.

(e) Joints:

(1) Expansion Joints: Expansion joints shall be filled with 1/2 inch (13 mm) thick preformed expansion joint filler. Expansion joints shall be installed at maximum 100-foot (30 m) intervals, and between intersecting paving and any fixed structure such as a building, bridge or curbing. Expansion joint material shall extend for the full width and depth of paving.

(2) Weakened Plane: Weakened planes shall be formed by a jointing tool or other acceptable means. Weakened planes shall extend into concrete for at least 1/4 of the depth and shall be approximately 1/8 inch (3 mm) wide.

a. Walks: Spacing of weakened planes for walks shall be equal to the width of walk.

b. Drives: A longitudinal weakened plane shall be formed along the centerline of drives more than 16 feet (5 m) wide, and transverse weakened planes shall be formed at not more than 16-foot (5 m) intervals.

c. Incidental Paving: Weakened planes for incidental paving shall be formed at intervals not exceeding 30 times the thickness of the concrete in length or width. Incidental paving poured adjacent to jointed concrete shall be jointed to match existing joints, with intermediate joints formed as necessary not to exceed the maximum joint spacing.

(3) Construction Joints: Construction joints shall be formed around manholes, utility poles, etc., extending into paving and 1/4 inch (6 mm) thick preformed expansion joint filler shall be installed in these joints.

(4) Tie-ins: Tie-ins of existing concrete shall be made by full depth sawing at no direct pay.

(f) Curing: Concrete shall be cured in accordance with Subsection 601.10.

(g) Detectable Warning Surface for Handicap Ramps: Handicapped curb ramps installed shall be equipped with a detectable surface warning system consisting of raised truncated domes as a transition between the sidewalk and the street as required by the Americans with Disabilities Act, 28 CFR Part 36, ADA Standards for Accessible Design. These standards are further described in the Americans with Disabilities Act Accessibility Guidelines (ADAAG), Section 4.29.2.

Detectable warnings (truncated domes) shall be installed on the ramp surface over the full width of the ramp throat for a distance of 24 inches (600 mm) in the direction of travel from the back of the curb. Truncated domes

shall be laid out on a square or triangular grid in order to allow enough space for wheelchairs to roll between the domes.

Light reflectance of the truncated domes and the underlying surface must meet the 70 percent contrast requirement of ADAAG.

706.04 MEASUREMENT. Quantities of concrete walks, drives and incidental paving slabs for payment will be the design quantities as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven or if design changes are made. Design areas are based on the horizontal dimensions shown on the plans. Excavation, backfill, reinforcing steel and joint materials will not be measured for payment.

Handicapped curb ramps included in the construction of a concrete walk, including the detectable surface warning system, will not be measured for payment.

706.05 PAYMENT. Payment for concrete walks, drives and incidental paving will be made on a lot basis at the contract unit price per square yard (sq m), adjusted in accordance with the following provisions. Payment for each lot will be made in accordance with Table 901-6. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
706-01	Concrete Walk (__inch (mm) Thick)	Square Yard (Sq m)
706-02	Concrete Drive (__inch (mm) Thick)	Square Yard (Sq m)
706-03	Incidental Concrete Paving (__inch (mm) Thick)	Square Yard (Sq m)

Section 707
Curbs and Gutters

707.01 DESCRIPTION. This work consists of furnishing and constructing curbs and gutters in accordance with these specifications and in conformity with lines, grades, dimensions and typical sections shown on the plans or established.

707.02 MATERIALS. Materials shall comply with the following Sections and Subsections:

Usable Soil	203.06(a)
Asphaltic Concrete	502
Portland Cement Concrete (Class M)	901
Asphalt Cement	1002
Aggregates	1003
Joint Fillers	1005.01
Joint Sealant	1005.02
Joint Seals	1005.03
Curing Materials	1011.01
Form Release Agent	1018.24

(a) Concrete Curbs and Gutters: When slip-formed methods are used, concrete shall have not more than a 1 1/2 inch (40 mm) slump.

(b) Asphaltic Curbs: Mixtures for these curbs shall be Superpave Asphaltic Concrete (Level A) in accordance with Section 502.

707.03 SUBGRADE. The subgrade shall be shaped and compacted to a firm, even surface. When possible, the subgrade shall be shaped and compacted at the same time and in the same manner as the subgrade for the pavement. Unsuitable material shall be removed and replaced with approved material at no direct pay.

707.04 CONCRETE FORMS. Forms for combination curb and gutter shall conform to Subsections 601.03(c) and 601.05. Forms for other curbs or gutters shall be wood or metal, straight, and of sufficient strength to resist pressure of the concrete without deforming. Forms shall be cleaned and coated with form release agent before concrete is placed against them. Forms

which have become excessively worn, bent or broken shall not be used. An approved mechanical curb forming machine conforming to Subsection 707.06(c) may be used without forms.

707.05 CONCRETE JOINTS. Joints shall be formed in integral curbing to correspond with transverse joints in the pavement slab. Joints shall extend under and through the curb and shall be finished and filled with the specified filler.

Other types of curbing shall be provided with 1/4 inch (6 mm) joints at maximum intervals of 20 feet (6 m) formed by using steel plates 1/4 inch (6 mm) thick, cut to section and set vertically in forms until concrete has set sufficiently to permit removal of plates.

707.06 PLACING CONCRETE.

(a) Integral Types: After concrete pavement has been struck off, curb forms shall be clamped or otherwise securely fastened in place on the slab form. Concrete for curbing shall be placed and thoroughly tamped within 30 minutes after pavement has been finished. Concrete shall be spaded or vibrated sufficiently to eliminate voids and shall be tamped to bring mortar to the surface. The concrete shall be finished smooth and even with a wooden float. Edges shall be rounded with an approved finishing tool to the specified radius. Care shall be taken to secure monolithic construction.

Integral type curb may be placed after completion of pavement, provided reinforcing steel is placed in the pavement of the size, type and spacing shown on the plans at no direct pay.

(b) Non-Integral Types: Concrete shall be placed on the prepared subgrade, struck off and consolidated to required thickness. Concrete shall be spaded or vibrated sufficiently to eliminate voids and shall be tamped to bring mortar to the surface, after which it shall be finished smooth and even with a wooden float. Edges shall be rounded to the specified radius.

(c) Slip-formed Concrete: Slip-formed concrete shall have uniform consistency and shall be placed with an approved extrusion machine designed to spread, consolidate and finish concrete in one pass of the machine such that minimum hand finishing is necessary. Sliding forms shall be rigidly held together to prevent spreading of forms. After the passing of the forms there shall be no noticeable slumping of concrete. Finished concrete shall be free from voids. Any additional finishing required shall be performed immediately after placement.

(d) Tolerances: Grade of combination curb and gutter shall not exceed the theoretical grade and shall not be more than 1/2 inch (13 mm) low.

707.07 FINISHING. Forms shall be removed within 24 hours after concrete has been placed. Honeycombed areas and other minor defects shall be filled with mortar composed of portland cement and sand complying with Subsection 702.02. Plastering will not be permitted on faces of curb or gutter. Rejected curb or gutter shall be removed and replaced. The top and face of curb or gutter shall be finished prior to initial set with a wood float, brush, and water.

707.08 ASPHALTIC CURB. Asphaltic curb shall be placed by an approved extruding machine. Prior to placing curb, the contractor shall apply asphaltic tack coat complying with Section 504.

707.09 CURING CONCRETE CURB OR GUTTERS. After finishing, curb or gutter shall be cured in accordance with Subsection 601.10.

707.10 BACKFILLING. After curb or gutter has set sufficiently, the contractor shall backfill adjacent to curb or gutter with usable soil compacted to the density of surrounding soil.

707.11 MEASUREMENT. Quantities of curbs and/or gutters for payment will be the design lengths as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are made. Excavation, backfill, joint materials, asphaltic tack coat and steel tie bars will not be measured for payment. When combination curb and gutter is specified, gutters required at catch basins will be included in design quantities for combination curb and gutter.

707.12 PAYMENT. Payment for curbs and/or gutters will be made at the contract unit price per linear foot (lin m), subject to the following provisions:

(a) Asphaltic Mixtures: Asphaltic curbs will be subject to the payment adjustment provisions for air voids under of Section 502. Asphalt cement shall comply with the requirements of Section 1002. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphalt cement.

(b) Portland Cement Concrete: The concrete in the curbs and/or gutters will be identified by lots and shall be subject to pay adjustments per linear foot (lin m) in accordance with Table 901-6. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
707-01	Concrete Curb	Linear Foot (Lin m)
707-02	Concrete Gutter	Linear Foot (Lin m)
707-03	Combination Concrete Curb and Gutter	Linear Foot (Lin m)
707-04	Asphaltic Curb	Linear Foot (Lin m)

Section 708
Right-of-Way Monuments

708.01 DESCRIPTION. This work consists of installing contractor furnished right-of-way monuments and right-of-way monument witness posts at various locations in accordance with these specifications, the project right-of-way map, the plan details or as directed.

708.02 MATERIALS.

(a) Right-of-Way Monuments: Right-of-way monuments shall be the type shown on the plans or an approved equal. Substitutions must be approved by the Location and Survey Section Administrator, Baton Rouge, LA.

The steel stakes shall be 3/4 inch x 3/4 inch x 2 feet (19 mm x 19 mm x 0.6 m) with stainless steel identification caps, also furnished by the contractor.

(b) Right-of-Way Monument Witness Posts: Witness posts shall be standard orange color, 6 feet (1.8 m) in length as shown on the plans or an approved equal. Substitutions must be approved by the Location and Survey Section Administrator, Baton Rouge, Louisiana. The standard DOTD decal logo as shown on the plans shall be attached to each post by the supplier.

708.03 GENERAL CONSTRUCTION REQUIREMENTS. Right-of-way monuments shall be positioned and set by, or under the responsible charge of a Louisiana licensed professional land surveyor. A reproducible final plat reflecting the surveyor's location of the monuments in accordance with the right-of-way map shall be prepared on standard size Department plan sheet(s) and submitted to the project engineer for forwarding to the Location and Survey Section Administrator, Baton Rouge, Louisiana. The contractor shall record the final plat in the appropriate parish courthouse(s) and a copy of the filing receipt(s) shall be furnished to the project engineer. A copy of the final plat shall also be furnished to the appropriate parish engineer(s) and Planning Commission(s) if applicable.

708.04 MEASUREMENT. Right-of-way monuments will be measured per each. Right-of-way monument witness posts will be measured per each.

708.05 PAYMENT. Payment for right-of-way monuments and right-of-way monument witness posts will be made at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
708-01	Right-of-Way Monument	Each
708-02	Right-of-Way Monument Witness Post	Each

Section 709
Steel Cattle Guards

709.01 DESCRIPTION. This work consists of constructing, furnishing and installing welded steel cattle guards at the locations shown on the plans and conforming to plan details and these specifications.

Cattle guards of types different from those shown on the plans may be furnished with prior approval.

709.02 MATERIALS. Materials shall comply with the following Sections and Subsections:

Concrete (Class M)	901
Steel Pipe (Wingwalls)	1007.12
Reinforcing Steel	1009.01
Bolts, Nuts and Washers	1010.10
Treated Timber	1014

Steel shall be at least the minimum size specified and fabricated in accordance with Section 815. Pipe wings shall be 2-inch (50 mm) diameter standard strength steel pipe. Steel shall be painted in accordance with Section 811. Galvanized pipe will not require painting. Damaged galvanized steel shall be repaired in accordance with Subsection 811.12.

709.03 CONSTRUCTION REQUIREMENTS. Excavation shall extend a minimum of 12 inches (300 mm) outside neat lines of concrete walls or footings. Backfill shall be deposited in layers not exceeding 6 inches (150 mm) compacted thickness and each layer shall be compacted to the density of adjacent soil with mechanical tampers. When the cattle guard is placed in the roadway, the compaction requirements shall conform to Subsection 203.07.

Concrete and reinforcing steel shall be placed in accordance with Sections 805 and 806.

709.04 MEASUREMENT. Steel cattle guards will be measured as a unit. Excavation, backfill, concrete and reinforcing steel will not be measured for payment.

709.05 PAYMENT. Payment for steel cattle guards will be made at the

contract unit price per each. The concrete placed in cattle guards will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-6 and Note 1 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
709-01	Steel Cattle Guard	Each

Section 710
Flowable Fill

710.01 DESCRIPTION. This work consists of furnishing, placing, and consolidating a controlled low strength flowable fill as an alternative to compacted soil. Applications for this material include, but are not limited to, general backfilling of drainage structures, entrenchments across pavements, encasements, beddings, void filling and other uses as shown on the plans or as approved by the engineer. The flowable fill shall be a cementitious mixture of portland cement, fly ash (depending on application and mix design), fine aggregate, water, entrained air, and appropriate admixtures for the particular application.

710.02 MATERIALS. Materials shall comply with the following Sections and Subsections.

Portland Cement	1001.01
Fine Aggregate	1003.02
Admixtures	1011.02
Water	1018.01
Fly Ash	1018.15

Flowable fill shall be designed and proportioned in accordance with Table 710-1. Trial batching will be required for excavatable and non-excavatable mixes to ensure appropriate job mix consistency and adherence to Table 710-1 properties.

Table 710-1
Flowable Fill Mix Design[1]

Material	Excavatable	Non-Excavatable
Portland Cement	75-100 lb/cu yd (45-60 kg/cu m)	75-150 lb/cu yd (45-90 kg/cu m)
Fly Ash	0-150 lb/cu yd (0-90 kg/cu m)	150-600 lb/cu yd (90-355 kg/cu m)
Water[2]	-	-
Air[3]	10-35%	5-20%
Concrete Sand	Proportioned to yield 1 cu yd (1 cu m)	Proportioned to yield 1 cu yd (1 cu m)
Unit Weight (wet)[3]	90-110 lb/cu ft (1440-1760 kg/cu m)	100-125 lb/cu ft (1600-2000 kg/cu m)
28-Day Compressive Strength[3]	Maximum 100 psi (0.7 MPa)	Minimum 125 psi (0.9 MPa)

[1]Mix designs shall yield 1.0 cubic yard (1.0 cu m) absolute volume.
[2]Mix designs shall produce a consistency that will result in a flowable self-leveling product at the time of placement and conform to the requirements of Subsection 710.02.
[3]The requirements for percent air, compressive strength and unit weight are for laboratory designs only and are not intended for jobsite acceptance requirements.

710.03 CONSTRUCTION REQUIREMENTS. Before placement, temporary enddams or soil berms shall be provided as directed by the engineer to confine the flowable fill. Flowable fill shall be placed to the lines and grades shown on the plans or as directed. Where flotation or misalignment may occur due to hydrostatic pressure, the contractor shall assure correct alignment and placement of the encased structure by using straps, soil anchors, or other approved means of restraint. Flowable fill shall be protected from freezing for 36 hours after placement. Flowable fill shall be placed by chute, pumping or other methods approved by the engineer. Due to flowable fill's liquid condition, hydrostatic pressure on adjacent structures shall be taken into account on deep fills where multiple lifts may be required. While in a liquid state, flowable fill in deep excavations is in a quick condition and shall be protected until hardening occurs. Flowable fill will not require field sampling or testing other than the approved trial batch mix design, unless otherwise directed by the project engineer.

710.04 MEASUREMENT. Flowable fill will be measured by the cubic yard (cu m) by batch tickets as adjusted by the project engineer.

710.05 PAYMENT. Payment for flowable fill will be made at the contract unit price per cubic yard (cu m).

Payment will be made under:

Item No.	Pay Item	Pay Unit
710-01	Flowable Fill	Cubic Yard (Cu m)

Section 711
Riprap

711.01 DESCRIPTION. This work consists of furnishing and placing riprap in accordance with these specifications and in conformity to lines, grades and thickness shown on the plans or as directed.

711.02 MATERIALS. Stone riprap shall be from an approved source listed in QPL 2. Stone riprap shall not disintegrate upon exposure to the elements or be easily broken from handling, and shall be reasonably free from earth and other foreign materials. When tested in accordance with AASHTO T 85, the solid weight of stone shall be at least 155 pounds per cubic foot (2490 kg/cu m) (based on bulk specific gravity). The least dimension of any individual stone shall be at least 1/3 its maximum dimension. Each shipment of stone shall be reasonably well graded within the specified limits.

Recycled concrete may be used as riprap unless otherwise indicated in Heading (a), provided its solid weight is at least 155 pounds per cubic foot (2490 kg/cu m) (based on bulk specific gravity) and it is free of protruding reinforcement.

Stockpiles of recycled concrete shall be source approved prior to use and kept separate from other materials. Stockpiles shall be uniform and free of soil, debris, excessive amounts of asphaltic materials, and foreign matter. Once a stockpile has been approved as an acceptable source of material, no material shall be added without prior approval.

Control of gradation will be by visual inspection at the source, project site or both.

Any difference of opinion between the engineer and contractor will be resolved by checking the gradation of two random truckloads (or equivalent size samples). Equipment, labor and sorting site shall be furnished by the contractor at no direct pay.

(a) Riprap: Riprap shall be reasonably well graded and shall comply with Table 711-1.

Table 711-1
Riprap

Riprap Class [1]	Stone Size lb (kg)	Spherical Diameter, ft (mm) [2]	Percent of Stone Smaller Than
2 lb (1 kg)	10 (4.5) 4 (2) 2 (1) 0.75 (0.30)	0.51 (155) 0.38 (115) 0.30 (90) 0.22 (65)	100 40-100 15-50 0-15
10 lb (5 kg)	50 (23) 20 (9) 10 (5) 5 (2.5)	0.88 (270) 0.65 (200) 0.51 (155) 0.41 (125)	100 50-100 15-50 0-15
30 lb (15 kg)	140 (64) 60 (27) 30 (15) 10 (4.5)	1.24 (375) 0.94 (285) 0.74 (225) 0.51 (155)	100 42-100 15-50 0-15
55 lb (25 kg) [3]	275 (125) 110 (50) 55 (25) 20 (9)	1.50 (460) 1.11 (335) 0.88 (270) 0.63 (190)	100 42-100 15-50 0-15
130 lb (60 kg) [3]	650 (295) 260 (120) 130 (60) 40 (18)	2.00 (610) 1.46 (450) 1.17 (360) 0.79 (240)	100 45-100 15-50 0-15
250 lb (115 kg) [3]	1250 (570) 500 (225) 250 (115) 80 (35)	2.50 (760) 1.83 (560) 1.46 (445) 1.00 (300)	100 45-100 15-50 0-15
440 lb (200 kg) [3]	2200 (1000) 900 (410) 440 (200) 130 (60)	3.00 (915) 2.23 (680) 1.76 (535) 1.17 (360)	100 40-100 14-50 0-15
1000 lb (455 kg) [3]	5000 (2270) 2000 (910) 1000 (455) 300 (135)	4.00 (1205) 2.91 (885) 2.31 (705) 1.55 (470)	100 45-100 10-50 0-15

[1]The stone size used to define the Riprap Class is the minimum median stone size for the stone class. The minimum thickness of a riprap layer shall be no less than the spherical diameter of the maximum stone size in the Riprap Class.
[2]Spherical diameters of riprap classes up to 30 lb (15 kg) are based on a solid weight of 140 lb/cu ft (2240 kg/cu m). Spherical diameters of riprap classes above 30 lb (15 kg) are based on a solid weight of 155 lb/cu ft (2480 kg/cu m).
[3]Recycled portland cement concrete may not be used in these riprap classes.

(b) Geotextile Fabric: Geotextile Fabric shall comply with Section 1019.01.

711.03 CONSTRUCTION REQUIREMENTS.

(a) Riprap: Areas on which riprap is to be placed shall be graded to the required section. Riprap shall be placed on the prepared slope or area in a manner which will produce a reasonably well-graded mass of stone with a minimum practicable percentage of voids. The entire mass of stone will be placed to be in conformance with the lines, grades, and thickness at one operation and to avoid displacing underlying material. Placing of riprap in layers, or dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

When placement in water currents is required, the contractor shall make drift checks and place riprap in such manner as to compensate for drift. The contractor shall furnish necessary facilities and personnel for checking riprap depth and distribution.

(b) Filter Stone: When specified, filter stone shall be placed on the prepared slope or area before placement of riprap. When filter stone is placed under water, free dumping will not be permitted. Underwater placement shall be by controlled methods using bottom dump buckets or wire rope baskets lowered through the water to the point of placement. If placement in strong water currents is required, placement of riprap will follow soon after placement of filter stone. Unless shown otherwise on the plans or directed, filter stone shall be Riprap Class 10 lb (5 kg) or less.

(c) Geotextile Fabric: When specified, geotextile fabric shall be placed on the prepared slope or area in accordance with Subsection 203.11(c) before placement of riprap. Care shall be taken not to damage the geotextile fabric when placing riprap. Placing riprap by rolling riprap down slope, or dropping riprap from extreme heights, or by similar methods likely to damage geotextile fabric, will not be permitted. Damaged geotextile fabric shall be repaired in accordance with Subsection 203.11(c) or replaced as directed.

711.04 MEASUREMENT.

Riprap and filter stone may be measured on either a square yard (sq m), cubic yard (cu m), or weight (mass) basis as specified.

When measured on a square yard (sq m) basis, the quantity measured will be that actually placed to the limiting dimensions shown on the plans or as directed by the engineer.

When measured on a cubic yard (cu m) basis, measurement will be made in vehicles at the point of delivery on the project in accordance with Subsection 109.01.

When measured on a weight (mass) basis the pay unit will be per ton (2000 pounds) [Mg (1000 kg)]. When riprap is delivered by vehicles or railroad cars, measurement will be based on certified weight (mass) tickets furnished by the contractor. When riprap is delivered by barge, measurement will be made by calculation from barge displacement, based on water weighing 62.4 pounds per cubic foot (1000 kg/cu m).

Geotextile fabric will be measured by the square yard (sq m) of covered area in place.

No measurement will be made for excavation or backfilling.

711.05 PAYMENT. Payment for riprap and geotextile fabric will be made at the contract unit prices. Filter stone will be paid for as riprap.

Payment will be made under:

Item No.	Pay Item	Pay Unit
711-01	Riprap (class & thickness)	Square Yard (Sq m)
711-02	Riprap (class)	Cubic Yard (Cu m)
711-03	Riprap (class)	Ton (Mg)
711-04	Geotextile Fabric	Square Yard (Sq m)

Section 712
Revetments

712.01 DESCRIPTION. This work consists of furnishing and constructing revetments for protection of embankment slopes, stream channels, culvert end treatments and other areas. Revetments shall be constructed in accordance with these specifications and in conformity with the details shown on the plans or as directed.

When an item for Flexible Revetments is included in the contract, the contractor has the option of furnishing revetments of either stone, recycled portland cement concrete, wet-batched sacked concrete or dry-batched prepackaged sacked concrete.

When an item for Stone Revetment is included in the contract, the contractor has the option of furnishing revetments of either stone or recycled portland cement concrete.

When an item for Sacked Concrete Revetment is included in the contract, the contractor has the option of furnishing revetments of either wet-batched sacked concrete or dry-batched prepackaged sacked concrete.

The same type revetment shall be used at each location. Revetment, except for cast-in-place revetment, shall be placed on geotextile fabric.

712.02 MATERIALS.

(a) Concrete: Concrete for cast-in-place revetment shall be Class R complying with Section 901.

(b) Geotextile Fabric: Geotextile fabric shall comply with Subsection 1019.01.

(c) Wet-Batched Sacked Concrete: Sacks shall comply with Subsection 1018.20. Concrete shall be Class R concrete complying with Section 901. Concrete shall be wet-batched prior to placement in sacks, and sacked concrete shall be immediately placed in the revetment after batching. Mixing water for concrete shall be added as required to produce a slump of 4 inches to 6 inches (100 mm to 150 mm).

(d) Stone and Recycled Portland Cement Concrete: Stone and recycled portland cement concrete shall comply with Section 711 Riprap Class 30 lb (15 kg).

(e) Dry-Batched Prepackaged Sacked Concrete: Prepackaged concrete shall be an approved product listed in QPL 48 and shall consist of one part cement and a maximum of 5 parts sand by weight (mass) or other

approved mix with the same cement content, and shall be dry mixed until uniform in color.

(1) Cement: Cement shall be in accordance with Subsection 901.08(a).

(2) Aggregate: Aggregates shall comply with the gradation requirements of Subsection 1003.02.

(3) Sacks: Sacks shall comply with Subsection 1018.20 and shall be capable of holding the concrete mixture without leakage during handling.

(4) Water: Water shall be from an approved source in accordance with Subsection 1018.01.

(f) Usable Soil: Usable soil shall be in accordance with Subsection 203.06.

712.03 CONSTRUCTION REQUIREMENTS. Revetments shall be constructed in dry or dewatered areas, unless otherwise directed. Logs, stumps and other undesirable material shall be removed from areas on which revetments are to be placed. Usable soil shall be used to bring areas to grade and shall be compacted to the density of surrounding ground to the engineer's satisfaction before final grading. The revetment areas shall be graded to required sections.

(a) Geotextile Fabric Placement: Ends of geotextile fabric shall be buried for anchorage as shown on the plans. Adjacent strips of geotextile fabric shall be lapped at least 18 inches (450 mm). The laps shall be pinned at maximum 5-foot (1.5 m) intervals. Geotextile fabric shall not be damaged during revetment placement. Damaged fabric shall be repaired in accordance with Subsection 203.11(c) or replaced at no direct pay.

(b) Concrete Cast-in-Place Revetment: Before placement, preformed 1/4 inch (6 mm) thick expansion joint filler complying with Subsection 1005.01(a) shall be placed around piles, columns, etc.

Placement of concrete revetment for slope protection shall commence at the toe of revetment and progress upslope. Revetment for stream channels and other relatively level areas shall be placed as directed.

After placement, the revetment surface shall be cured in accordance with Subsection 601.10.

(c) Wet-Batched Sacked Concrete Placement: Sacks shall be uniformly filled to approximately 3/4 cubic foot (0.02 cu m). The open end shall be folded under the bag during placement. Sacks of wet-batched concrete shall be placed in one layer in contact with adjacent sacks and tamped into position by approved methods. Placement of sacked concrete shall begin at the revetment toe and progress upslope. Sacked concrete

revetment for stream channels and other relatively level areas shall be placed as directed.

(d) Dry-Batched Prepackaged Concrete Placement: Sacks shall be uniformly filled to approximately 3/4 cubic foot (0.02 cu m) and the ends shall be sealed by tying, stitching or other approved methods. The filled sacks shall be tightly packed against each other. Placement shall begin at the revetment toe and progress upslope with staggered joints. At the end of each day's operations and upon completion at a location, the sacks and contents shall be saturated with water as required to produce a slump of 2 to 5 inches (50 to 125 mm). The compressive strength shall comply with Section 901 for Class R concrete. The quantity of water required shall be as directed at no direct pay.

(e) Stone Placement: Toe and end walls shall be constructed by placing stone in the trench lined with geotextile fabric. Placement of stone shall begin at the bottom of the slope in a layer having the specified average thickness. Stone shall be placed by approved methods. A tolerance of 2 inches (50 mm) above or below the specified thickness will be allowed. Openings between stones exposing more than 4 square inches (2500 sq mm) of geotextile fabric will not be permitted.

712.04 MEASUREMENT. Revetments will be measured by the square yard (sq m) of surface area to be revetted as shown on the plans and as directed. Site preparation, geotextile fabric, and expansion joint filler will not be measured for payment.

712.05 PAYMENT. Payment for revetments will be made at the contract unit price which includes furnishing and installing all materials as shown on the plan details and in accordance with this section. Payment for concrete cast-in-place, wet-batched sacked concrete, and dry-batched prepackaged sacked concrete revetment will be made on a lot basis at the contract unit price per square yard (sq m), adjusted in accordance with the following provisions. Payment for each lot will be made in accordance with Table 901-6. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
712-01	Concrete Cast-in-Place Revetment	Square Yard (Sq m)
712-02	Sacked Concrete Revetment	Square Yard (Sq m)
712-03	Stone Revetment	Square Yard (Sq m)
712-04	Flexible Revetment	Square Yard (Sq m)

Section 713
Temporary Traffic Control

713.01 DESCRIPTION. This work consists of furnishing, installing, maintaining, and removing temporary construction barricades, precast concrete barriers, lights, signals, pavement markings and signs; providing flaggers; and complying with all other requirements regarding the protection of the work, workers and safety of the public. Unless otherwise noted in the plans or special provisions this work also includes traffic control management in compliance with the contract documents and the Manual on Uniform Traffic Control Devices (MUTCD), including the installation, inspection, maintenance, and removal of all traffic control devices on the project. Signs, barricades, barriers, channelizing devices, pavement markings, etc., shall comply with plan details, the MUTCD and these specifications.

Signs, barricades, barriers, channelizing devices, pavement markings and arrangements thereof, as shown on the plans, are minimum requirements. Appropriate signs for special conditions shall be furnished and installed as directed. Requirements for proper signs, barricades, barriers, channelizing devices, or other safety precautions promulgated by the contractor's insurers are not negated by these specifications. These specifications shall not be construed to relieve the contractor of responsibilities for the safety of the public, for liability in connection therewith, or compliance with State and local laws or ordinances.

The contractor shall assign one or more authorized Traffic Control Supervisors (TCS) to provide traffic control management for the project. If more than one TCS is assigned, then a weekly schedule identifying who will be in charge of providing traffic control management on a daily basis shall be submitted to the engineer. The TCS shall have a set of all contract documents relating to traffic control or traffic staging and a current copy of the MUTCD and a current copy of Louisiana Work Zone Traffic Control Details readily available at all times.

If the contractor utilizes a subcontractor to provide traffic control management, the subcontractor’s TCS shall meet all the requirements set forth herein.

The contractor may assign one or more Traffic Control Technicians (TCT) to assist the TCS in inspection and maintenance of Traffic Control Devices.

713.02 MATERIALS. Materials for temporary signs, barricades, barriers and related devices shall comply with the following Sections and Subsections:

Portland Cement Concrete	901
Reinforcing Steel	1009
Backing Material	1015.04(b)
Reflective Sheeting	1015.05
Temporary Pavement Markings	1015.08
Raised Pavement Markers & Adhesive	1015.09
Thermoplastic Pavement Markings	1015.10
Traffic Paint	1015.12
Barricade Warning Lights	1018.12

(a) Temporary Pavement Markings: Temporary pavement markings shall be a minimum of 4 inches (100 mm) wide.

(b) Reflective Sheeting: Reflective sheeting requirements for temporary signs, barricades, channelizing devices, drums and cones shall comply with the following:

(1) Temporary Signs and Barricades: On the mainline of freeways and expressways, the initial advanced warning construction sign shall be fabricated using ASTM D 4956 Type X (Fluorescent Orange) reflective sheeting. Reflective sheeting for all other temporary signs and barricades shall comply with the requirements of ASTM D 4956, Type III.

(2) Vertical Panels: Reflective sheeting for vertical panels used to channelize or divide traffic shall meet the requirements of ASTM D 4956, Type III.

(3) Drums: Reflective sheeting for drums shall be a minimum of 6 inches (150 mm) wide and shall meet the requirements of ASTM D 4956, Type III, and the Supplementary Requirement S2 for Reboundable Sheeting as specified in Subsection 1015.05.

(4) Cone Collars: Reflective sheeting for traffic cone collars shall meet the requirements of ASTM D 4956, Type VI.

713.03 FABRICATION. Fabrication of temporary signs, barricades and related devices shall conform to Subsection 729.04. Fabrication of precast concrete barriers shall conform to Section 805.

713.04 TEMPORARY SIGNS AND BARRICADES.

(a) General: Temporary signs, barricades and related devices will be required when the contractor's work is in progress on portions of the work covered by the Notice to Proceed or when operations are suspended. During such times that temporary signs, barricades and related devices are not in place, appropriate existing regulatory signs shall be maintained by the contractor.

Construction work shall not begin until signs, barricades and other traffic control devices have been erected and approved.

When signs to be furnished and erected by the contractor are in place and approved, the contractor's Traffic Control Supervisor (TCS) shall remove or cover any standard signs that are in conflict with temporary signs.

When placing signs, the contractor shall coordinate with the engineer in removing Departmental signs, so that appropriate signs are in place at all times.

Signing shall remain in place and be maintained by the contractor, supplemented by additional signs as required, throughout the period of work. When previously used signs are to be erected on a project, the engineer will inspect and approve these signs before erection. The engineer will require any sign with reduced reflectivity or excessive color fading to be removed from the work zone. In case of a dispute over a rejected used sign, the Department at its discretion, may take such measurements or review reflectivity and color data obtained by the contractor to determine if the sign meets minimum standards for new materials. Signs that do not meet the minimum standards for new materials shall be replaced by the contractor at no direct pay.

Rejected signs will be marked "NOT FOR USE ON STATE PROJECTS" on the back of the sign.

Signs placed by the contractor shall be removed according to the Traffic Control Plan. It will be the responsibility of the Department to see that all permanent highway signs are in place upon completion and acceptance of the project.

On projects where the surface course is constructed with asphaltic concrete or portland cement concrete, permanent striping and raised pavement markers (when required) shall be completed prior to removal of barricades.

Signs, barricades and related devices furnished and placed by the contractor shall, upon removal, remain the contractor's property.

(b) Advance Warning Area: When specified, advance warning arrow panels for temporary traffic control shall be provided at locations shown on the plans or as directed. Panels shall be one of the specified types

complying with the Department's MUTCD. If no type is specified, Type C panels shall be furnished.

(c) Construction Zone: In areas of the construction zone all traffic control devices used shall be in accordance with Temporary Traffic Control Standard Detail TC-00.

713.05 TEMPORARY PRECAST CONCRETE BARRIERS. Barrier units will be furnished by the contractor unless specified otherwise. Each barrier unit shall be 15-feet (4.6 m) in length.

When the barrier units are furnished by the Department the units will be furnished at no cost to the contractor. The contractor shall load the barrier units at the location specified, deliver the units to the construction site and place them as required.

The contractor shall relocate barrier units as required during construction.

Connecting pins and plastic reflectors shall be furnished by the contractor at no additional cost to the Department. Reflectors shall have 7.0 square inches (4,500 sq mm) minimum reflective area, and be installed a maximum of 15 feet (4.6 m) apart (each side) in accordance with the manufacturer's recommendations. Damaged pins or reflectors shall be replaced as directed by the engineer.

After completion of the work, barrier units shall become the property of the Department and shall be removed and transported by the contractor to the location specified and unloaded as directed. All costs of loading, transporting and unloading the barrier units shall be included in the price bid on this item.

Barrier units damaged shall be satisfactorily repaired or replaced at no direct pay.

713.06 PAVEMENT MARKINGS. Color, width and type of temporary pavement markings shall be in accordance with Table 713-1 and the MUTCD. Temporary pavement markings shall be in place at the end of each day's operation.

Temporary striping tape shall be applied by approved methods to the satisfaction of the engineer. Thermoplastic Pavement Markings shall be applied in accordance with Subsection 732.03. Painted Traffic Striping shall be applied in accordance with Section 737.

Table 713-1
Temporary Pavement Markings[1,2]

		Two-lane Highways	Undivided Multilane Highways	Divided Multilane Highways
SHORT TERM	ADT<1500; or ADT>1500 and time<3 days	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers; with "Do Not Pass" and "Pass With Care" signs as required		
	ADT>1500; Time>3 days and<2 weeks	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers with no passing zone markings		
	All ADT's with time <2 weeks		Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers; double yellow centerline	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers
	All ADT's with time >2 weeks	Standard lane lines, no-passing zone markings, legends and symbols and when pavement width is 22 feet (6.7 m) or greater, edge lines	Standard lane lines, centerlines, edge lines, and legends and symbols	Standard lane lines, centerlines, edge lines, and legends and symbols.

[1]No-passing zones shall be delineated as indicated whenever a project is open to traffic.
[2]On all Asphaltic Surface Treatments that are open to traffic and used as a final wearing course or as an interlayer, temporary pavement markings (tabs) on 20-foot (6 m) centers shall be used, in lieu of the 4-foot (1.2 m) tape, on 40-foot (12 m) centers.

(a) Short-term Pavement Markings: Short-term pavement markings will be required on any pavement surface under traffic.

Centerlines on two-lane highways and lane lines on multilane highways shall be temporary striping tape a minimum of 4 feet (1.2 m) long on a maximum of 40-foot (12 m) centers. When short-term pavement markings require no-passing zone markings or double yellow centerlines on undivided multilane highways, they shall be any of the temporary pavement markings listed in Subsection 713.02.

Removal of short-term pavement markings will only be required on the final surface.

(b) Long-term Pavement Markings: Long-term pavement markings will be required on any surface which is not covered by an additional surface

in 2 weeks or less. Long-term pavement markings shall include, but are not limited to, standard lane and centerline markings (i.e., 10-foot (3 m) stripes on a maximum of 40-foot (12 m) centers), edgelines, no passing zone markings on 2-lane highways, stop bars, and legend and symbol markings as shown on the permanent pavement marking details. Layout work for exact location of markings will only be required on the final surface.

These markings shall consist of any of the pavement markings listed in Subsection 713.02.

Long-term markings do not include the installation of raised pavement markings.

(c) Final Surface: On the final surface (portland cement concrete pavement or asphaltic concrete pavement), temporary markings shall be placed with sufficient accuracy to avoid conflict with permanent striping where possible. Temporary pavement markings on the final surface shall be any of the pavement markings listed in Subsection 713.02.

Placing permanent markings over traffic paint will be acceptable on final surfaces provided the temporary markings have been placed in the final configuration (proper final layout) and the painted lines are not flaking or showing signs of deterioration.

The removal of temporary pavement markings, if required, shall be in accordance with the requirements for the type of permanent marking being used. There shall be no objectionable staining of pavement surface as a result of the removal procedure.

(d) Temporary Reflectorized Raised Pavement Markings: When required, temporary reflectorized raised pavement markings shall be installed in accordance with Section 731.

(e) Pavement Markings for Asphaltic Surface Treatment: The type of markings shall be in accordance with Table 713-1. Short-term temporary pavement markings shall be in place at the end of each day's operation. Long-term temporary pavement markings shall be in place as soon as practical after expiration of the 4 day maintenance period following the asphaltic surface treatment operation. On the final wearing course, permanent markings shall be placed two weeks following completion of the long-term temporary pavement markings.

When used on the final wearing course, painted traffic striping shall be in accordance with Section 737.

Centerlines on two-lane highways and lane lines on multilane highways shall be temporary raised markers in accordance with Subsection 1015.08(c). "No-passing zone" markings shall be any of the temporary pavement markings listed in Subsection 713.02.

The temporary raised pavement markers shall be installed in accordance with the manufacturers' recommendations or as directed by the engineer. The temporary raised markers shall be flexible reflective tabs placed at 20-foot (6 m) intervals on the centerline of the roadway. The markers shall be installed so that the reflective faces of the markers are perpendicular to a line parallel to the roadway centerline.

If directed by the engineer, the temporary raised pavement markers shall be removed after permanent striping has been accomplished. Damage to the pavement surface shall be repaired at no direct pay.

713.07 PORTABLE WORK ZONE TRAFFIC CONTROL DEVICES.

All Category I, II, and III portable work zone traffic control devices, as described below, shall be crashworthy as determined by evaluations through the National Cooperative Highway Research Program (NCHRP) 350 for Test Level 3 (TL-3).

(a) Category I Devices: Category I devices are low-mass, single-piece traffic cones, tubular markers, single-piece drums and flexible delineators and are, by definition, considered crashworthy devices meeting NCHRP Report 350 TL-3 criteria. Drum and light combinations with Type A or C warning lights and fastener hardware consisting of vandal resistant 1/2 inch (13 mm) diameter cadmium plated steel bolts and nuts used with 1 1/2 inch (38 mm) diameter by 3/4 inch (19 mm) cup washers are included as Category I devices. In lieu of testing for crashworthiness, acceptance of Category I devices for compliance with NCHRP 350 will be allowed based on self-certification by the supplier. The supplier shall certify that the product is crashworthy in accordance with the evaluation criteria of NCHRP 350. This certification may be a one-page affidavit signed by the supplier, with supporting documentation kept on file to be furnished if requested.

(b) Category II Devices: Category II devices include other low mass traffic control devices such as portable barricades either with or without lights and or signs, portable sign stands, portable vertical panel assemblies, and drums with lights not meeting the drum and light combination requirements for Category I. Individual crash testing is required for Category II devices. FHWA letters of approval shall serve as verification that these devices comply with the crash testing requirements of NCHRP Report 350 TL-3. The contractor shall provide the engineer a listing of all the Category II devices to be used on the project prior to installation including a reference to the FHWA Work Zone letter number for each device. The contractor shall also certify that each device has been crash tested and meets the NCHRP 350 requirements.

(c) Category III Devices: Category III devices include massive devices such as concrete barriers, water filled barriers and portable attenuators. Individual crash testing is required for Category III devices. FHWA letters of approval shall serve as verification that these devices comply with the crash testing requirements of NCHRP Report 350 TL-3. The contractor shall provide the engineer a listing of all the Category III devices to be used on the project prior to installation including a reference to the FHWA Work Zone letter number for each device. The contractor shall also certify that each device has been crash tested and meets the NCHRP 350 requirements.

713.08 TRAFFIC CONTROL MANAGEMENT.

(a) Authorization: Prior to commencing work requiring traffic control management, the contractor shall submit to the engineer proof of the Traffic Control Supervisor's (TCS) and Traffic Control Technician's (TCT) current authorizations.

The Department will accept the TCS authorization of other approved agencies or firms only if all of the following minimum TCS requirements are met:

(1) Successful completion of a work zone traffic control supervisor course approved by the Department.

(2) Passing a written examination on the work zone traffic control supervisor course.

(3) A minimum of one year full-time field experience, verified by the agency or firm, in work zone traffic control. This experience may be verified by the Department at its discretion.

The Department will accept the TCT authorization of other approved agencies or firms only if all of the following minimum requirements are met.

(1) Successful completion of a work zone traffic control technician course approved by the Department.

(2) Passing a written examination on the work zone traffic control technician course.

(b) Traffic Control Supervisor (TCS) Duties: The TCS's responsibility shall be traffic control management, and the TCS shall be available to the engineer to address traffic control management issues as needed. The following is a listing of the TCS's primary duties:

(1) The TCS shall personally provide traffic control management and supervision services at the project site. The TCS may have other assigned duties, but shall be readily available at all times to perform TCS duties as required in the contract. A minimum of one TCT shall be required on site

during working hours.

(2) The TCS shall be responsible for observing and evaluating both the day and night time performance of all traffic control devices installed on the project, in accordance with the Traffic Control Plan (TCP), to ensure that the devices are performing effectively as planned for both safety and traffic operations. This shall be done upon the initial installation of the devices and when any modifications and/or changes are made, in addition to the inspection of traffic control required in Heading (e).

(3) The TCS shall be responsible for revisions requested by the contractor to the traffic control plan established in the contract and shall submit the new traffic control plan in accordance with Heading (c).

(4) The TCS shall be responsible for the training of flagging personnel. This training will ensure that all flagging done on the project is in compliance with the MUTCD Part VI and Louisiana Work Zone Traffic Control Details.

(5) The TCS shall coordinate all traffic control operations for the duration of the contract, including those of subcontractors, utility companies, and suppliers, to ensure that all traffic control is in place and fully operational prior to the commencement of any work. The Department recognizes that the contractor does not have direct control over the traffic control operations of the utility companies. The coordination provided by the TCS when dealing with utility companies is specifically for the purpose of coordinating concurrent utility traffic control with any other construction traffic control to avoid conflicts.

(6) The TCS shall coordinate, in writing, all project activities with the appropriate law enforcement, fire control agencies, and other appropriate public agencies as determined at the pre-construction conference by the engineer. The TCS shall also invite the above agencies to the pre-construction conference.

(7) The TCS shall prepare and submit statements concerning road closures, delays, and other project activities to the news media on a weekly basis or more often as needed. News releases shall be submitted to the engineer for review and approval prior to the contractor's submittal to the news media.

(8) The TCS shall be responsible for notifying the engineer, or designee, immediately of all vehicular accidents and/or incidents related to the project traffic control. The time and date of notification shall be documented in the traffic control diary. The TCS shall also monitor and document queues that occur as necessary.

(9) The TCS assigned to the project shall attend the pre-construction

conference and all project meetings.

(10) The TCS shall be responsible for the maintenance, cleanliness, replacement and removal of traffic control devices of the existing traffic control plan during working and non-working hours.

(c) Traffic Control Plan Revisions: Requests for revision in the traffic control plan must be made in writing to the engineer a minimum of 14 calendar days in advance of the needed revision. If the requested revision falls within the scope of the existing contract drawings, the engineer may approve the revision. If the engineer determines that the requested revision is outside the scope of the contract drawings, the contractor will be required to submit a change order. The change order drawings shall conform to the following:

(1) Letter size original contract drawings --The change order drawings shall be submitted on high quality white 8 1/2 x 11 inch letter size paper. The drawings may be hand drafted or computer drafted and arranged in landscape format on the page. The text and drawings must be legible after reproduction on standard reproduction equipment. Left, bottom and right hand margins shall be at least 1/2 inch and the top margin shall be 1 inch.

(2) Full size original contract drawings -- The change order drawings shall be submitted on high-quality, 4-mil, double-matte film using a plotting or reproduction process that fuses the graphics to ensure durability. Repeated handling and friction due to stacking of plans shall not smear, flake or rub off the graphics. Improper plotter settings and plotter wear may cause inconsistent durability of the drawings. The contractor shall test samples of the submitted drawings for durability. Advance samples of matte films may be submitted for approval; however, the contract plans will be tested separately. Failures will result in rejection of the submittal. Drawing sizes shall be in accordance with Subsection 801.03(a).

Lettering on change order drawings shall be of adequate size to facilitate a 50 percent reduction of plans. Additions or changes shall be made with a permanent type of waterproof ink made for this purpose. If revised cross sections are required, the cross-sections shall be plotted on standard plate cross-section sheets. The ground line, centerline elevation, and station numbers, as a minimum, shall be drawn in ink; the remaining information may be in pencil.

Regardless of size, all change order drawings and documents required shall be identified with the DOTD project title and project number. All plans and calculations shall be signed and sealed by a professional civil engineer currently registered to practice in Louisiana.

All plans submitted by the contractor shall conform to these specifications

and standards. The DOTD Chief Engineer may reject any plans not conforming to these standards.

Revisions to the TCP that are determined to be outside the scope of the original contract drawings must be approved by the DOTD District Traffic Engineering Division prior to implementation of the requested revision. In some cases on high traffic routes or high priority projects, the revisions must be approved by the HQ Traffic Operations Engineer.

(d) Traffic Control Diary: The TCS shall maintain a project traffic control diary in a bound book. The contractor shall obtain a sufficient number of the diaries from the Louisiana Associated General Contractors (LAGC). The TCS shall keep the traffic control diary current on a daily basis, and shall sign each daily entry. Entries shall be made in ink in a standard format furnished by the engineer, and there shall be no erasures or white-outs. Incorrect entries shall be struck out and then replaced with the correct entry. Photographs and videotapes may be used to supplement the written text.

The traffic control diary shall be available at all times for inspection by the engineer; and the diary shall be reviewed with the engineer on a weekly basis and a copy submitted to the engineer on a monthly basis. Failure to submit the monthly copy of the diary to the engineer shall result in the withholding of the next partial payment until the past due copies of the diary are submitted. The traffic control diary shall become the property of the Department at the completion of the project.

(e) Inspection of Traffic Control: The TCS shall be responsible for the inspection of all traffic control devices every calendar day that traffic control devices are in use. This inspection may be delegated to the TCT. The "Quality Guidelines for Work Zone Traffic Control Devices" standard by the American Traffic Safety Services Association (ATSSA) shall be used to evaluate the condition of the traffic control devices to determine if acceptable for use. The TCS shall provide for the immediate repair, cleaning, or replacement of any traffic control devices not functioning as required to ensure the safety of the motorist and construction personnel and/or not meeting the ATSSA standard.

Inspection of the traffic control devices shall be conducted by the TCS at the beginning and end of each workday, and as scheduled or directed by the engineer during the workday. The traffic control devices shall be inspected by the TCS on weekends, holidays, or other non-work days at least once per day. Traffic control devices shall be inspected by the TCS at least once a week during nighttime periods and the same night after any modifications or changes have been made in the traffic control devices.

(f) Failure to Comply: The engineer may suspend all or part of the

contractor's operation(s) for failure to comply with the approved "Traffic Control Plan" or failure to correct unsafe traffic conditions within a reasonable period of time after such notification is given to the contractor in writing.

In the event that the contractor does not take appropriate action to bring the deficient traffic control into compliance with the approved traffic control plan or to correct the unsafe traffic conditions, the Department may proceed with the corrective action using its own forces, and such costs will be deducted from payments owed to the contractor.

If the contractor's operations are suspended, the normal assessment of contract time will not cease for the period required to correct these unsafe conditions and traffic control deficiencies. The contractor shall not be relieved of the responsibility to provide traffic control safety to the traveling public when a project is under full or partial project suspension. When a project is under suspension due to the contractor's failure to comply with this section, or when the contract is under stipulated damages, the contractor shall continue to provide traffic control management and no additional measurement or payment will be made. If suspensions or partial suspensions are requested by the contractor, the additional traffic control management costs will be at the contractor's expense.

(g) Engineer Modifications: The provisions included in the plans and specifications for handling and controlling traffic during construction may be changed by the engineer, with the approval of the DOTD District Traffic Operations Engineer, due to actual field conditions encountered. Such changes will be made by written instruction to the contractor and shall be considered an amendment to the plans and specifications as of the date of change.

713.09 MEASUREMENT.

(a) Temporary Signs and Barricades: When the contract does not include a pay item for "Temporary Signs and Barricades," the providing of temporary construction signs, barricades and related devices will not be measured for payment. When a pay item for "Temporary Signs and Barricades" is included in the contract, the furnishing, erecting, maintaining and subsequent removing of temporary construction signs, barricades and related devices will be measured on a lump sum basis.

Advance warning arrow panels will not be measured for separate payment, but will be included in the contract lump sum price for Temporary Signs and Barricades.

(b) Temporary Pavement Markings: When the contract does not include an item for "Temporary Pavement Markings," provision of these markings will not be measured for payment.

When the contract includes an item for "Temporary Pavement Markings", these markings acceptably furnished, placed, maintained and subsequently removed will be measured by the linear foot (lin m), or by the mile (km) as specified.

When measurement is made by the linear foot (lin m) of striping, measurement will be made for the material placed. Gaps will be excluded.

When measurement is made by the mile (km) of single strip per roadway per application, no deduction will be made for the standard design gaps in broken line striping; however, deductions will be made for the length of other gaps or omitted sections.

Temporary pavement legends and symbols will be measured per each legend or symbol.

Temporary reflectorized raised pavement markers will be measured by counting the number of markers furnished, placed and accepted. Removal of raised pavement markers will not be measured for payment.

(c) Temporary Precast Concrete Barriers: When the contract does not include a pay item for Temporary Precast Concrete Barriers, the provision of these barriers will not be measured for payment. When the contract includes a pay item for Temporary Precast Concrete Barriers, the barriers will be measured per each unit installed, which includes construction, delivery, placement and removal from the job site one time. Further movements of barriers for subsequent construction phases will be measured per movement of each barrier.

(d) Traffic Control Management: Traffic control management will not be measured for payment.

713.10 PAYMENT. Payment for temporary construction signs, barricades and related devices will be at the contract lump sum price in accordance with the payment schedule of Table 713-2.

Table 713-2
Payment Schedule
Temporary Signs, Barricades and Related Devices

Percent of Total Contract Amount Earned	Allowable Percent of Lump Sum Price for Temporary Signs and Barricades
Initial Erection	40
25	60
50	80
75	95
100	100

Payment for temporary pavement markings will be made at the respective contract unit prices. Payment for temporary precast concrete barriers will be made at the contract unit price per each. The concrete in temporary precast barriers furnished by the contractor will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-5 and Note 1 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment for movement of temporary concrete barriers will be made per movement of each barrier.

Payment will be made under:

Item No.	Pay Item	Pay Unit
713-01	Temporary Signs and Barricades	Lump Sum
713-02	Temporary Pavement Markings (__inch (__mm) Width)	Linear Foot (Lin m)
713-03	Temporary Pavement Markings (Broken Line)(__inch (__mm) Width) (__foot (__m) Length)	Mile (km)
713-04	Temporary Pavement Markings (Solid Line) (__inch (__mm) Width)	Mile (km)
713-05	Temporary Pavement Legends and Symbols (Type)	Each
713-06	Temporary Reflectorized Raised Pavement Markers	Each
713-07	Temporary Precast Concrete Barrier (Contractor Furnished)	Each
713-08	Temporary Precast Concrete Barrier (Department Furnished)	Each
713-09	Temporary Portable Barrier (Type)	Each
713-10	Temporary Precast Concrete Barrier Movement	Each

Section 714
Sodding

714.01 DESCRIPTION. This work consists of furnishing, hauling, planting, rolling, watering and maintaining live grass sod at locations shown on the plans or as directed.

714.02 MATERIALS. Approved sod shall be either field grown grass or nursery grown grass delivered in rolls or slabs.

Field grown grass sod shall be Bermuda grass, carpet grass, or other approved grass native to the sodded area.

Nursery grown grass sod shall be Centipede, Tiffway Bermuda, Nomow Bermuda, Common Bermuda or St. Augustine grass.

Fertilizer shall comply with Subsection 1018.16 and agricultural lime shall comply with Subsection 1018.17.

Sod shall be free from noxious weeds or other vegetation.

Water may be obtained from any source. Brackish, chemically contaminated, or oily water shall not be used.

714.03 GENERAL CONSTRUCTION REQUIREMENTS. Sod shall be cut with approved sod cutters. The designated area shall be mowed when necessary. Sod shall be cut to a minimum soil depth of 1 1/2 inches (40 mm) for field grown grass and 1 inch (25 mm) for nursery grown grass, and to a uniform width and in convenient lengths for handling. Soil shall be retained on roots of sod during excavating, hauling and planting. Only common Bermuda sod shall be used within 30 feet (9 m) of the outer edges of paved shoulders.

Sod cut more than 48 hours before placing shall not be used unless authorized. Sod taken from areas that may produce inferior growth will not be accepted.

Watering required in connection with digging, storing or hauling sod will be at no direct pay.

714.04 HANDLING SOD. Slab sod shall be placed flat, grass side up on pallets containing no more than 50 square yards (42 sq m) of slab sod and hauled, covered, to the planting site with soil intact. Pallets shall be off-loaded and placed as close as practical to the planting site. Rolls of sod shall contain no more than 225 square feet (21 sq m) per roll and shall be covered

and hauled to the planting site with soil intact. Rolls shall be off-loaded and placed as close as practical to the planting site.

714.05 PLANTING. Areas to receive sod shall be pulverized to a depth of at least 3 inches (75 mm), graded and cleared of weeds, grass, stones and other debris. If an item for agricultural lime is included in the contract, liming shall be done when the area is being pulverized. When an item for fertilizer is included in the contract, approximately 90 percent shall be broadcast over the area to receive sod, and the remaining 10 percent shall be broadcast over sod after placing and rolling. Upon delivery to the planting site, sod shall be transferred onto the surface soil. Areas to be sodded shall be watered as directed. Sod shall be placed with no space between edges. Slab and roll edges shall be staggered to avoid a continuous seam along the line of flow. Along the edges of such staggered areas, the offsets of individual strips shall not exceed 6 inches (150 mm). Slab edges which do not fit closely shall be pulled together by hand without stretching or tearing and pegged when necessary. When directed, sod surface will be top dressed with sand to smooth-out uneven spots.

714.06 ROLLING. Sod shall be rolled after planting with smooth drum steel wheel rollers or cultipackers. Where rolling is impractical, sod shall be tamped by approved hand methods.

714.07 WATERING. Water shall be the responsibility of the contractor unless otherwise noted. The contractor shall keep all sodded areas thoroughly watered for 30 calendar days after installation. Watering required by the engineer after 30 calendar days will be at no direct pay. Water shall not contain elements toxic to the plant life. Watering shall be started immediately after completing each day of installing sod. Water shall be applied at least 3 times per week to supplement rainfall, at a rate sufficient to ensure moist soil conditions to a minimum depth of 2 inches (50 mm). Watering trucks shall not be driven over newly installed turf areas.

714.08 PERIOD OF ESTABLISHMENT - SODDING. The sod establishment period to obtain a healthy stand of grass plants shall begin on the first day that sod is placed under the contract and shall end 60 calendar days after the last day of the sodding operation. A written calendar time period shall be furnished for the sod establishment period. When there is more than one sod establishment period, the boundaries of the sodded area covered for each period shall be described. The sod establishment period

shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

If an application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted to the engineer for approval by the District Roadside Development Coordinator. The contractor will be responsible for the application of any EPA approved chemicals.

714.09 SATISFACTORY STAND OF GRASS PLANTS: Grass plants shall be evaluated for species and health. All sod must be moist and growing at the time of acceptance. A satisfactory stand of grass plants from the sodding operation shall be living sod, uniform in color and leaf texture. Bare spots shall be a maximum of 2 inches (50 mm) square. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.

Unsatisfactory areas of sod shall be repaired or reinstalled, and eroded areas shall be repaired. If, at the end of the establishment period, the growth or stand of the sod is unacceptable, the sod will be rejected.

714.10 MEASUREMENT. Sodding: Sodding will be measured by the square yard (sq m) along the surface of completed sodding.

714.11 PAYMENT. Payment for sodding will be made at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
714-01	Sodding	Square Yard (Sq m)

Section 715
Topsoil

715.01 DESCRIPTION. This work consists of furnishing and placing topsoil on areas designated on the plans or as directed.

The contractor shall obtain the services of an established soil testing entity to coordinate soil sampling, perform testing and analyses, and prepare recommendations for materials and procedures to be used during the preplanting phase. When practicable, soil testing shall be performed early enough to permit agricultural lime or other additives (if required) to be applied sufficiently in advance of planting so that the soil pH adjustment will occur before planting. Samples shall be tested and analyzed to determine pH and fertility conditions. The test results and recommendations shall be used to determine the quantities of agricultural lime and fertilizer required for preplanting applications. A copy of the test report with recommendations shall be furnished to the engineer. Testing will be at no direct pay. Agricultural lime recommendations shall consider probable time of application.

715.02 MATERIALS.

(a) Topsoil: When available, the topsoil shall be the existing surface soil stripped and stockpiled. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by soil tests. Soil tests shall be provided prior to delivery of topsoil to the site. The tests shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested for particle size, pH, organic content, textural class, chemical composition and soluble salts. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over 1 1/2 inches diameter. Topsoil shall be free from viable plants and plant parts. Topsoil shall also be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. Topsoil shall have a minimum PI of 4, a maximum PI of 12, a pH of 5.5-8.0, a minimum organic content of 2 percent, and shall be capable of supporting adequate vegetation.

(b) Soil Amendments. Soil amendments to be blended with the topsoil shall be delivered to the site either in the original, unopened

containers bearing the manufacturer's chemical analysis, or in bulk. A chemical analysis shall be provided for bulk deliveries.

Existing topsoil meeting the above requirements within construction limits may be used in accordance with Subsection 106.02. If agricultural lime or organic matter is added to a soil to bring topsoil into conformance with these specifications, it shall be at no direct pay.

715.03 CONSTRUCTION REQUIREMENTS. Areas to receive topsoil shall be scarified as directed. Topsoil shall be uniformly spread over the areas to a depth of 6 inches (150 mm) and rolled to a uniform surface with a cultipacker or other suitable equipment.

715.04 MEASUREMENT. Topsoil will be measured by the cubic yard (cu m) in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01, which includes testing and the test report.

Preparation of the areas to receive topsoil will not be measured for payment. Agricultural lime treatment of areas to receive topsoil will be measured in accordance with Subsection 718.04.

715.05 PAYMENT. Payment for topsoil will be made at the contract unit price, which includes testing and test reports.

Payment will be made under:

Item No.	Pay Item	Pay Unit
715-01	Topsoil	Cubic Yard (Cu m)

Section 716
Vegetative and Fiber Mulch

716.01 DESCRIPTION. This work consists of furnishing and placing an approved vegetative or fiber mulch with a tacking agent on seeded areas to promote seed germination and growth, while temporarily protecting the soil from erosion.

716.02 MATERIALS. Mulching materials and tacking agents shall comply with Subsection 1018.19. The contractor shall notify the engineer at least 7 calendar days in advance of commencing operations so that the mulch can be inspected and approved prior to use.

Vegetative and fiber mulch shall be delivered in bales or bags of uniform size. Storage of mulching materials shall be in accordance with Subsection 106.09. Mulch stockpiles shall be protected from the weather.

716.03 GENERAL CONSTRUCTION REQUIREMENTS. Mulching shall follow seeding operations within 48 hours. Mulch shall not be sprayed on structures. All stains resulting from the mulch or the tacking agent shall be removed, and the surface left in acceptable condition. During windy conditions the contractor shall make adjustments in operations to ensure uniform spreading.

Damage to seeded areas shall be repaired and re-seeded at no direct pay.

(a) Tacked Vegetative Mulch: Vegetative mulch shall be distributed uniformly over the seeded area by blowing it simultaneously with an approved tacking agent. Jet nozzles in the muzzle of the blower shall be spaced to provide a uniform coating of the mulch as it is blown through the nozzles.

The tacked vegetative mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and reduce the impact of rainfall on the soil surface. Mulching shall begin at the top of the slopes and extend downward. Blower pipe extensions shall be used where slopes cannot be reached by the blower.

(b) Fiber Mulch: The application equipment shall have a built in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix the fiber mulch, water and any tacking agent that is part of the fiber mulch system. The fibers shall be kept in uniform suspension throughout the mixing and distribution cycles. The slurry distribution lines

shall be large enough to prevent stoppage. Hydraulic spray nozzles in the discharge line shall provide uniform distribution of the slurry.

716.04 SPREADING RATES.

(a) Tacked Vegetative Mulch: Vegetative mulch shall be applied at a rate of 1 1/2 to 2 tons of mulch per acre (3.4 to 4.5 Mg/ha) simultaneously with the tacking agent. Final application rates for the tacking agent shall be in accordance with the application rate shown in QPL 72 for the particular type of vegetative mulch being used.

(b) Fiber Mulch: Fiber mulch shall be applied as a slurry at a rate of 1 to 1 1/2 tons per acre (2.3 to 3.4 Mg/ha) based on dry weight (mass) of the fibers. The application rate of the tacking agent, if not pre-blended with the fibers by the manufacturer, shall be in accordance with the application rate shown in QPL 72 for the particular type of fiber being used.

716.05 MANUAL SPREADING. In order to prevent defacing structures, mulch shall be manually spread around structures. When manual spreading is performed, mulch shall be placed in a shredded condition, after which the tacking agent shall be sprayed over the mulch at the specified rate.

716.06 MEASUREMENT. Vegetative mulch and fiber mulch products will be measured for payment by the ton (kg) of mulch material used. The weight (mass) of vegetative mulch to be used in determining spread rates of mulch and tacking agents will be the product of the number of bales or bags used and the average weight (mass) per bale or bag as determined on scales provided by the contractor which have been certified by a qualified independent scale service or the Weights and Measures Division, Louisiana Department of Agriculture and Forestry.

Quantities of tacking agents used with vegetative mulch will be measured by the pound (kg) and be determined by marked container count.

Tacking agents used with fiber mulch are considered part of the system and shall be included in the unit cost for the system.

716.07 PAYMENT. Payment for vegetative mulch and fiber mulch products will be made at the contract unit prices per ton (kg) and includes all materials including tacking agents, labor, equipment and other incidentals necessary to complete the work.

Payment will be made under:

Item No.	Pay Item	Pay Unit
716-01	Mulch	Ton (kg)

Section 717
Seeding

717.01 DESCRIPTION. This work consists of preparing seed beds and furnishing and sowing grass seed on the areas designated on the plans or as directed. Unless otherwise specified, seed shall be applied either mechanically in a dry condition under this section or with hydro-seeding equipment in accordance with Section 739.

The contractor shall obtain the services of an established soil testing entity to coordinate soil sampling, perform testing and analyses, and prepare recommendations for materials and procedures to be used during the preplanting phase of new turf establishment. When practicable, soil testing shall be performed early enough to permit agricultural lime or other additives (if required) to be applied sufficiently in advance of planting so that the soil pH adjustment will occur before planting. Samples shall be tested and analyzed to determine pH and fertility conditions. The test results and recommendations shall be used to determine the quantities of agricultural lime and fertilizer required for preplanting applications. A copy of the test report with recommendations shall be furnished to the engineer. Testing will be at no direct pay. Agricultural lime recommendations shall consider probable time of application.

717.02 MATERIALS. Materials for seeding shall comply with the following Sections and Subsections:

Topsoil	715
Fertilizer	1018.16
Agricultural Lime	1018.17
Seed	1018.18

Water may be obtained from any source, except that brackish, chemically contaminated, or oily water shall not be used.

717.03 SOIL AREAS. Seed shall be selected on the basis of five general soil areas as follows:

(1) Alluvial soils of Mississippi and Red River bottoms.

(2) Mississippi terraces and loessial hill soils.

(3) Coastal plain soils (rolling, hilly and flatwoods areas in central, northern and eastern part of the State).

(4) Coastal prairie soils.

(5) Ouachita River bottom.

717.04 PREPARATION OF SEED BED. Seed beds shall be prepared by disking, harrowing or other approved methods. Soil on slopes of 3-horizontal-to-1-vertical and flatter shall be tilled to a minimum of 4 inches (100 mm) depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum of 2 inches (50 mm) depth by scarifying with heavy rakes, or other methods. Rototillers may be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1-vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on the plans. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure. The prepared surface shall be a maximum 1 inch (25 mm) below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

(a) Lawn Area Debris: Debris and stones over a maximum of 5/8-inch (15 mm) in any dimension shall be removed from surfaces designated on the plans as lawn areas or as directed by the engineer.

(b) Field Area Debris: Debris and stones over a maximum of 3-inches (75 mm) in any dimension shall be removed from the surface.

(c) Protection: Prepared surface areas shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

717.05 PERMANENT SEEDING. Seed shall be planted within the dates shown in Table 717-l, unless otherwise permitted in writing.

717.06 TEMPORARY SEEDING. During construction, temporary seeding shall be placed as directed. Temporary seeding may be any of the types given in Table 717-1. Annual rye grass is the only acceptable grass for winter cover.

The contractor will be allowed to apply seed by use of a hydro-seeder in accordance with Section 739.

717.07 WATERING. When deemed necessary due to dry conditions, seeded areas shall be periodically watered until final acceptance at no direct pay.

717.08 SEED ESTABLISHMENT PERIOD. Turf will be considered to be established and completed when the areas to be turfed have produced Bermuda grass stems or runners which overlap adjacent Bermuda grass growth over a minimum of 85 percent of the entire area as determined by the engineer by random sampling on a square yard (sq m) basis and when the areas to be turfed have no spots greater than 4 square feet (0.4 sq m) that are void of Bermuda grass.

Acceptance of the entire turfed area will be based on the engineer's visual inspection and determination of the required coverage. Acceptance will be based on coverage by Bermuda grass only. Dying or dead turf and eroded areas will not be accepted. Partial areas will not be accepted unless determined by the engineer to be in the best interest of the Department.

717.09 MEASUREMENT. Seeding will be measured by the pound (kg).

717.10 PAYMENT. Payment for temporary and permanent seeding will be made at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
717-01	Seeding	Pound (kg)

Table 717-1
Seeding

Type	Seed Mixtures[1]	Pounds/ Acre	Kilogram/ Hectare	Soil Area[2]	Planting Dates	Establishment Period[7]
A	Hulled Bermuda	30	34	1,2,3,4,5	Mar.-Sep.	Mar.-Dec.
B	Hulled Bermuda Crimson Clover[3]	20 25	22 28	1,2,3,5	Feb.-Mar.	Feb.-Jun.
C	Kentucky 31 Fescue Unhulled Bermuda	25 20	28 22	1,2,3,4,5	Sep.-Feb.	Sep.-May
D	Unhulled Bermuda Crimson Clover[3]	20 40	22 45	1,2,3,4,5	Sep.-Feb.	Sep.-May.
E	Pensacola Bahia[4]	25	28	1,2,3,5	Mar.-Sep.	Mar.-Dec.
F	Ball Clover Unhulled Bermuda	25 20	28 22	1,2,3,4,5	Feb.-Mar.	Feb.-Jun.
G	Vetch (Common) Unhulled Bermuda	40 20	45 22	1,2,3,4,5	Sep.-Oct.	Sep.-Jan.
H[6]	Lespedeza Browntop Millet Hulled Bermuda Pensacola Bahia	6 20 15 50	7 22 17 56	1,2,3,4,5	Mar.-Jul.	Mar.-Oct.
I	Annual Rye	30	34	1,2,3,4,5	Sep.-Jan.[5]	Sep.-Apr.

[1]Only Hulled Bermuda or Unhulled Bermuda shall be planted in rest areas.
[2]See Subsection 717.03.
[3]Inoculated prior to planting with proper bacterial culture.
[4]Type E shall be used only upon the approval of the Roadside Development Specialist.
[5]Annual Rye grass shall not be planted before September 20. Annual Rye grass may be planted as late as January 15 if climatic conditions and soil temperatures will allow germination.
[6]This planting mixture is to be used in the Kisatchie National Forest areas only.
[7]The seed establishment period shall begin on the first day of seeding work under the contract and shall continue through the remaining life of the contract and end 3 months after the last day of the seeding operation. The contractor shall provide a written calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of each seeded area covered by each period shall be described. The seed establishment period may be modified for inclement weather, shut down periods, or for separate completion dates of areas as approved by the engineer.

Section 718
Fertilizer and Agricultural Lime

718.01 DESCRIPTION. This work consists of furnishing and applying commercial fertilizer and agricultural lime on the areas designated on the plans or as directed.

718.02 MATERIALS.

(a) Fertilizer: Fertilizer shall be an approved brand complying with requirements of the Louisiana Department of Agriculture and Forestry. Fertilizer shall be either 8-8-8, 12-12-12, 13-13-13 or 16-16-16, and shall comply with Subsection 1018.16. Fertilizer shall be delivered in sack or bulk.

Fertilizer tablets shall be an approved brand containing nitrogen fixing and phosphorus solubilizing bacteria, slow-release nitrogen, natural organic nutrients, and humic acid complying with the requirements of Subsection 1018.16. The fertilizer tablets shall be delivered in sealed waterproof containers.

(b) Agricultural Lime: Agricultural lime shall comply with Subsection 1018.17 and shall be delivered either in sacks or bulk.

718.03 APPLICATION.

(a) Commercial Fertilizer: Fertilizer shall be uniformly broadcast over areas to be fertilized by either hand or machine methods. The rate of fertilizer application shall be as shown in Table 718-1.

Table 718-1
Fertilizer Application Rates

Type Fertilizer	Pounds Per Acre	Kilogram Per Hectare
8-8-8	1000	1120
12-12-12	667	748
13-13-13	615	689
16-16-16	500	560

Other balanced fertilizer may be used at the proportional rate. Fertilizer applied after surface dressing shall be thoroughly incorporated into the soil

by light disking, harrowing, or rototilling. Fertilizer shall be applied before final disking, harrowing, or rototilling during surface dressing. When the surface is dressed by hand, the fertilizer may be applied before final raking and leveling.

(b) Agricultural Lime: Agricultural lime shall be spread uniformly at a minimum rate of 2 tons per acre (4.5 Mg/ha**)** with a spreader. Lime shall be applied prior to seeding, topsoil placement and slab sodding and may be applied in conjunction with fertilizer. After application, the areas shall be disked, harrowed, or rototilled to incorporate lime or lime-fertilizer into the top 3 inches to 6 inches (75 mm to 150 mm) of soil.

(c) Hydro-seeding: If hydro-seeding methods are used, the contractor will be permitted to include fertilizer and lime in the seeding slurry. When specified by the manufacturer, water soluble or liquid fertilizer will be allowed for hydro-seeding product applications.

718.04 MEASUREMENT.

(a) Fertilizer: Fertilizer will be measured by the pound (kg). The estimated quantity shown in the plans is based on Type 8-8-8 fertilizer. If other types of fertilizer are used, the measured quantities will be multiplied by the factors of Table 718-2 to determine pay quantities.

Table 718-2
Fertilizer Factors

Type	Factor
12-12-12	1.5
13-13-13	1.625
16-16-16	2.0

When other balanced fertilizers are used the factor will be determined by dividing the type of fertilizer by eight.

(b) Agricultural Lime: Agricultural lime will be measured by the ton (Mg).

718.05 PAYMENT. Payment for fertilizer and agricultural lime will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
718-01	Fertilizer	Pound (kg)
718-02	Agricultural Lime	Ton (Mg)

Section 719
Landscaping

719.01 DESCRIPTION. This work consists of furnishing and planting various plant materials in accordance with the plans and these specifications.

719.02 LANDSCAPE CONTRACTOR REQUIREMENTS. The landscape contractor shall conduct his operations in accordance with Section 107, the requirements of the Louisiana Horticulture Law and Regulations, and this section.

719.03 MATERIALS. Materials for landscaping shall comply with the following Sections and Subsections, and the following requirements.

Mortar Sand	1003.02
Fertilizer	1018.16
Agricultural Lime	1018.17
Water Management Gel	1018.29
Mycorrhizal Inoculant	1018.30

Water may be obtained from any source, except that brackish, chemically contaminated, or oily water shall not be used.

Individual plant varieties, species, and size will be indicated on the plans.

(a) Pine Bark for Bed Preparation and Backfilling: The contractor shall furnish pulverized, well rotted, ground pine bark for use in preparing backfill soil and the soil in bed areas.

(b) Backfill Soil: Backfill soil shall be prepared as follows:

5 parts topsoil
3 parts pine bark for bed preparation and backfilling
1 part sand
1 part manure
Water Management Gel
Mycorrhizal Inoculant

Water Management Gel and Mycorrhizal Inoculant shall be added at the manufacturer's recommended rate for individual trees or plants at the time of planting.

All clods, stones, roots, gravel, and other debris shall be removed from the excavated soil. Backfill soil shall be mixed with excavated soil from individual planting holes at a rate of three parts backfill soil to one part excavated soil. This mixture shall then be used to backfill individual planting holes.

Fertilizer shall be added in accordance with Section 718 except as specified herein.

(c) Water Management Gel: Water management gel shall be in accordance with Subsection 1018.29.

(d) Mycorrhizal Inoculant: Mycorrhizal inoculant shall be in accordance with Subsection 1018.30.

(e) Topsoil: Topsoil, if called for on the plans, shall be furnished and placed at the specified rate in accordance with Section 715.

(f) Top Dressing Mulch: Top dressing mulch shall be pine bark, pine straw, redwood chips, hardwood mulch or cypress bark.

When pine bark mulch is specified, mulch shall consist of 1/2 inch (15 mm) minimum size chipped pine bark. Excessively "green" and/or decomposed pine bark will be rejected.

(g) Fertilizer Tablets: Fertilizer tablets shall be in accordance with Subsection 1018.16.

719.04 QUALITY AND EXTENT OF WORK. The engineer shall notify the Department's Landscape Architect before work begins to coordinate the planting. Work shall be done in accordance with accepted landscaping practices. Plant materials approved for planting shall be container grown or balled and burlap, loaded, moved, unloaded, planted, fertilized, pruned, watered and maintained as necessary to ensure their healthy growth.

719.05 PLANT MATERIALS. Plants will be subject to approval at the project site before planting. Trees and other plant materials shall be inspected by the Department's Landscape Architect, with the landscape contractor present. In the event that plant material is rejected, it shall be removed from the site, and the contractor shall locate acceptable plant material from other nursery sources at no direct pay.

(a) State and Federal Regulations: Plant material shall be free from injurious insect pests and plant diseases and subject to regulations of Federal and State Departments of Agriculture. Shipments of plants shall comply with nursery inspection and plant quarantine regulations of the states of origin and destination. The contractor shall obtain proper certificates for movement of nursery stock intrastate and interstate, and shall comply with all

other requirements before and during movement or shipment of plants. A copy of the Certificate of Inspection shall accompany each delivery.

(b) Plant Names: Scientific and common plant names shall comply with the current edition of "Hortus." Plants shall be true to name and legibly tagged. There shall be no substitutions for the types, species, quantities or sizes of materials specified without written permission, and then only when sufficient evidence has been presented that the specified plants cannot be obtained and that the substituted plants are equal to the plants specified.

(c) Grading Standards: Grading of plants shall comply with the latest edition of "American Standards for Nursery Stock," as published by the American Nursery and Landscape Association, unless otherwise specified.

(d) Plant List: A complete list of plants will be shown on the plans including botanical name, common name, quantity, height, caliper, etc. Sizes of stock shown are the minimum acceptable sizes.

(e) Quality and Source of Plants: Plants shall be nursery grown, well formed, and at least No. 1 Grade unless written permission is obtained to use selected native stock. This permission may be granted only if native stock is better suited or superior in quality to plants obtained from a nursery.

Plants and trees shall equal or exceed the measurements specified in the Plant List. They shall be measured before pruning, with branches in normal position. Dimensions for height and spread refer to the main body of the plant and not from branch tip to branch tip. The determining measurements for trees shall be caliper and/or height as described in the Plant List. Caliper of the trunk shall be taken 6 inches (150 mm) above the ground level for sizes up to and including 4-inch (100 mm) and 4-feet 6-inches (1350 mm) (Diameter Breast Height) above the ground level for larger sizes. Trees shall have a habit of growth which is normal for the species. Plants shall be healthy, vigorous, and free from insects, diseases and injuries.

The contractor shall not trim or cut leaders or main branches of trees.

(f) Balled and Burlapped Plants: Balled and burlapped plants shall be dug with firm, natural balls of soil of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be firmly wrapped with burlap or similar material and bound with twine, cord or wire. Balled and Burlapped plants shall be watered prior to transportation and kept moist until planted.

(g) Container Grown Plants: Container grown stock which has become potbound or in which the top system is out of proportion (larger) to the size of the container will not be acceptable. The stock shall have a fibrous, cohesive root system. Container grown plants shall not be removed from the container until just before planting, and care shall be taken to

prevent root system damage. Container grown plants shall be watered prior to transportation and shall be kept moist until planted.

(h) Handling and Storage: The contractor shall protect plants from drying out by covering the root system with mulch, wood chips or suitable materials and watering the root system and foliage as necessary. Plants shall be protected from drying winds and sun as directed.

Plants shall be lifted from the bottom only, not by stems or trunks. Plants will be rejected if the soil is cracked or loosened.

(i) Delivery and Receipt of Plant Materials: The contractor shall notify the engineer at least 48 hours before delivery of plant materials to the project. Each shipment shall be accompanied by an invoice showing sizes and varieties in the shipment.

(j) Inspection: Plant materials shall be subject to inspection and approval at any time during the life of the contract. Plants having any of the following deficiencies will be rejected: excessive abrasions of bark, dried out root system, excessive dead wood, dried up wood, excessive sun scald injuries, undeveloped and weak top or roots, crooked or one-sided development of tops, no straight leaders on trees normally having them, broken or removed leaders, untrue types or sizes, not complying with Federal and State Laws or regulations bearing on inspection and certificates, excessively damaged balls of soil, balls of soil dug from loose soil which will not properly ball, dead plants and plants otherwise not complying with these specifications.

Rejected material shall be replaced with new plant material of the same kind at no direct pay.

719.06 CONSTRUCTION METHODS.

(a) Seasonal Operations: Unless otherwise authorized in writing, the planting season is between November 1 and April 15.

Work shall be suspended when the ambient temperature falls below 32°F (0°C), wind velocity is excessive, ground is frozen or too wet, or continuation of prevailing weather would likely cause unsatisfactory results. The contractor shall complete planting as early as practical in the planting season.

When the only landscape work on the project consists of shrub planting at dead end road installations, planting may be performed at any time during the year, provided the ambient air temperature is above 32°F (0°C) and weather and ground conditions are suitable for planting. Container grown plants will be required at dead end road installations.

(b) Pruning: If necessary, plant material shall be pruned on the project in accordance with the plan details.

Pruning shall be limited to the removal of injured twigs and branches. The normal shape of the plant shall be left intact unless otherwise directed by the Department's Landscape Architect. Selective pruning may be required on trees of special type or character at no direct pay.

(c) Soil Testing: The contractor shall obtain the services of an established soil testing entity to coordinate soil sampling, perform testing and analyses, and prepare recommendations for materials and procedures to be used during the preplanting phase. When practicable, soil testing shall be performed early enough to permit agricultural lime or other additives (if required) to be applied sufficiently in advance of planting so that the soil pH adjustment will occur before planting. Samples shall be tested and analyzed to determine pH and fertility conditions. The test results and recommendations shall be used to determine the quantities of agricultural lime and fertilizer required for preplanting applications. Agricultural lime recommendations shall consider probable time of application. A copy of the test report with recommendations shall be furnished to the engineer. Testing will be at no direct pay.

(d) Location of Plants: Plants shall be located in accordance with plans or as directed by the project engineer or landscape architect.

(e) Setting Individual Plants Not in Beds: The planting hole shall be dug twice the width of the root ball of the plant. The sides of the planting hole shall be straight and the bottom flat. A mound shall then be built in the center of the plant hole with excavated material for the plant to sit on. Plants shall be set plumb and at such level that, after settlement, a normal relationship of the crown of the plant with the ground surface will be established. Each plant shall be in the center of the planting hole. When plants are set, backfill soil shall be tamped under and around the base of each root mass to fill all voids. Plants shall be planted in backfill soil complying with Subsection 719.03(b) thoroughly settled by watering and tamping to minimize settling and leaning of plant material. Plants 6 feet (2 m) tall and taller, shall be staked in accordance with applicable nursery practices at no direct pay. The contractor shall be responsible for maintaining all plant material in a vertical position for the contract period. On balled and burlapped stock, any wire or cord shall be cut or removed from the root balls and stems. The top one-third of burlap shall be removed from the root ball.

Tree planting holes shall be loosened to a depth of 2 feet (0.6 m) below the bottom of the pit or to such depth that any hardpan has been broken and moisture is allowed to move freely. The contractor shall notify the engineer in writing of any problems before installing the trees.

When plants are grouped together in a plant bed or in a line less than 5 feet (1.5 m) apart, the area shall be loosened and lumps broken to a minimum depth of 6 inches (150 mm) prior to excavating planting holes.

After planting has been completed, a bowl shall be formed using excavated material around each plant as shown in the planting details. Bowls shall extend to the limits of the planting holes for trees and shrubs. No bowls are required in areas of bed preparation. Shrubs in lines or groups may share a common bowl around their perimeter.

(f) Fertilizer: The contractor shall furnish and place either granular or tablet commercial fertilizer at the specified rate in accordance with this section and Subsection 718.03(a). Fertilizer shall be mixed with backfill soil before backfilling. The recommended amount of fertilizer tablets shall be equally placed in the upper 2 inches (50 mm) of backfill soil 2 inches (50 mm) from the root ball or in accordance with the manufacturer's recommendations.

Fertilizer tablets shall be used in individual plant holes, separate from bed areas. After the tree or shrub has been placed, the manufacturer's prescribed amount and spacing of tablets for the specified plant size shall be applied.

(g) Agricultural Lime: The contractor shall furnish and place agricultural lime in accordance with Section 718 to adjust the soil pH.

(h) Backfilling: Care shall be taken in placing backfill under the sides and over the root mass. Backfill shall be placed to 3/4 the depth of the ball on the sides and watered uniformly on the sides of the root mass to allow settlement of the plant. Plants which settle or lean before or after watering, shall be straightened, raised or replanted.

Excavated material not used as backfill or for bowls shall be spread on areas of the project as directed or disposed of in accordance with Subsection 202.02.

(i) Water: The contractor shall furnish and apply water in sufficient quantities for proper irrigation of the plants at no direct pay.

(j) Bed Preparation: The contractor shall remove grass, weeds, sticks, roots, stones and other debris from the planting bed. The contractor shall treat the planting bed with an approved pre-emergence herbicide in accordance with the manufacturer's recommendations. The contractor shall rototill the planting bed to a minimum depth of 10 inches (250 mm) and add the materials of Table 719-1. Water management gel and mycorrhizal inoculant shall be mixed into the top 4 inches (100 mm) of soil at the rate recommended by the manufacturer prior to planting or seeding. It shall be broadcast by shaker, spreader, or hand, then raked or rototilled into the soil to produce a uniformly mixed layer.

Table 719-1
Bed Preparation Material

Material	Per 1000 Sq Ft	Per 100 Sq m
Mortar Sand	3 Cubic Yards	2.5 Cu m
Peat Moss	3 Cubic Yards	2.5 Cu m
Manure	3 Cubic Yards	2.5 Cu m
Pine Bark	7 Cubic Yards	6.0 Cu m
Fertilizer 8-8-8 (Or Other Balanced Equivalent At Proportional Rates)	25 Pounds	12 kg
Mycorrhizal Inoculant	per manufacturer	per manufacturer
Water Management Gel	per manufacturer	per manufacturer

The contractor shall create a trench for drainage purposes around the entire bed. All beds shall be built as "raised" beds. Beds shall be raked smooth and dirt lumps, stones, sticks, grass and other foreign matter shall be removed. Finish grades of bed trenches next to walks or buildings shall be 1 to 2 inches (25 to 50 mm) below finish grade of adjoining surfaces unless otherwise shown on the plans or as directed.

(k) Mulching: Mulch shall be placed uniformly to a minimum depth of 3 inches (75 mm) within the planting bowls and bed areas and watered. When plants are planted in rows or groups not more than 5 feet (1.5 m) apart, the entire area between the bowls shall be mulched. Avoid placing mulch directly around the trunks of trees and the stems of shrubs.

(l) Weeding: Weeds shall be removed from bed areas, the planting basin of each plant and groups of plants, including bowl walls. The contractor shall mow, for a radial distance of 5 feet (1.5 m), around plant materials not planted in beds. Use of selective herbicides will be permitted when approved by the District Roadside Development Coordinator. Contact-type herbicides shall be compatible with plants and the grass in the 10-foot (3 m) circle shall be cut to a satisfactory height. Weeding shall be performed as directed to maintain a neat appearance throughout the period of establishment and replacement.

719.07 PERIOD OF ESTABLISHMENT AND REPLACEMENT. Upon completion of planting and providing all plants are in place, living and conforming to these specifications, this portion of the contract will be given provisional acceptance.

(a) Period of Establishment: The contractor shall care for planted and mulched areas for a period of establishment, which shall be one full growing season, after provisional acceptance is made. A growing season shall begin April 16 and extend one full year until April 16 of the next year. The contractor can complete planting any time during the planting season specified in Subsection 719.06(a). If the contractor completes planting prior to April 16, the growing season shall begin at provisional acceptance and extend to April 16 of the following year. Any extension of the planting season past April 15 shall result in an extension of the period of establishment to October 31 of the following year. During this period of establishment, the contractor shall preserve plants in a healthy, growing condition. Such plant establishment work shall include cultivation, weeding, watering, pruning, controlling insects, pests and disease and other work determined necessary by the engineer to ensure healthy plant growth.

The contractor shall contact the engineer every week and outline activities which will be performed on the project. Failure to contact the engineer weekly and perform activities will result in a 1 percent reduction of the landscape contract amount, for each week of noncompliance before final payment. The contractor shall weed in the vicinity of plants, place mulch, and water the plants as required. During the period of establishment, the contractor shall maintain a neat and clean appearance of planting areas.

(b) Replacement: Plants that show signs of failure to grow at any time, or which are so injured or damaged as to render them unsuitable for the purpose intended, as determined by the engineer, shall be removed and replaced. Unless otherwise directed by the engineer, the contractor shall complete replacement of unsuitable plants within 15 calendar days after the engineer marks or otherwise indicates that the plants shall be replaced. Failure to comply in the time allotted will result in having the costs of these replacement plants deducted from the contract amount upon final payment, while the contractor shall remain liable for the original contract specifications.

Replacement planting shall comply with the spacing and size requirements specified for the plants being replaced. Replacement ground cover plants shall be the same species as specified for the ground cover being replaced. Other replacement plants shall be the same species as the plants being replaced unless the engineer, after consultation with the Department's Landscape Architect, approves the substitution of alternative species of plants in accordance with the provisions in this subsection.

Replacement plants shall be furnished and planted by the contractor at the contractor's expense.

(c) Semifinal Inspection: A semifinal inspection by the contractor and the engineer will be held 2 weeks prior to the end of the period of establishment to determine the acceptability of plants. Replacement planting, as required, shall be performed in accordance with Subsections 719.06(a) and 719.07(b).

Unsatisfactory plants shall be replaced in kind, quantity and size with live, healthy plants installed as originally specified. Substitute varieties of plants shall be used only when approved. These replacement plantings shall be made at no direct pay. Only these replacements made at this time will not require a period of establishment. However, all plants that must be replaced at the semifinal inspection will be replaced at the contractor's expense.

Upon completion of said replacements and prior to final acceptance of the project, the contractor shall weed around plants and remove discarded materials, rubbish and equipment from areas of the right-of-way affected by operations.

(d) Final Acceptance: Final inspection of plant material will be held approximately 2 weeks after replacement planting has been completed. Final acceptance will be made if all plants are in place, alive and are in conformance with plans and specifications.

Plants that are unsatisfactory at the time of final inspection of the project shall be replaced by the contractor in kind, quantity and size with live, healthy plants installed as originally specified. Substitute varieties of plants shall be used only when approved. These replacement plantings shall be made at no direct pay.

719.08 MEASUREMENT. Furnishing and planting the various types and sizes of plant materials will be measured per each. No measurement for payment will be made for plant hole preparation, backfill material, fertilizer tablets, water, plant maintenance or plant replacement of individual trees and shrubs either inside or outside of bed areas.

Bed preparation and top dressing mulch will be measured by the square yard (sq m).

When an item for "Landscaping" is included in the contract, the furnishing and planting of all required plant materials under the contract will be measured on a lump sum basis.

719.09 PAYMENT. Payment for furnishing and planting the various types and sizes of plant materials will be made at the contract unit price per each.

Payment for bed preparation and top dressing mulch will be made at the contract unit prices. Payment for mulch required for individual tree and

shrub planting will be included in the contract unit price for the plant and not as top dressing mulch. When an item for "Landscaping" is included in the contract, payment will be made at the contract lump sum price.

Partial payment during the period of establishment will be limited to 75 percent of the contract price upon provisional acceptance. Midway through the period of establishment, if the project engineer's records show that plants have been properly maintained and replacement plantings have been completed, 15 percent of the contract price for landscaping items will be paid, minus any reduction in accordance with Subsection 719.07(b). At the end of the full period of establishment, if the project engineer's records show that plants have been properly maintained and replacement plantings have been completed, the remaining 10 percent of the contract price for landscaping items will be paid, minus any reduction in accordance with Subsections 719.07(a) and (b). Payment for adjustment of pH will be made in accordance with Subsection 109.04.

Payment will be made under:

Item No.	Pay Item	Pay Unit
719-01	Plants (Type, Size)	Each
719-02	Top Dressing Mulch (__inch (__mm) Depth)	Square Yard (Sq m)
719-03	Bed Preparation (__inch (__mm) Depth)	Square Yard (Sq m)
719-04	Landscaping	Lump Sum

Section 720
Erosion Control Systems

720.01 DESCRIPTION. This work consists of furnishing and placing erosion control systems in accordance with plan requirements for use as soil retention blankets on slopes or as flexible channel liners in ditches.

720.02 MATERIALS.

(a) General: Erosion control systems shall comply with Subsection 1018.23. The manufacturer's installation plan and hardware (staples, stakes, etc.) are considered part of the system and shall be the same as that used during the evaluation for source approval.

The type of erosion control system to be used shall be shown on the plans. The contractor shall have the option of substituting a higher grade system for a lower grade system within the same application (slope protection or flexible channel liners) at no additional cost to the Department.

(b) Acceptance: Pretested lots of erosion control systems shall be accepted based on a Certificate of Delivery showing DOTD Lot Numbers and laboratory numbers representing the pretested material, including hardware. Erosion control systems that are not accompanied by a Certificate of Delivery shall be sampled in accordance with DOTD S 613 at the rate of 1/200 rolls for rolled type materials (or mats) or 1/200 bags for mulch systems per manufacture's lot. The sample size shall consist of not less than 3 square yards (sq m) of rolled (or mat) material or one 50 lb (20 kg) bag of mulch. Installation hardware, additives such as tackifiers, and any other component of the system not covered above shall be sampled at the rate of one item/type/size or one quart (L) per manufacturer's lot in accordance with DOTD S601. All samples shall be submitted to the Materials and Testing Section. A copy of the approved installation plan shall accompany each shipment to the project.

(c) Packaging: Materials shall be packaged in such a way as to maintain the quality of the product throughout handling. Each package shall be identified with the manufacturer's name, product name, and manufacturer's lot number. Each package that is represented by a Certificate of Delivery shall also be identified by the DOTD Lot Number corresponding to that shown on the Certificate of Delivery.

720.03 EQUIPMENT. Equipment necessary to satisfactorily perform the

work shall be furnished and maintained by the contractor. Equipment for hydraulically applying fiber mulch shall be equipped to eject the thoroughly wet mulch material at a uniform rate equal to the manufacturer's recommendations or as designated by the plans to provide the mulch coverage specified.

720.04 CONSTRUCTION REQUIREMENTS. Erosion control systems shall be installed in accordance with the approved installation plan, no later than 48 hours after completion of seeding or sodding operations. All staples shall be installed flush to the ground and shall penetrate all layers of overlapped or adjacent rows.

(a) Slope Protection: Slopes shall be constructed to the required grade, fertilized, and seeded prior to application of erosion control systems. At the time of coverage, the area to be covered shall be free of ruts, clods, stones, roots or other foreign matter that will prevent close contact of the blanket with the soil. Rolled products or mats with netting only on one side are to be placed with the netting exposed and the fibers in contact with the soil.

(b) Flexible Channel Liners: Channels shall be prepared in accordance with Heading (a). Flexible channel liners shall be placed beginning at the downstream end.

720.05 MAINTENANCE. The contractor shall maintain the areas on which erosion control systems have been placed until final acceptance of the project. This shall consist of the repair of damage by erosion, wind, fire or other cause. Such areas are to be repaired to reestablish the condition that existed prior to placing the erosion control systems and may include fertilizing, seeding, mulching or sodding as required at no direct pay.

720.06 MEASUREMENT. Erosion control systems, including hardware, will be measured by the square yard (sq m) of surface area covered.

720.07 PAYMENT. Payment for erosion control systems will be made at the contract unit price and includes all materials, labor, equipment and other incidentals necessary to complete the work. Required burial of ends and edges, overlaps and hardware will not be measured for payment.

Payment will be made under:

Item No.	Pay Item	Pay Unit
720-01	Erosion Control System (Type)	Square Yard (Sq m)

Section 721
Mowing, Trimming and Debris Collection

721.01 DESCRIPTION: This work consists of mowing grass and weeds, trimming overhanging branches, vegetation and trees, and collecting and removing trimmings and debris within the highway right-of-way or as directed.

721.02 EQUIPMENT: Rotary mowers will normally be utilized in the mowing of the right-of-way however, sickle bar mowers, side mounts, flail or boom mowers may be used to mow around bridges, culverts, sign posts, mailboxes, delineators, guard rails, wet areas and ditches, etc., as approved by the engineer. Other types of grass-cutting equipment may be used provided they have been approved by the engineer prior to use. All rotary mowers must be equipped with safety chains to prevent damage to property by flying debris from under the mower. Maximum cutting widths for rigid frame rotary mowers shall be 9 feet (2.7 m). Hand trimming will be required in some areas.

Mowers shall be shielded to prevent flying debris from the cutter blades in accordance with OSHA 29 CFR Part 1928.57. All vehicles and equipment used in performance of the work shall be equipped with amber flashing lights. Tractors shall be equipped with two fender mounted amber flashing lights, two red flags mounted on each side of the rollover protective structure (ROPS) cage, one plainly visible, rear mounted slow moving vehicle emblem, and working headlights.

All mowers shall be kept in good operating condition and shall be maintained to provide a clean sharp cut at all times. All equipment shall be inspected by the engineer for safety devices and suitability for the work prior to being placed in operation. All safety devices shall be properly maintained and functioning at all times.

721.03 GENERAL CONSTRUCTION REQUIREMENTS:

(a) Debris Collection: The contractor shall pick up and properly dispose of all trash and debris ahead of the mowing operation. The areas to be cleaned include all grassed areas, ditches, paved roadside shoulders, fences and under overhead bridges within the project limits. All trash which is uncovered by the mowing operations shall be picked up within 48 hours. Trash and debris picked up and piled or bagged on the roadside shall be

removed from the right-of-way by the end of the same work day. Bagged trash and debris shall not be piled on travel lanes or paved shoulders.

(b) Mowing Operations: The contractor shall have sufficient number and types of equipment best suited to perform the work. Mowers shall be adjusted for a cutting height of approximately 5 inches (125 mm). A follow vehicle equipped with warning lights will be required along with personnel and equipment to do the trimming. Trimming shall be done directly behind the mower.

(c) Mowable Areas: Mowable areas are defined as all of the grassed or vegetative areas of the right-of-way, extending from right-of-way line to right-of-way line or tree line to tree line or fence line to fence line as applicable including but not limited to banks of natural waterways, swale ditches, V-ditches, ditch bottoms and slopes. Areas under bridges and around guard rails, sign posts, delineators, culvert ends, trees, shrubs, plants, culvert head walls, bridge abutments, bridge or overpass columns and piling, and fences where the contractor is required to mow on both sides due to the presence of service roads, swale ditches, V-ditches and slopes or other facilities, etc. are mowable areas. These areas may not be accessible to standard mowing equipment and may require hand trimming or specialized mowing equipment such as boom or side mount mowers.

Mowable vegetation is defined as any trees, vegetation, brush, etc., which is 2 inches (50 mm) in diameter or less measured 5 inches (125 mm) above the ground.

(1) Divided and Undivided Highway and Frontage Roads: All mowable areas within the right-of-way shall be mowed. Any overhanging vegetation or trees, regardless of size, which may hinder or prohibit mowing to the tree line or right-of-way line shall be removed or cut back to the tree line or right-of-way line by the contractor at no direct pay. Trimmings must be removed from the right-of-way or chipped. Chips shall be dispersed in such manner as to not interfere with drainage.

(2) Right-of-Way Line: A strip approximately 7 feet (2.1 m) wide along the fence line or right-of way line is included as mowable area, if applicable and terrain permits. Any overhanging vegetation or fallen trees, regardless of size which may hinder or prohibit mowing of this strip shall be removed by the contractor at no direct pay.

(3) Natural Waterways or Canals Crossing the Right-of-Way: All vegetation (weeds, grasses, vines, and trees) on the waterway banks (slopes), canal bottoms, in the median, beneath the interstate bridges, and in the right of way to the tree line or right-of-way fence line shall be cut to within 5 inches (125 mm) of the ground by any means the contractor chooses

except that all non-mowable vegetation will be removed to ground level. Mowing of this area may require specialized equipment such as weed trimmers, boom or slope mowers. There will be no direct pay for this work as the area involved is included in the mowable acreage listed elsewhere.

(4) Catch Basins: The contractor shall perform the mowing operation in such manner to prevent the buildup of grass clippings on catch basins. If the mowing operation deposits grass clippings on catch basins, the contractor will be required to remove such from the entrance to the catch basin by hand or other methods acceptable to the engineer.

The contractor shall mow as close as practicable to all fixed objects exercising extreme care not to damage trees, plants, shrubs, delineators or other appurtenances which are part of the facility.

(d) Hand Trimming: Hand trimming will be required around fixed objects such as sign posts, delineators, culvert ends, trees, shrubs, plants, guard rails, culvert head walls, bridge abutments, bridge or overpass columns and piling, and fences where the contractor is required to mow on both sides due to the presence of service roads or other facilities, etc. as directed by the engineer. Trimming shall follow the mowing operation by no more than 24 hours.

(e) Use of Herbicides: The contractor may use herbicides around signs, guard rails, culvert ends, bridges revetments, ditches, laterals, fences, etc., to reduce the volume of hand trimming. General spraying of herbicides to control vegetation and spraying around shrubs, bushes and trees will not be allowed except as otherwise provided in these specifications. Vegetation treated with herbicides will be removed by hand or mechanical means to ground level after the manufacturer's suggested time period for the herbicide to affect the plant growth. Prior to the use of any herbicides, the contractor shall obtain the approval of the District's Roadside Development Coordinator for use, type and rate of application of any herbicide. The contractor must present evidence that his personnel applying herbicides have met all the requirements of the Department of Agriculture for training and certifications and shall keep on file for inspection all documentation and records required by law.

(f) Inaccessible Areas: Mowing will not be permitted when, in the opinion of the engineer, soil and weather conditions are such that the right-of-way will be damaged. However, the contractor will be required to provide specialized equipment such as boom or slope mowers to mow areas not accessible to standard mowing equipment. The contractor must use caution to assure that mud is not tracked onto the road surface.

The contractor shall skip the following areas when mowing:

1. Swamp areas or areas having ponded water.

2. Areas with large rocks or other obstructions that might damage the mowers.

3. Shoulder edge when shoulder material has been left in a windrow.

(g) Safety Requirements: The contractor shall conduct his operation in a manner such that the safety and convenience of the public shall be regarded as a prime importance. All equipment and traffic control devices shall be in accordance with the MUTCD and these specifications.

721.04 MEASUREMENT: Mowing will be measured by the acre (ha) and will include all labor, equipment, materials and incidentals required to complete the work. Trimming and debris collection will not be measured for payment.

721.05 PAYMENT: Payment for mowing will be made at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
721-01	Mowing	Acre (ha)

Section 722
Field Laboratories

722.01 DESCRIPTION. This work consists of furnishing laboratory buildings at the project sites for soils and aggregates testing.

These laboratories are to be provided exclusively for the use of Department personnel involved in the Department's Quality Assurance Program.

722.02 GENERAL REQUIREMENTS. Field laboratories shall be weather tight and constructed of wood, metal, masonry or other approved material for the purpose of housing the personnel, testing equipment, records and reports as necessary for the Quality Assurance Program.

Each laboratory shall have a minimum floor space of 160 square feet (15 sq m), or other approved size, that provides sufficient space with a minimum ceiling height of 7 feet (2.1 m). The laboratory shall have at least one outside door and have sufficient windows. The laboratory buildings shall have electric lighting and power outlets as directed. Fume hoods with electric exhaust fans of such size and location to ensure continuous removal of hazardous fumes and air borne particles during testing operations shall be provided. The building and contents shall be secured by suitable lock and catches. The engineer shall be afforded access to the laboratory at all times and shall be provided with a set of keys as necessary.

Laboratory buildings shall be constructed, furnished, maintained and located as approved. The contractor shall provide suitable desks, chairs and file cabinets for personnel using these facilities. Sturdy work benches shall be constructed along at least one wall, or as directed, to provide sufficient work area for the types of tests being conducted. Laboratory buildings shall be heated and air conditioned, and have approved sanitary facilities. A telephone shall be provided for Departmental use.

The laboratories may be used for successive phases of a project without additional compensation.

722.03 PROJECT SITE LABORATORY. Field laboratory buildings at the project site shall be movable types which can be placed near construction areas. The building shall be moved to various locations on the project as directed.

722.04 EQUIPPED PROJECT SITE LABORATORY. The contractor

shall furnish, install and maintain the following equipment in satisfactory condition, as needed, for soils and aggregates testing throughout the life of the project:

(1) An automatic soil compaction hammer capable of compacting both standard and modified proctors, with arrangement for both 12 inch and 18 inch (300 mm and 450 mm) drops and 4 inch and 6 inch (100 mm and 150 mm) molds and adjustable hammer weights from 5.5 to 10 pounds (2.5 kg to 4.5 kg). The specifications for the hammer shall be in accordance with TR 415, Field Moisture-Density Relationships., and TR 418, Moisture-Density Relationships as specified for each mold diameter. The equipment shall include two (2) molds of each size.

(2) A compaction block or pedestal composed of portland cement concrete shall be furnished for use with the automatic compaction hammer. The block shall weigh a minimum of 200 pounds (90 kg). The hammer shall be secured to the block.

(3) An electronic scale capable of measuring in both English and metric units having a capacity of 30 pounds (13.6 kg) or more with a sensitivity of 0.1 pounds (5 grams).

(4) An electronic scale capable of measuring in metric units having a capacity of 2 kilograms or more with a sensitivity of 0.1 grams.

(5) Two (2) electric or gas hot plates and drying pans. An open flame hot plate shall be equipped with suitable shield to disperse heat evenly and to prevent direct contact of the flame with the drying pan. The hot plates shall be of sufficient size to accommodate the drying pans.

The automatic soil compaction hammer and scales noted above shall be calibrated by an independent laboratory on an annual basis and shall be verified by the engineer.

722.05 MEASUREMENT.

Project site laboratories furnished, equipped, satisfactorily maintained, moved as directed, and subsequently removed from the project will be measured per each building.

722.06 PAYMENT. Payment for project site laboratories will be made at the contract unit price per each under:

Item No.	Pay Item	Pay Unit
722-01	Project Site Laboratory	Each
722-02	Project Site Laboratory, (Equipped)	Each

Section 723
Granular Material

723.01 DESCRIPTION. This work consists of furnishing and placing granular material in accordance with these specifications and in conformity with the lines, grades and typical sections shown on the plans or as directed.

723.02 MATERIALS. Granular material shall comply with Subsection 1003.07.

723.03 CONSTRUCTION REQUIREMENTS. Materials shall be placed, properly shaped and uniformly compacted by approved methods to a minimum of 95 percent of maximum dry density. Maximum dry density will be determined in accordance with DOTD TR 415 or TR 418 and in-place density will be determined in accordance with DOTD TR 401. Granular materials shall not be displaced during subsequent operations.

723.04 DIMENSIONAL TOLERANCES. When net section measurement is specified, the thickness and width of completed granular material courses will be checked for determining acceptance in accordance with DOTD TR 602. Areas with thickness and width deficiencies in excess of the following tolerances shall be corrected to plan dimensions by furnishing, placing, shaping and compacting additional materials as required at no direct pay.

(a) Thickness: Underthickness shall not exceed 3/4 inch (20 mm). Overthickness will be at no additional cost to the Department.

(b) Width: Underwidth shall not exceed 6 inches (150 mm). Overwidth will be at no additional cost to the Department.

723.05 MEASUREMENT.

(a) Net Section: The quantities of granular material for payment will be the design volumes as specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions and the compacted thickness of the granular material shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

(b) Vehicular Measurement: Granular material will be measured by the cubic yard (cu m) in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01.

723.06 PAYMENT. Payment for granular material will be made at the contract unit price per cubic yard (cu m) under:

Item No.	Pay Item	Pay Unit
723-01	Granular Material (Net Section)	Cubic Yard (Cu m)
723-02	Granular Material (Vehicular Measurement)	Cubic Yard (Cu m)

Section 724 (Reserved)

Section 725
Temporary Detour Roads and Bridges

725.01 DESCRIPTION. This work consists of furnishing, constructing, maintaining and subsequently removing temporary detour roads and bridges.

Plan details and specified materials for temporary detour roads and bridges indicate minimum requirements. Other approved designs and materials may be used at the option of the contractor.

725.02 MATERIALS.

(a) Detour Roads: Materials for detour roads, except low profile runarounds, shall comply with applicable sections of these specifications.

Temporary culvert pipe shall be one of the types listed in Section 701. Temporary fencing shall be of a type acceptable to the engineer.

Temporary pavement markings shall comply with Subsection 1015.08.

(b) Detour Bridges: Timber shall be treated, either new or used. Defects which, in the opinion of the engineer, materially affect the strength of the timber, will not be permitted. Timber shall comply with the species, grade and stress rating requirements of Subsection 1014.01.

Unless otherwise specified, piles for substructures shall be treated timber, either new or used. Piles shall be reasonably straight, shall satisfactorily withstand driving and shall be satisfactory to the engineer.

When required by the plans, steel piles for substructures shall be of the size and type specified. Painting will not be required.

Substructures shall be precast concrete spans as called for in the plans, except that the contractor will be permitted to submit drawings and calculations, stamped by a licensed engineer, for an alternate superstructure and substructure. Concrete superstructure spans may be new or used and shall be satisfactory to the engineer.

725.03 CONSTRUCTION REQUIREMENTS.

(a) General: The contractor shall perform all necessary additional clearing and grubbing, and provide all necessary temporary fencing and culverts for detours. Construction signs, warning devices and pavement markings shall be in accordance with Section 713 and shall be placed for detours prior to being opened to traffic. The contractor shall maintain detours in a satisfactory condition.

(b) Detour Roads: The contractor shall furnish all embankment

material for detours and shall compact embankments by approved methods to the satisfaction of the engineer. When embankment is placed against slopes of existing embankments, the contractor shall remove from such slopes all grass, weeds, trash, brush and other objectionable material and shall plow slopes to form steps as directed.

Base and surfacing construction shall be performed in accordance with applicable sections of these specifications.

Temporary pavement markings complying with Section 713 shall be placed on detours surfaced with asphaltic concrete or portland cement concrete. These markings shall be in place at the time the detour is opened to traffic. Existing markings in tie-in areas shall be removed. Temporary pavement markings to effect tie-ins to existing striping shall be included in the cost of these markings.

(c) Low Profile Runaround: Low profile runaround type detour roads shall be surfaced with approved aggregate. Aggregate surfacing shall be placed to a minimum depth of 4 inches (100 mm) and a minimum width of 20 feet (6 m). Alignment and grade of runaround type detour roads shall be acceptable to the engineer. The contractor shall be responsible for drainage for low profile detours.

(d) Detour Bridging: Temporary bridge lengths shown on the plans are approximate, and the lengths to be constructed will be determined by the engineer. The contractor shall construct temporary bridges to allow passage of maximum legal loads. Temporary bridge construction shall be performed in accordance with applicable sections of these specifications. Guard rail shall be placed as shown on the plans or as directed.

725.04 REMOVAL OF DETOURS. Upon completion of permanent construction and diversion of traffic thereto, the contractor shall remove detour roads and bridging, temporary fencing, and culverts, eliminate construction scars and seed and fertilize to restore the area to its original condition. When not covered under other items, permanent fencing shall be replaced in kind as directed. Temporary markings on existing surfaces shall be removed in accordance with Section 713.

Temporary bridging shall be removed in accordance with Subsection 202.03. Removed temporary bridge materials, fencing and culverts shall remain the property of the contractor and shall be disposed of outside the right-of-way. Detour embankment, base and surfacing materials shall also be disposed of in accordance with Subsection 202.02 unless reuse of these materials on the project is permitted.

725.05 MEASUREMENT.

(a) Detour Roads: Temporary detour roads will be measured by the square yard (sq m) of completed detour road surfacing.

(b) Low Profile Runaround: Low profile runarounds will be measured per each runaround.

(c) Detour Bridging: Temporary detour bridging will be measured by the linear foot (lin m) along the centerline of completed bridging in accordance with the following:

(1) When constructed in accordance with the design shown on the plans, measurement will be made from beginning to end of bridging as shown on the plans.

(2) When constructed in accordance with an approved design other than as shown on the plans, measurement will not exceed the length required for the design shown on the plans.

(d) Incidentals: Additional clearing and grubbing, temporary fencing and culverts, will not be measured for payment.

When the contract includes items for "Temporary Pavement Markings", these markings will be paid for under the "Temporary Pavement Marking" items. When the contract does not include items for "Temporary Pavement Markings", these markings will be included in the items for "Temporary Detour Roads."

725.06 PAYMENT. Payment for temporary detour roads and bridging furnished, constructed, maintained and subsequently removed will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
725-01	Temporary Detour Roads	Square Yard (Sq m)
725-02	Temporary Detour Bridging	Linear Foot (Lin m)
725-03	Low Profile Runaround	Each

Section 726
Bedding Material

726.01 DESCRIPTION. This work consists of furnishing and placing aggregate bedding material on geotextile fabric for drainage structures.

726.02 MATERIALS. Materials shall comply with the following Subsections:

Plastic Soil Blanket	203.10
Bedding Material	1003.01 & 1003.08
Geotextile Fabric	1019.01

Bedding materials shall be properly proportioned and mixed prior to being placed in the foundation.

726.03 PLACEMENT OF BEDDING. Geotextile fabric shall be placed in accordance with plan details prior to placing bedding material. Care shall be taken to prevent damage to geotextile fabric during placement of bedding material. Materials shall be placed, shaped and uniformly compacted to the satisfaction of the engineer.

Adjacent rolls of fabric will be overlapped or sewn. When rolls are overlapped, the overlap shall be a minimum of 18 inches (450 mm) , including the ends of the rolls. The top layer of the fabric shall be parallel with adjacent rolls and in the direction of bedding materials placement. When rolls are sewn, the contractor shall join adjacent rolls by sewing with polyester, or kevlar thread. Field sewing shall employ the "J" seam or "Butterfly" seam with the two pieces of geotextile fabric mated together, turned in order to sew through 4 layers of fabric and sewn with 2 rows of Type 401, two-threaded locking chain stitch. Factory seams other than specified may be submitted to the Materials and Testing Section for approval. When the ground is covered with water or supersaturated soil, sewing of the fabric will be required.

Damaged fabric shall be either removed and replaced with new fabric or covered with a second layer of fabric extending 2 feet (0.6 m) in each direction from the damaged area.

Excavation below the established grade of the structure for placement of bedding material shall be used or disposed of in accordance with Section 203.

A plastic soil blanket in accordance with Subsection 203.10 shall be placed

at structure ends when bedding material is exposed.

726.04 MEASUREMENT. Bedding material, including plastic soil material, completed and accepted, will be measured by the cubic yard (cu m) (net section). The length and width will be measured horizontally to the theoretical points established by the plans for bedding material. The depth will be as shown on the plans or established by the engineer.

Geotextile fabric will not be measured for payment.

Necessary excavation and disposal of excess excavated materials will not be measured for payment.

726.05 PAYMENT. Payment for bedding material will be made at the contract unit price under:

Item No.	Pay Item	Pay Unit
726-01	Bedding Material	Cubic Yard (Cu m)

Section 727
Mobilization

727.01 DESCRIPTION. This work consists of preparatory work and operations, including those necessary for movement of personnel, equipment, supplies and incidentals to the project site; the establishment of offices, buildings and other facilities necessary for work on the project; the cost of bonds and any required insurance; and other preconstruction expenses necessary for start of the work, excluding the cost of construction materials.

727.02 PAYMENT.

(a) When the contract does not include a pay item for mobilization, no direct payment will be made for mobilization.

(b) When the contract contains a pay item for mobilization, payment will be made at the contract lump sum price, subject to the following provisions:

Partial payments for mobilization will be made in accordance with the schedule of Table 727-1 up to a maximum of 10 percent of the original total contract amount, including this item. Payment of any remaining amount will be made upon completion of all work under the contract.

Table 727-1
Mobilization Payment Schedule

Percent of Total Contract Amount Earned	Allowable Percent of the Lump Sum Price for Mobilization
1st Partial Estimate	25
10	50
25	75
50	100

No payment adjustments will be made for this item due to changes in the work in accordance with Section 109.

Payment will be made under:

Item No.	Pay Item	Pay Unit
727-01	Mobilization	Lump Sum

Section 728
Jacked or Bored Pipe

728.01 DESCRIPTION. This work consists of furnishing and installing pipe in embankments at the locations shown on the plans by jacking or boring in accordance with these specifications.

728.02 MATERIALS. Pipe and joint materials shall comply with Subsection 701.02. Corrugated metal pipe to be jacked or bored shall have corrugated bands a minimum of 24 inches (600 mm) wide with four lines of approved gasket material. These bands shall be secured by a minimum of four galvanized steel rods and lugs in accordance with the plans.

728.03 CONSTRUCTION REQUIREMENTS. In general, pipes 30 inches (750 mm) diameter and greater shall be jacked, and pipes less than 30 inches (750 mm) diameter shall be bored.

The work shall begin at the outfall end of pipe when possible. When the grade at the jacking or boring end is below ground surface, suitable pits or trenches shall be excavated for conducting operations and placing joints of pipe. Adequate sheeting and bracing shall be provided to prevent earth caving.

For pipe with bell joints, if the outside diameter of pipe bell exceeds the outside diameter of pipe barrel by more than 1 inch (25 mm), pipe shall be either cased or pressure grouted its full length. The casing shall be an approved type and size, and shall be furnished and installed by the contractor in accordance with these specifications. Pressure grouting shall be performed with approved materials placed by approved methods.

The method used shall be such as not to weaken or damage the embankment. The contractor shall furnish the engineer for approval a plan showing the proposed procedure, including backstop or jacking frame arrangement, pipe guides, position of jacks and jacking head. Approval of this plan shall not relieve the contractor from responsibility to obtain the desired result.

(a) Jacking: Heavy duty jacks suitable for forcing pipe through the embankment shall be provided. Even pressure shall be applied to all jacks and shall be transmitted to the pipe end through a jacking head. The jacking head shall be designed so that pressure is uniformly applied around the ring of the pipe. Backstop or jacking frame shall be adequate to resist pressure of the

jacks under load. Pipe shall be set on guides properly fastened together to support the pipe in the proper direction at correct grade. Suitable cushioning material, such as plywood, shall be provided between sections of concrete pipe.

Material shall be excavated ahead of the pipe and shall be removed through the pipe. Excavation shall not extend more than 24 inches (600 mm) beyond the forward end of pipe. When the character of embankment material dictates, the distance shall be reduced to prevent the embankment from being damaged. Excavated material shall be disposed of in accordance with Subsection 202.02.

Excavation on the underside of pipe, for at least 1/3 the circumference of pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches (50 mm) may be provided for the upper half of pipe, tapered to zero at the point where excavation conforms to contour of pipe.

A steel cutting edge may be used around the forward end of pipe, constructed so that it will transmit pressures uniformly around the ring of the pipe.

Jacking shall continue without interruption, to prevent pipe from becoming firmly set in the embankment.

Pipe shall not vary horizontally or vertically by more than 1/4 inch in 10 feet (0.6 mm in 3 m) from established line and grade. Any variation shall be regular, and no abrupt changes in direction will be permitted. Any pipe damaged or misaligned in jacking operations shall be removed and replaced by the contractor at no direct pay.

(b) Boring: Boring shall be done mechanically, using a pilot hole approximately 2 inches (50 mm) in diameter. The pilot hole shall extend through the embankment and shall be checked for line and grade before boring begins. Variations from line and grade shall not exceed those specified for jacking. The pilot hole shall serve as centerline of the larger diameter hole to be bored.

The use of water and other fluids with boring operations will be permitted only to lubricate cuttings. Jetting will not be permitted.

In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10 percent high-grade, bentonite may be used to consolidate cuttings of the bit, seal walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of pipe.

Overcutting in excess of 1 inch (25 mm) shall be remedied by pressure grouting the entire length of the installation.

Pipe shall be joined as specified in Section 701.

728.04 MEASUREMENT. Quantities of jacked or bored pipe for payment will be the design lengths as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Required excavation, sheeting, bracing, falsework, casing, joint materials and grouting will not be measured for payment.

728.05 PAYMENT. Payment for jacked or bored pipe will be made at the contract unit price per linear foot (lin m) under:

Item No.	Pay Item	Pay Unit
728-01	Jacked or Bored Pipe (Size, Type, Class or Thickness)	Linear Foot (Lin m)

Section 729
Traffic Signs and Devices

729.01 DESCRIPTION. This work consists of furnishing and installing traffic signs, dead end road installations, markers and delineators, with accessories, posts and overhead spans of specified materials, sizes, shapes, weights and designs.

In general, the work and materials shall comply with the MUTCD as modified by these specifications or as shown on the plans.

Signs shall be fabricated in an approved plant.

The term "legend" shall mean border strip, letters, numerals and symbols which convey the message on signs.

729.02 MATERIALS. Materials shall be new stock conforming to the following:

(a) Sign and Marker Sheeting: Sheeting material for sign panels, delineators, barricades and other markers shall comply with Section 1015. All permanent signs shall meet the requirements of ASTM D 4956, Type III, except as follows:

Reflective sheeting for the permanent signs of Table 729-1 shall meet the requirements of ASTM D 4956, Type IX.

Table 729-1
Permanent Signs for Use With Type IX Reflective Sheeting

Sign	MUTCD Number
Stop	R1-1
Yield	R1-2
4-Way	R1-3
All Way	R1-4
Do Not Enter	R5-1
Wrong Way	R5-1a
Chevrons	W1-8
No Passing Zone Pennants	W14-3
Type 3 Object Marker	OM-3 (Right & Left)
Type 2 Object Marker	-------
Guardrail End Decals	-------

(b) Ferrous Metal: Ferrous metals shall comply with Subsection

1015.02(a). Reinforcing steel shall comply with Section 1009. Ferrous metal, except reinforcing steel, shall be galvanized in accordance with Section 811.

(c) Aluminum: Aluminum alloys for structural members shall comply with Subsection 1015.02(b). Aluminum sign panels shall comply with Subsection 1015.04(a).

(d) Fittings: Structural bolts, nuts, washers and miscellaneous hardware shall comply with Subsection 1015.02.

(e) Guard Rail: Guard rail materials for dead end road installations shall comply with Section 1010.

(f) Timber: Treated piling and timber for barricades in dead end road installations shall comply with Section 1014.

(g) Concrete: Concrete shall be Class M complying with Section 901.

(h) Flexible Sign Posts: Flexible posts for small signs, markers and delineators shall comply with Subsection 1015.03.

(i) Silk Screen Paste: Silk screen paste shall be as recommended by the sheeting manufacturer.

(j) U-Channel Posts: U-channel posts shall comply with Subsection 1015.02(a)(3).

729.03 GENERAL REQUIREMENTS.

(a) Sign Face Fabrication: Signs of Types A, B, D and E, overhead signs and sign face overlay panels shall be fabricated in accordance with the MUTCD, the "Standard Highway Signs" booklet, and the signing detail sheets of the plans.

The contractor shall furnish shop drawings of sign faces for Types D and E, overhead signs and sign overlay panels and for any non-standard sign faces of Types A and B not provided by the Department. Approval of shop drawings shall be obtained before sign face fabrication is begun.

(b) Sign Mountings Fabrication: The contractor shall have the option of furnishing either steel or aluminum sign supports for both post mountings and overhead mountings and either rigid steel or flexible posts for small signs, markers and delineators. Before beginning work, the contractor shall notify the engineer in writing of signing materials he proposes to furnish. The same signing materials shall be used throughout the project.

Fabrication of sign mountings shall conform to Section 807. The contractor shall furnish fabrication and erection drawings of all sign mountings in accordance with Subsection 801.03 with the exception of standard roadside installations. Fabrication and erection drawings will be approved only after approval of sign face shop drawings. Neither fabrication of sign mountings nor construction of sign footings will be allowed before

drawings are approved and distributed.

An approved damper is required for each aluminum truss. Dampers shall be installed during truss fabrication and shall remain in place.

Structure mounted delineator and milepost assemblies shall be installed in accordance with plan details.

Welding shall comply with Section 815.

(c) Material Sampling and Certification: Material sampling and certification for sign faces, sign mountings and U-channel posts shall be in accordance with the Materials Sampling Manual.

729.04 FABRICATION OF SIGN PANELS AND MARKERS.

(a) General: The completed product shall have a surface free of cracks, blisters, blemishes, and wrinkles.

Metal fabrication including shearing, cutting and punching of holes shall be completed prior to surface treatment of metal and application of sheeting. Metal panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication. Surface of sign panels shall be flat.

Splice plates joining sign panels shall not extend behind horizontal sills. Flat aluminum panels shall be a nominal 0.080 inch (2 mm) thick. Extruded aluminum panels shall be 12 inches (300 mm) wide and have a nominal face thickness of 0.125 inches (3 mm).

(b) Surface Treatment: Surface treatment shall be as specified herein or in accordance with approved recommendations of the reflective sheeting manufacturer.

(1) Degreasing:

a. Vapor Degreasing: Panels shall be immersed in a saturated vapor of organic solvent. Trademark printing shall be removed with lacquer thinner or a controlled alkaline cleaning system.

b. Alkaline Degreasing: Panels shall be immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specifications. Immersion time shall depend upon amount of contaminants present and thickness of metal.

(2) Etching:

a. Acid Etch: The panels shall be etched in a 6 to 8 percent phosphoric acid solution at 100°F (38°C). The panels shall then be rinsed thoroughly with running cold water followed by hot water tank rinse.

b. Alkaline Etch: Etch precleaned aluminum surface in an alkaline etching material controlled by titration, using time, temperature and concentration specified by solution manufacturer. Rinse thoroughly. Remove

smut with an acidic, chromium compound solution specified by solution manufacturer and thoroughly rinse.

(3) Drying Panels: Panels shall be dried with a forced hot air drier. Panels shall be handled with clean canvas gloves or by other approved methods between cleaning and etching operations and sheeting application. Cleaned panels shall be protected from grease, oil or other contaminants prior to application of reflective sheeting.

(c) Sheeting Application: Application of reflective sheeting shall be in accordance with the approved written recommendations of the sheeting manufacturer. Sheeting shall be applied to sign faces in an orientation that will result in optimum retroreflectance, or as directed by the engineer.

Reflective sheeting shall be applied with no horizontal splices. Reflective sheeting applied directly to extruded panels shall have no more than two vertical splices per sign, with no more than one vertical splice per individual panel. When splices are used in this manner, only those that occur during, and as a part of , the manufacturing process will be allowed. Fabricated splices will not be allowed.

ASTM D 4956 Type IX reflective sheeting shall be applied with an orientation determined by the engineer to obtain the optimum entrance angle performance. Fabricated vertical splices in ASTM D 4956 Type IX reflective sheeting will be allowed only when the horizontal dimension of the sign face or attached shield is in excess of the maximum manufactured width of the sheeting. Fabricated vertical splices in ASTM D 4956 Type IX reflective sheeting will also be allowed when the specified orientation will create excessive sheeting waste.

Sign faces comprised of two or more pieces of reflective sheeting shall be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance, both day and night. Alternate, successive width sections of either sheeting or panels shall be reversed and consecutive to ensure that corresponding edges of reflective sheeting lay adjacent on the finished sign. Reflective sheeting splices and sign edges shall be sealed in accordance with the manufacturer's recommendations. Legend shall be of the shape, size, dimension, and stroke specified in the MUTCD and sign face shop drawings.

Legend shall be applied by one of the following methods:

(1) Direct Applied: Legend shall be an adhesive coated reflective sheeting as specified in Subsection 1015.05. Legend shall be applied in such manner as to provide a wrinkle-free surface.

(2) Demountable: Legend shall be an adhesive coated reflective sheeting as specified in Subsection 1015.05, permanently adhered to a 0.032-

inch (0.8 mm) thick flat aluminum backing, except that route marker shields shall be 0.080-inch (2.0 mm) thick aluminum. Aluminum shall be treated in accordance with Heading (b). Legend shall be attached to sign face in such manner as to provide a smooth, flat surface. Sign fabrication rivets that prohibit such application shall be removed and replaced through legend, or legend may be raised by approved spacers. Legend shall show clean cut, uniform width of stroke and have essentially a plane surface.

(3) Screened: Legend shall be applied to sign faces by an approved screening process in accordance with the reflective sheeting manufacturer's recommendations. Screen pastes shall be compatible with reflective sheeting and shall not reduce reflectivity of sheeting less than the values shown in Subsection 1015.05(c). Completed screen surface shall be uniform in color, have sharp edges, be free of bubbles and blemishes, streaks or livered areas, and show good workmanship.

(4) Overlay Film: Legend shall be applied to the sign faces by an approved transparent electronic cuttable overlay film that is compatible with the reflective sheeting to which it is applied. Application shall be in accordance with the recommendations of the manufacturer(s) of both the film and the reflective sheeting. Areas covered by film shall have sharp edges, be free of bubbles and blemishes and show good workmanship. This material shall be in accordance with Subsection 1015.07(c). Direct or reversed application will be permitted.

(d) Screening Process: Screening of sign faces shall be in accordance with Subsection 1015.07(b). Screening shall be by direct or reverse silk screen methods accomplished in the manner specified by the sheeting manufacturer. Screening on sheeting may be accomplished either before or after application of sheeting to panels.

(e) Packaging: Before being packed, signs shall be allowed to stand for at least 12 hours after completion of screening. Signs shall be slipsheeted and packed in such manner as to ensure their arrival at their destination in an undamaged condition. Packaged signs shall not be permitted to become wet during storage or shipment.

729.05 CONSTRUCTION REQUIREMENTS. When removal of existing signs is required, the contractor's sign removal operations shall be coordinated as directed with new sign construction to provide for adequate signing to be in place at all times.

(a) Sign Location: Sign support locations will be as shown on the plans or as directed. Sign locations, after initial staking by the contractor, must be approved by the engineer. Sign locations which are obviously

improper because of topography, existing appurtenances or other conflicting conditions will be adjusted to the closest desirable location. The contractor shall then determine elevations for post length determinations at the established sign support location. The contractor shall be responsible for orientation, elevation, offset and leveling of signs.

(b) Sign Positioning:

(1) Overhead Signs: Signs shall be constructed so that the top edge of the sign face is tilted towards oncoming traffic 3 degrees (approximately 1:20) from vertical and at right angles to the road, unless otherwise directed.

(2) Road Edge Signs: Road edge signs shall be constructed with sign faces vertical. Sign faces located less than 30 feet (9 m) from the edge of travel lane shall be placed at a 93 degree angle from the center of the travel lane. Sign faces located 30 feet (9 m) or more from the edge of the travel lane shall be placed at an 87 degree angle from the center of the travel lane. Where the lanes divide or are on curves or grades, sign faces shall be oriented to be most effective both day and night and avoid specular reflection.

(3) Delineator, Object Marker and Milepost Assemblies: These assemblies shall be placed at least 24 inches (600 mm) beyond the outer edge of roadway shoulder, 24 inches (600 mm) beyond the face of curb, or in the line of guard rail.

(4) Vertical and Horizontal Clearances: Vertical and horizontal clearances shall be in accordance with the MUTCD and/or shall be as shown on the plans.

(c) Sign Overlay Panels: When specified, existing signs shall be completely overlaid with new sign panels placed over the existing sign face. No partially overlaid signs shall be allowed to remain exposed overnight. Only one overlay shall be placed on a sign. When an overlay is to be placed on an existing overlaid sign, the previous overlay shall be removed prior to placement of the new overlay. Overlay panels shall conform to Section 729.04. Raised legends shall be removed from the existing sign face prior to placing the overlay panel. The size of the overlay panel shall not exceed the size of existing sign panel by more than 3 inches (75 mm) on any side. Overlay panels shall be attached to the existing sign with rivets complying with Subsection 1015.02. Rivets shall be placed on 12-inch (300 mm) centers (maximum) along the perimeter of panel and at panel splices, and on 24-inch (600 mm) centers (maximum) both vertically and horizontally in interior portions of each panel. Rivets shall be centered horizontally on panels less than 24-inch (600 mm) wide. A 4 by 4-inch (100 mm by 100 mm) shim with a nominal 0.080-inch (2.0 mm) thick aluminum plate shall be placed between existing panel and overlay panel at interior rivet locations. Shims cut from

salvaged sign panels may be used. The existing sign panels shall be kept reasonably flat during installation of the overlay panels. Splice arrangement for overlay panels shall conform to the requirements for traffic sign blanks.

(d) Excavation and Backfill: The contractor shall perform excavation for sign installation to levels and dimensions shown on the plans, or as directed. Excavation and backfill shall be performed in accordance with Section 802.

(e) Footings: Foundation piles, concrete, reinforcing steel and anchor bolt assemblies shall comply with Sections 804, 805, 806 and 807.

Posts for ground mounted delineator, object marker and milepost assemblies may be driven; no footings will be required.

(f) Bolt Tensioning: Slip plates for breakaway sign posts shall be assembled in the shop with high strength bolts tightened at a minimum bolt tension in accordance with Subsection 807.21. After field installation, high strength bolts in the breakaway base connection shall be tightened to the specified minimum bolt tension. The bolt tension in both the slip plate connection and the breakaway base connection will be checked by the engineer. Bolt tensioning shall be corrected as required.

(g) Cleaning and Clearing: Prior to erection, sign faces shall be cleaned to allow adequate visibility of the sign. Any clearing or tree trimming required to provide for full sign visibility shall be in accordance with the plans or as directed. Trimming of trees of significant local interest shall be performed by a licensed arborist.

(h) U-Channel Posts: U-channel posts for ground mounted small signs, markers and delineators shall be driven vertically to a minimum depth of 3 feet (1 m) below natural ground using a suitable protective driving cap.

U-channel posts may be spliced where long lengths are required. The upper section shall overlap the lower section by at least 24 inches (600 mm). The bottom edge of the upper section of the splice shall be a minimum of 24 inches (600 mm) above the ground. The spliced sections shall be secured with at least four 5/16 inch (8 mm) diameter hex head bolts spaced equally along the splice.

Splicing of U-channel posts will not be allowed when break-away footings are required.

729.06 DEAD END ROAD INSTALLATIONS. Dead end road installations shall be of the specified type and located as shown on the plans. Timber barricade type installations shall be constructed in accordance with Section 812 and the following requirements. Timber piling shall be set in full depth holes and backfilled as directed or driven to required depth. Steel posts

for other type installations shall be driven with a suitable protective cap. Piles and posts shall be vertical. Guard rail shall be constructed in accordance with Section 704.

729.07 ACCEPTANCE OF SIGNS. After the installation of signs is complete, the engineer or an authorized representative shall perform a daytime and nighttime inspection of the signs, sign faces, mounts, installations, hardware and matters relating to the requirements of this section.

After this inspection the engineer and the Department's Sign Inspection Team shall inspect for color match and for conformance to applicable plans, standards and project specifications.

Color match, uniformity and spacing of legend, specular glare, and sign type and design will be inspected for conformance to plans and specifications. When specular reflection is apparent on any sign, its positioning shall be adjusted by the contractor to eliminate this condition. Signs shall be clean at the time of inspection. Reflective sheeting shall be free of cuts, scratches, breaks or other defects which might allow moisture to infiltrate and damage reflective cells. Nonstandard or otherwise unacceptable signs and traffic control devices shall be replaced or repaired as directed. The contractor will be required to correct damage that is discovered at the time of the sign inspection. When the damage was obviously caused by vandalism, the contractor will be paid for corrective work in accordance with Subsection 109.04.

In lieu of removing and replacing new sign faces that have been rejected, sign overlay panels complying with Subsection 729.05(c) may be used to correct the deficiencies at no direct pay.

729.08 MEASUREMENT.

(a) Sign Faces and Overlay Panels: Quantities for payment will be the design areas in square feet (sq m) of sign faces as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Material used in blanks and backing incidental to the sign face will not be measured for payment. In determining the area of sign faces, no deductions are made for corner radii or mounting holes. The area of octagonal signs and Interstate shields is computed as the area of its smallest rectangle or square. The area of triangular signs is computed as the area of the triangle.

(b) Post Mountings: Post sign mountings, including breakaway supports, will be measured per each post.

(c) Overhead Mountings: Overhead sign mountings will be measured per each structure.

(d) Delineator, Object Marker and Milepost Assemblies: Delineator, object marker and milepost assemblies will be measured per each assembly.

(e) Dead End Road Installations: Dead end road installations will be measured per each installation.

(f) Footings: Concrete footings for overhead sign mountings will be measured per each footing. Footings and aprons for post sign mountings will not be measured for payment.

(g) U-Channel Posts: U-channel posts will be measured per each unit installed when not part of an assembly.

(h) Clearing or Tree Trimming: Any clearing or tree trimming required by this section which is not provided for elsewhere in the contract will be included in the contract unit price for signs.

729.09 PAYMENT.

(a) Sign Faces and Overlay Panels: Payment for sign faces and overlay panels will be made at the contract unit price per square foot (sq m), which includes furnishing, fabricating and constructing the signs and furnishing necessary attaching devices.

(b) Post Mountings: Payment for post sign mountings will be made at the contract unit price per each, which includes furnishing, fabricating and constructing the support complete, ready for affixing signs, and includes required excavation, concrete and reinforcement for footings and aprons, and the sign mounting. Payment for sign layout will be made in accordance with Section 740.

(c) Overhead Mountings: Payment for overhead sign mountings, including bridge fascia mountings, will be made at the contract unit price per each, which includes furnishing, fabricating and erecting the structure complete, ready for affixing signs, and the sign mounting.

(d) Delineator, Object Marker and Milepost Assemblies: Payment for delineator, object marker and milepost assemblies will be made at the contract unit prices per each, which includes posts.

(e) Dead End Road Installations: Payment for dead end road installations will be made at the contract unit price per each, which includes piling, posts, barricades, sign materials, reflectors, and any required guard rail.

(f) Footings: Payment for footings for overhead sign mountings will be made at the contract unit price per each, which includes excavation, piling, concrete, reinforcing steel, anchor bolt assemblies and backfill. The concrete

in footings will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-6 and Note 1 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

(g) U-Channel Posts: Payment for U-channel posts will be made at the contract unit price per each which shall include all labor, equipment, tools, materials, and incidentals necessary to complete the work, including splicing of posts, and when required removing and remounting of existing signs, and mounting of new signs.

Payment will be made under:

Item No.	Pay Item	Pay Unit
729-01	Sign (Type A)	Square Foot (Sq m)
729-02	Sign (Type B)	Square Foot (Sq m)
729-03	Sign (Type C)	Square Foot (Sq m)
729-04	Sign (Type D)	Square Foot (Sq m)
729-05	Sign (Type E)	Square Foot (Sq m)
729-06	Sign (Overhead Mounted)	Square Foot (Sq m)
729-07	Sign (Overlay Panel)	Square Foot (Sq m)
729-08	Mounting (_____Size Post)	Each
729-09	Mounting (Overhead Truss) (Ground Mounted)	Each
729-10	Mounting (Overhead Truss) (Structure Mounted)	Each
729-11	Mounting (Overhead Cantilever) (Ground Mounted)	Each
729-12	Mounting (Overhead Cantilever) (Structure Mounted)	Each
729-13	Mounting (Bridge Fascia Mounted)	Each
729-14	Delineator Assembly (Ground Mounted)	Each
729-15	Delineator Assembly (Structure Mounted)	Each
729-16	Object Marker Assembly	Each
729-17	Milepost Assembly (Ground Mounted)	Each
729-18	Milepost Assembly (Structure Mounted)	Each
729-19	Dead End Road Installations (Type)	Each
729-20	Footings for Overhead Mounting (Type)	Each
729-21	U-Channel Post	Each

Section 730
Electrical Systems

730.01 DESCRIPTION. This work consists of furnishing all necessary equipment and materials, performing all necessary work and making any necessary modifications or fabrications required for a complete, operational and safe system in accordance with the plan details and these specifications. The work shall also include furnishing and installing electrical equipment and materials required for air conditioning equipment, motors, controls, pumps and other appliances. The plans and these specifications are supplemental to the applicable codes, manufacturer's instructions, and best prevailing construction trade practices.

730.02 EQUIPMENT AND MATERIALS. Equipment and materials shall be suitable for the intended use and shall be furnished with all necessary hardware and components.

References to a specific manufacturer's name and/or catalog number is intended to denote the quality of the equipment or material and not to specifically exclude other acceptable products. When specified model or catalog numbers are in conflict with descriptive specifications, plans or system compatibility, the descriptive specifications, plans, or system compatibility shall govern.

Except for those products designated as fabricated or those that are no longer produced, all specified products shall be manufactured by companies that are regularly engaged in the production of the specified products.

The products specified shall be specifically designed, tested and manufactured for the purpose for which they will be used. Modification of equipment for other than design purposes will be permitted only when no currently manufactured products meet the specifications.

All equipment and materials shall be new. Like equipment and materials shall be made by the same manufacturer.

The item descriptions and specifications do not necessarily include or define everything necessary for a complete and operational item. When required, the contractor shall provide any modifications, fabrications, extra hardware, and equipment necessary for the satisfactory installation and operation of the system to coordinate with other items or conditions at no direct pay.

Materials shall comply with the following Sections and Subsections:

Backfill	203.06(b) & 1003.07
Portland Cement Concrete (Classes M and S)	901
Reinforcing Steel	1009
Timber	1014
Anchor Bolts, Nuts and Washers	1015.02(c)(1)
Stainless Steel Hardware	1018.08(c)
Conduit	1018.09
Electrical Conductors	1018.10

730.03 CONTRACTOR REVIEW. The drawings are diagrammatic and do not show the exact location and size of equipment. The contractor shall coordinate the work to avoid interference and conflicts. The work shall comply with the applicable requirements of the latest National Electric Code, National Electrical Safety Code and U.L. Standards except where superseded by applicable laws. The contractor shall check mounting space, equipment dimensions, and installation requirements before ordering equipment. The contractor shall establish the electrical circuit requirements of all equipment to be served before ordering material. Where circuits are to serve specific appliances, equipment or feeders, the contractor shall verify the electrical requirements and the exact location of connection before installing the service to the equipment.

730.04 DRAWINGS AND EQUIPMENT SUBMITTALS. The contractor shall submit to the Bridge Design Engineer for checking shop drawings, working drawings and equipment brochures for all required equipment and materials. Nine prints of each checked drawing shall be submitted for final approval and distribution. Drawings submitted shall show construction details, dimensions, and ratings. Drawing format shall be in accordance with Subsection 801.03. Corrections and/or comments made on submittals are not intended to relieve the contractor from compliance with the contract documents. The review and approval of drawings and equipment submittals are to assure that the quality of the equipment and materials meet the requirements of the contract documents.

Approval of the brochures and drawings does not imply that the equipment described is complete, can be constructed or installed, will operate successfully, or will coordinate with existing or other equipment specified. The contractor shall remain responsible for confirming and correlating all quantities and dimensions; for selecting fabrication processes and construction

techniques; for coordination of the work; for performing the work in a safe and satisfactory manner; and for satisfactory installation and operation of equipment.

(a) Working Drawings: Before beginning construction, the contractor shall submit for approval a complete set of working drawings for the project. The intent of the working drawings is to provide the extra detail necessary to communicate the exact scope and details of construction. The drawings are also intended to resolve all potential conflicts between subcontractors, equipment compatibilities and equipment mountings. When the contract drawings are of sufficient detail, the contractor may request approval to use the contract drawings as working drawings. However, any errors on the working drawings are the responsibility of the contractor. The engineer may require the contractor to submit additional details to resolve conflicts or ambiguities which arise during construction.

(b) As-Built Drawings: Upon completion of the project, the contractor shall furnish one set of plans which reflect the final as-built condition of the electrical portion of the project. The drawings shall reflect the plan or field changes and shall include a complete equipment list showing each manufacturer's name and catalog or shop drawing number for each piece of equipment furnished. The drawings shall show the exact location of the underground wiring, light poles, junction boxes, under roadway crossings, service poles, controllers and conduits or cables. Complete schematic and wiring diagrams shall also be required. Light poles shall be located by station number. Underground equipment shall be located by dimensioning to fixed objects. Drawing sizes and format shall be in accordance with Subsection 801.03.

730.05 MAINTENANCE AND OPERATION INSTRUCTION BOOKLETS. Maintenance and operation instruction booklets shall comply with Subsection 801.03(e)(2).

730.06 SYSTEM TESTING. The contractor shall furnish all testing equipment and conduct the tests required by the plans and specifications. A copy of the test results shall be provided to the engineer.

(a) Performance Tests: Equipment shall be given a minimum two week performance test before final acceptance. The performance test shall allow for the normal operation of the equipment during the testing period. When the normal operation is insufficient to adequately test the equipment, artificial cycling or continuous "on" periods will be required. The contractor shall correct any defective equipment, materials and workmanship.

(b) Receptacle Tests: After completion of the electrical system, the contractor shall test each receptacle for proper polarity and continuity of the ground.

(c) Special Tests: The contractor shall conduct special tests when equipment or systems are suspected of improper operation, or when additional data is necessary to determine proper operation.

(d) Insulation Tests: The contractor shall conduct insulation resistance tests on all direct buried conductors and all other A.W.G. No. 10 and larger conductors. Tests shall be made after the conductors are installed and before connecting equipment that may be damaged by the tests. Readings below 50 megohms, when measured with a 1000 volt D.C. insulation tester, will be considered defective.

730.07 ELECTRICAL SERVICE. The contractor shall make arrangements with the power company for temporary and permanent electrical service and shall verify the exact location and points of attachment before installation.

(a) Temporary Service: Temporary electrical service, including power usage and installation shall be at no direct pay.

(b) Permanent Service: The Department will pay the power company for line extensions when the charges are not the result of contractor errors or failure to verify or coordinate with the power company.

(c) Power Usage: Power usage during construction and testing shall be at no direct pay.

730.08 MEASUREMENT.

(a) Trenching and Backfilling: Trenching and backfilling will be measured by the linear foot (lin m) of trench excavated and backfilled, which will include excavation, backfilling, and any required compaction.

(b) Conduit with Conductors: Conduit with conductors will be measured by the linear foot (lin m) of conduit which will include furnishing and installing conduit, conductors, clamps, fittings, flexible metal conduit, and miscellaneous hardware required for conduit installation.

(c) Conductors in Existing Conduit: Conductors will be measured by the linear foot (lin m) of conductors furnished and installed, which will include connectors, terminations and wire markers.

(d) Conduit: Conduit will be measured by the linear foot (lin m) of conduit which will include furnishing and installing conduit, clamps, fittings, flexible metal conduit, and miscellaneous hardware required for conduit installation.

(e) Jacked or Bored Casing: Jacked or bored casings will be measured by the linear foot (lin m) of casing furnished and installed, which will include the casing, duct markers, fittings, and required excavation and backfill.

(f) Light Pole: Light poles will be measured per each pole furnished and installed which will include the pole, decals, ownership plate, wiring and connections to circuit conductors, base assembly, grout and oxide-inhibiting compound. Measurement for ground mounted poles will also include the concrete foundation, concrete apron, underground junction boxes in apron, anchor bolts, reinforcing steel, conduits in foundation, ground rod, ground wires, ground clamp, excavation, backfill, and disposal of excess excavated material.

(g) Relocate Light Poles: Relocation of existing light poles will be measured per each pole, which will include disconnection of the wiring at the source; the removal or abandonment of underground wiring to the pole; the removal and storage of existing pole and luminaire; the complete removal and disposal of existing foundation and apron; the backfilling of existing foundation void; the re-installation of the existing pole and luminaire; the construction of a new foundation with apron; the installation of new ground rod, fused connectors, and pole wiring.

(h) Removal and Storage of Light Poles: Removal of existing light poles will be measured per each pole, which will include the disconnection of wiring at the source; the removal and transporting of the pole to the District compound; the furnishing of 6 inch by 6 inch (150 mm by 150 mm) creosote timbers, and the stacking of the standards as directed.

(i) Removal and Disposal of Light Pole Foundations: Removal of existing light pole foundations will be measured per each foundation, which will include the removal and disposal of the complete concrete foundation and apron; the backfilling to grade of all voids; and the removal or abandonment of underground wiring to the pole.

(j) High Mast Poles: High mast poles will be measured per each pole furnished and installed, which will include the pole, luminaire ring, lowering assembly, drive assembly, grounding, wiring, electrical connections, fuses, mounting hardware, and grout. Measurement for ground mounted poles will also include the concrete foundation, anchor bolts, reinforcing steel, conduit in foundation, ground rod, excavation, backfilling, disposal of excess excavated material, and all hardware and appurtenances required for a complete installation.

(k) Luminaire: Luminaires will be measured per each which will include the luminaire, ballast, lamp, fuse, lightning arrestor, mounting,

connections and hardware.

(l) Removal and Disposal of Luminaires: Removal and disposal of existing luminaires will be measured per each luminaire, which will include removal and the disposal of the luminaire and lamp.

(m) Electrical Service Points: Electrical service points will be measured per each which will include pole, controller assembly, footing, anchor bolts, ground rod, conduits in footing, rigid conduit and conductors on utility company pole connections, hardware, and all equipment as shown on the plans.

(n) Electrical System: Electrical system will be measured on a lump sum basis, which will include furnishing and installing all equipment and apparatus, and performing all work required for a complete and operational electrical system.

(o) Fabricated Light Pole Supports: Fabricated light pole supports will be measured per each, which will include fabrication and installation of the support, concrete anchors, anchor bolts and nuts, and grout.

(p) Underground Junction Box: Underground junction boxes will be measured per each box installed, and will include the box, cover, concrete pad, rigid steel conduits, ground rod bonding, splices, and any material and equipment required for a complete installation.

(q) Structure Junction Box: Structure junction boxes will be measured per each box installed, and will include the box, cover, mounting hardware, shims, terminal blocks, fittings, bonding, and any material and equipment required for a complete installation.

(r) Service Pole: Service poles will be measured per each, and will include the pole conduit and conductors on pole, fittings, conduit clamps, ground rod, hardware, and all equipment as shown on the plans.

(s) Removal and Disposal of Electrical Equipment: The removal of existing electrical equipment as indicated on the plans will be measured as a lump sum, which will include the disconnecting of wiring at the source, the removal of exposed conduit and wiring, and the removal of associated electrical equipment. Measurement for outside systems will include the removal of structure mounted conduit, wire clamps, junction boxes, and underpass luminaires; the removal of service poles and equipment; the removal of conduit risers and the demolition of underground manholes to 24 inches (600 mm) below grade; the removal of underground junction boxes; the back filling to grade of all voids; and the disposal of material and equipment declared not salvageable.

730.09 PAYMENT. Payment for electrical work will be made at the

contract unit prices. The concrete in foundations for light poles, high mast poles, and other electrical equipment will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-6 and Note 1 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
730-01	Trenching and Backfilling	Linear Foot (Lin m)
730-02	Conduit with Conductors (Size and Type)	Linear Foot (Lin m)
730-03	Conductors in Existing Conduit (Size and Type)	Linear Foot (Lin m)
730-04	Jacked or Bored Casing (Size and Type)	Linear Foot (Lin m)
730-05	Light Pole (Size and Type)	Each
730-06	High Mast Pole (Size and Type)	Each
730-07	Luminaire (Size and Type)	Each
730-08	Electrical Service Point (Type)	Each
730-09	Electrical System	Lump Sum
730-10	Fabricated Light Pole Support	Each
730-11	Removal and Disposal of Electrical Equipment	Lump Sum
730-12	Removal and Storage of Light Poles	Each
730-13	Removal and Disposal of Light Pole Foundations	Each
730-14	Removal and Disposal of Luminaires	Each
730-15	Relocate Light Poles (Size and Type)	Each
730-16	Underground Junction Box (Size)	Each
730-17	Structure Junction Box (Size)	Each
730-18	Service Pole	Each

Section 731
Raised Pavement Markers

731.01 DESCRIPTION. This work consists of furnishing and placing raised pavement markers in accordance with plan details.

The contractor will be responsible for field layout and alignment of raised pavement markers. Existing pavement striping shall generally be used as a guide in determining raised marker locations. The Department will make every effort to replace obliterated striping prior to installation of raised pavement markers; however, if no striping exists at the time of raised marker installation, the contractor shall determine raised pavement marker locations in accordance with plan details or as directed.

731.02 MATERIALS.

(a) Markers: Markers shall comply with Subsection 1015.09. The same product shall be used throughout the project. Markers shall be the specified class, type, color, size and shape.

(b) Adhesive: Markers shall be placed with bituminous adhesive on asphaltic surfaces and epoxy adhesive on portland cement concrete surfaces.

(1) Epoxy Adhesive: Epoxy adhesive shall be Type V epoxy resin system complying with Subsection 1017.02. Epoxy components shall be mixed in equal parts by volume. Adhesive shall be mechanically mixed and dispensed, unless hand methods are permitted.

(2) Bituminous Adhesive: Bituminous Adhesive shall comply with Subsection 1015.09(c)(2).

731.03 CONSTRUCTION REQUIREMENTS.

(a) Weather Limitations: Markers shall not be applied when there is moisture on the surface.

(1) Epoxy Adhesive: When a normal set adhesive is used, application of markers will not be permitted at ambient air temperatures less than 50°F (10°C). When a rapid set adhesive is used, application of markers will be permitted at ambient air temperatures between 35°F (2°C) and 50°F (10°C), provided adhesive is adequately heated to obtain proper viscosity for mixing and application, and provided adhesive is identified as a rapid set type on container labels and Certificates of Delivery.

(2) Bituminous Adhesive: Markers shall be applied when the ambient air temperature is 50°F (10°C) or greater.

(b) Cleaning of Surfaces: Surfaces on which markers are to be applied shall be cleaned of all materials that may reduce the bond of adhesive. Surfaces shall be cleaned by blast cleaning or other approved methods which do not damage the surface; however, blast cleaning equipment shall be provided with positive cutoff controls. Surfaces shall be maintained in a clean dry condition until placement of markers.

(c) Application of Markers: Surfaces on which markers are to be placed shall be blown dry immediately prior to marker placement. Markers shall be applied to surfaces with adhesive in accordance with the manufacturer's recommendations.

(1) Epoxy Adhesive: Mixed adhesive shall have a uniformly grey color with no streaks of either black or white on the surface or within mixed adhesive. Voids in a cured undisturbed sample approximately 1/16 inch (2 mm) thick from the extrusion nozzle shall not exceed 4 percent by volume. Machine mixer and applicator shall be capable of accurately and uniformly proportioning the two components in a 1 to 1 ratio within 5 percent by volume of each component (i.e., within 47.5 to 52.5 percent for each component). Periodic checks of proportioning equipment shall be made to determine the actual ratio of components. This shall be done by placing containers in front of the mixing chamber and measuring the actual volume of each component. Equipment shall be arranged so it is possible to bypass the mixer to perform these periodic checks. Temperature of adhesive shall be maintained between 70°F (21°C) and 110°F (43°C) before mixing. The temperature shall be adjusted to prevent excessive flow of epoxy from the marker when installed. The area of the epoxy adhesive bed shall be equal to the bottom area of marker. Adhesive shall be applied in sufficient quantity to cause excess adhesive to be forced out around the perimeter of the marker. Voids in markers with an open grid pattern on bottom shall be filled with adhesive immediately prior to placement.

(2) Bituminous Adhesive: The adhesive shall be heated and melted in either thermostatically controlled double boiler type units utilizing heat transfer oil or thermostatically controlled electric heating pots. The melter/applicator unit shall be suited for both melting and pumping application through heated applicator hoses. The adhesive shall be heated to between 375°F and 425°F (190°C and 220°C) and applied directly to the pavement surface from the melter/applicator by either pumping or pouring. The area of the bituminous adhesive bed shall be a minimum of 6 inches (150 mm) in diameter. Markers shall be applied to the adhesive within 10 seconds. The marker shall be placed in the adhesive bed by applying downward pressure until the marker is firmly seated. Adhesive on exposed surfaces of

markers shall be immediately removed with soft rags moistened with mineral spirits or kerosene. Markers shall be protected against impact until the adhesive has hardened. The adhesive may be reheated and reused; however, the pot life at application temperatures shall not be exceeded.

731.04 MEASUREMENT. Raised pavement markers will be measured by counting the number of markers furnished, placed, and accepted.

731.05 PAYMENT. Payment for field layout and alignment of raised pavement markers will be in accordance with Section 740. Payment for raised pavement markers will be made at the contract unit prices per each under:

Item No.	Pay Item	Pay Unit
731-01	Nonreflectorized Raised Pavement Markers	Each
731-02	Reflectorized Raised Pavement Markers	Each

Section 732
Plastic Pavement Markings

732.01 DESCRIPTION. This work consists of furnishing and placing reflective pavement markings of hot applied thermoplastic or preformed (cold or hot applied) plastic at the locations shown on the plans or as directed. This work shall be in compliance with the MUTCD, plan details and these specifications. Plastic pavement markings include stripes, gore markings, lines, legends and symbols.

732.02 MATERIALS.

(a) Thermoplastic Markings: Thermoplastic marking material shall be a plastic compound reflectorized by internal and external application of glass beads, complying with Subsections 1015.10 and 1015.13. Width and color of markings shall be as specified.

Thermoplastic material shall be delivered in containers of sufficient strength to permit normal handling during shipment and transportation without loss of material. Approved heat-degradable containers that can be placed in heating kettles along with the plastic material will be permitted. Each container shall be clearly marked to indicate color of material, process batch number, name of manufacturer and date of manufacture.

(b) Preformed Plastic Markings: Preformed plastic markings shall comply with Subsection 1015.11.

(c) Surface Primer: A single component surface primer or two component epoxy primer sealer shall be provided by the contractor for the appropriate application in accordance with Subsection 732.03(e). The primer shall form a continuous film that dries rapidly and adheres to the pavement. The primer material shall not discolor or cause any noticeable change in the appearance of the pavement outside of the finished pavement marking. A sample of the primer shall be submitted with the recommended method of application to the engineer and to the manufacturer of the thermoplastic marking material. Written approval shall be obtained from the engineer and the manufacturer before applying the primer.

(d) Glass Beads: Glass beads used for drop-on application to molten plastic shall be shipped in moisture resistant sacks (containers). The sacks shall be strong enough to permit handling without damage. Sacks shall be sufficiently water-resistant so that beads will not become wet or caked in transit.

Glass beads for standard (flat) thermoplastic markings shall be in accordance with Subsection 1015.13.

732.03 CONSTRUCTION REQUIREMENTS FOR PLASTIC PAVEMENT MARKING MATERIAL.

(a) Equipment for Standard (Flat) Thermoplastic Marking Material: The application equipment shall consist of an extrusion die or a ribbon gun that simultaneously deposits and shapes lines at a thickness of 90 mils (2.3 mm) or greater on the pavement surface. Finished markings shall be continuous and uniform in shape, and have clear and sharp dimensions. Applicators shall be capable of producing various widths of traffic markings. Applicators shall produce sharply defined lines and provide means for cleanly cutting off stripe ends and applying broken lines. The ribbon extrusion die or shaping die shall not be more than 2 inches (50 mm) above the roadway surface during application. A spray application will only be allowed when applying 40 mil (1.0 mm) thermoplastic.

The application equipment shall provide continuous mixing and agitation of material. Thermoplastic conveying equipment components located between the main material reservoir and discharge mechanism shall be free from material accumulation and clogging. Parts of application equipment in contact with the material shall be easily accessible for cleaning and maintaining. Mixing and conveying equipment shall maintain material at the application temperature.

Glass beads shall be applied to the molten surface of completed stripes by either a single drop or a double drop application depending on the thickness of the thermoplastic striping as shown in Table 1015-13. The first (large) bead drop shall be applied by a gravity bead dispenser attached to the striping machine in such a manner that beads are dispensed simultaneously with the thermoplastic material at a controlled rate of flow on installed lines. The second (small) bead drop shall be applied immediately after the first bead drop by a gravity bead dispenser attached to the striping machine.

Applicators and kettles shall be equipped and arranged to comply with requirements of the National Board of Fire Underwriters. Applicators shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. Applicator equipment shall consist of a motorized mobile unit capable of installing traffic stripes either left or right of the applicating unit so that only one lane of traffic will be occupied during installation.

(b) Weather Limitations: Application of markings will not be permitted when there is excessive pavement moisture or when the surface

temperature or ambient temperature is below 50°F (10°C). The pavement shall be considered excessively moist when it is visibly wet or when a 1 square foot (0.1 sq m) piece of polyethylene film condenses moisture after being placed on the pavement surface for 15 minutes.

(c) Cleaning of Surfaces: Surfaces on which markings are to be applied shall be cleaned of materials that may reduce adhesion of the thermoplastic marking materials to the pavement. Cleaning shall be done by blast cleaning or grinding. Surfaces shall be kept clean until placement of markings.

(d) Removal of Existing Markings: Existing thermoplastic markings that are not flaking or peeling will not require removal prior to placement of 40 mil (1.0 mm) thick thermoplastic. Existing thermoplastic markings, regardless of condition, shall be removed prior to placement of 90 mil (2.3 mm) thick or greater thermoplastic except on asphalt pavements.

When thermoplastic markings replace existing painted markings, the existing painted markings will not require removal prior to applying new thermoplastic markings, provided the existing painted markings are not flaking or peeling.

When preformed plastic markings (tape) replace any existing markings, the existing markings shall be removed prior to applying the preformed plastic markings.

Removal of markings shall be accomplished by methods that will not damage the pavement or bridge deck. Removal shall be to such extent that 75 percent of the pavement surface or bridge deck under the markings is exposed. After the markings are removed, compressed air or a power blower shall be used to blow clean the pavement surface of residue and debris resulting from the removal. At the end of each day's operations the engineer may direct that temporary pavement markings complying with Section 713 be used in areas where existing markings have been removed and new markings not placed. Temporary pavement markings shall be satisfactorily removed prior to resuming thermoplastic marking operations.

All markings made in error or not conforming to the traffic operation in use shall be removed by either an abrasion or burning process to the satisfaction of the engineer. Markings shall not be obliterated by painting with asphalt binder or other material.

(e) Application of Surface Primer: A single component surface primer will be required prior to placement of preformed plastic markings over an existing painted stripe, over old bleached asphalt, on portland cement concrete surfaces, or all surfaces when ambient temperatures are below 70°F (20°C) unless otherwise directed by the engineer. A two component epoxy

primer sealer will be required prior to placement of thermoplastic materials on portland cement concrete surfaces or all surfaces when ambient temperatures are below 70°F (20°C) unless otherwise directed by the engineer.

(f) Application of Markings: Material shall be installed in specified widths from 4 inches to 24 inches (100 mm to 600 mm). Finished lines shall have well defined edges and be free of waviness. Measurements shall be taken as an average through any 36-inch (900 mm) section of line. Longitudinal lines shall be offset approximately 2 inches (50 mm) from longitudinal joints. A tolerance of +1/2 inch and -1/8 inch (+13 mm and -3 mm) from the specified width will be allowed, provided the variation is gradual. Segments shall square off at each end without mist or drip. Transverse variations from the control device up to 1 inch (25 mm) will be allowed provided the variation does not increase or decrease at the rate of more than 1/2 inch in 25 feet (15 mm in 10.0 m). Lines not meeting these tolerances shall be removed and replaced at no direct pay.

(1) Thermoplastic Markings: Thickness of material, not including drop-on beads, shall be not less than 90 mils (2.3 mm) for lane lines, edge lines and gore markings and not less than 125 mils (3.2 mm) for crosswalks, stop lines, and word and symbol markings.

Thermoplastic material at 90 mil (2.3 mm) thickness or greater shall be applied by extrusion at 390°F to 450°F (200°C to 230°C). Thermoplastic material at 40 mil (1.0 mm) thickness shall be applied by spray at 410°F to 450°F (210°C to 230°C). Immediately after application of the markings, glass beads for a single drop application shall be applied at a minimum rate of 230 pounds per mile (65 kg/km) for a 4-inch (100 mm) solid line stripe. Glass beads for a double drop application shall be applied at a minimum rate of 211 pounds per mile (60 kg/km) for each drop on a 4-inch (100 mm) solid line. Material shall not scorch or discolor when kept at this temperature range for 4 hours.

(2) Preformed Plastic Markings: Plastic tape shall be applied by removing release paper and applying adequate pressure to ensure proper adhesion. Other preformed heat-applied material shall be applied in accordance with the manufacturers' recommendation. Material not adhering properly shall be satisfactorily corrected at no direct pay.

(g) Field Testing of Roadway Markings: The Department will field test the pavement markings in accordance with Subsections 1015.10 and 1015.11 and Table 732-1. Failure to meet these requirements will require the contractor to replace the portion of the material shown to be out of specifications as directed by the engineer.

(h) Corrective Work: Any line found to be defective shall be restriped

or replaced as directed by the engineer. The corrective work shall also be subject to these requirements. The contractor shall replace the pavement marking material at no cost to the Department.

(i) Guarantee: The contractor shall provide the Department with a guarantee stating that if the pavement marking fails to comply with the stated performance requirements, the contractor shall take the remedial action required. Replacement striping shall carry the unexpired guarantee of the striping it replaces.

732.04 MEASUREMENT.

(a) Plastic Pavement Striping: Plastic striping will be measured by the linear foot (lin m) or mile (km), as specified. When a bid item is not included for gore markings, the Department will measure the quantity by converting the actual length and width of line installed to an equivalent length of the normal width line on that section of roadway.

(1) Linear Foot (Lin m): Measurement will be made by the linear foot (lin m) of striping, exclusive of gaps.

(2) Mile (km): Measurement will be made by the mile (km) of single stripe. No deduction will be made for standard 30-foot (9 m) design gaps in broken-line striping; however, deductions will be made for the length of other gaps or omitted sections.

(b) Plastic Pavement Legends and Symbols: Plastic legends and symbols will be measured per each legend or symbol. Symbols shall include all letters, lines, bars or markings necessary to convey the message at each location.

(c) Removal of Existing Markings: Removal of existing pavement markings for undivided highways will be measured by the linear mile (km) of full roadway width including shoulders. For divided highways, the full roadway width including shoulders and ramps will be measured separately for each direction of travel. Removal of pavement markings will include removal of lane lines, edge lines, gore markings, legends, symbols, and raised pavement markers.

732.05 PAYMENT. Payment for the completed and accepted quantities of plastic pavement markings and removal of existing markings will be made at the contract unit prices under:

Payment will be made under:

Item No.	Pay Item	Pay Unit
732-01	Plastic Pavement Striping (__inch (__mm) Width)	Linear Foot (Lin m)
732-02	Plastic Pavement Striping (Solid Line) (__inch (__mm) Width)	Mile (km)
732-03	Plastic Pavement Striping (Broken Line) (__inch (__mm) Width)	Mile (km)
732-04	Plastic Pavement Legends and Symbols (Type)	Each
732-05	Removal of Existing Markings	Mile (km)

Table 732-1
Field Testing of Plastic Pavement Markings

Length of Roadway	Number of Random Test Segments	Length of Test Segments
Less than 1 mile (1.5 km)	3 segments per line type	250 feet (75 m)
1 mile (1.5 km) to 9 miles (14.5 km)	3 segments per line type	1000 feet (300 m)
Greater than 9 miles (15 km)	1 segment per every 3 miles (4.8 km) per line type	1000 feet (300 m)

Measurements

1. Test segments will be selected randomly by the engineer unless night reviews or other knowledge supersedes a random selection process.
2. Each line type will be measured separately.
3. Measurements will be taken on dry, clean roadways.
4. Data will be collected in direction of traffic flow.
5. A minimum of 10 readings will be taken in each test segment line type.
6. On broken lines (skip striping), no more than two readings will be taken per stripe, with readings 20 inches (0.5 m) from ends of marking.
7. For solid lines, the test segment will be divided into ten locations of 100 feet (30 m) each; readings will be spaced a minimum of 25 feet (7.5 m) and a maximum of 150 feet (45 m) apart.
8. The Department may take additional readings or test segments.
9. Acceptance will be based on the average of the readings for each test segment for each line type.
10. Failure of the average reading for any segment to meet the specified minimum values will require replacement.
11. Limits of replacement will be determined by the engineer.

Section 733
Concrete Roadway Barriers

733.01 DESCRIPTION. This work consists of furnishing and constructing concrete barriers for roadways. Barriers may be precast or cast-in-place concrete, at the contractor's option.

733.02 MATERIALS. Materials shall comply with the following Sections and Subsections.

Portland Cement Concrete	901
Joint Materials	1005
Reinforcing Steel	1009
Curing Materials	1011.01
Special Surface Finish Materials	1011.03

Cast-in-place concrete shall be Class M. Precast concrete shall be either Class A or Class P, except that the compressive strength requirements of Class P concrete shall be the same as specified for Class A concrete.

733.03 CONSTRUCTION REQUIREMENTS. Barriers shall be constructed in accordance with Sections 805 and 806 as modified herein. Exposed surfaces of barriers shall be given a Class 2A finish in accordance with Subsection 805.13(b).

The contractor shall perform necessary excavation and backfilling for barriers and shall dispose of excess excavated material in accordance with Subsection 202.02.

Slip-formed concrete shall be placed with an approved slip-form placing machine designed to spread, vibrate, consolidate and finish concrete in one pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense, homogeneous unit. Sliding forms shall be rigidly held together to prevent spreading of forms. After passing there shall be no noticeable slumping of concrete. Concrete shall be held at a uniform consistency, having a slump of 1/2 inch to 1 1/2 inches (13 mm to 38 mm).

Expansion joints shall be formed in accordance with plan details and shall be located at the junction of the barrier with bridge railings, footings for sign supports and light standards, and other fixed structures. Vertical joints in barriers shall match joints in existing underlying concrete pavement. When

pavement joint spacing exceeds 20 feet (6 m), intermediate joints shall be placed as required, but shall not exceed a 20 foot (6 m) spacing. Vertical joints shall be formed to a minimum depth of 1 1/2 inches (38 mm) by an approved jointing tool or sawing the plastic concrete.

733.04 MEASUREMENT. Quantities of concrete barriers for payment will be the design lengths as specified on the plans and adjustments thereto. Design lengths will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made.

Design quantities are based on lengths of continuous sections of barrier, including joints but excluding other openings in the barrier. Required concrete, excavation, backfill, disposal of excess excavated material, reinforcement, joint materials and admixtures will not be measured for payment.

733.05 PAYMENT. Payment for concrete barriers for roadways will be made at the contract unit price per linear foot (lin m). The concrete in cast-in-place roadway barriers will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-6 and Note 1 therein. The concrete in precast roadway barriers will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-5 and Note 1 therein.

Payment will be made under:

Item No.	Pay Item	Pay Unit
733-01	Concrete Roadway Barrier (Type)	Linear Foot (Lin m)

Section 734
Rubblizing Portland Cement Concrete Pavement

734.01 DESCRIPTION. This work consists of rubblizing and compacting the existing reinforced or non-reinforced portland cement concrete pavement. The work shall be performed in accordance with the lines, grades, and typical sections shown in the plans and the following requirements.

734.02 EQUIPMENT. The existing pavement shall be rubblized with a self-contained, self-propelled, resonant frequency breaker capable of producing low amplitude 2000 pound (910 kg) force blows at a rate of not less than 44 cycles per second.

A steel wheel vibratory roller having a gross weight of not less than 10 tons (9 Mg), operated in the vibrating mode, shall be used to compact the rubblized pavement.

A pneumatic-tired roller as specified in Subsection 503.17(c) shall also be used to compact the rubblized pavement.

734.03 CONSTRUCTION REQUIREMENTS. A joint shall be saw cut full depth or load transfer devices shall be severed prior to rubblizing at an existing joint on ramps or roadway where rubblizing abuts concrete pavement which is to remain in place.

The existing concrete pavement shall be broken into pieces ranging from sand size to pieces generally 6 inches (150 mm), with no more than approximately 10 percent of the material larger than 6 inches (150 mm) and no individual pieces larger than 8 inches (200 mm). The majority of rubblized concrete material shall be pieces 1 to 3 inches (25 to 75 mm) in size.

The breaker shall be operated with a maximum amplitude of 1 inch (25 mm) to avoid disruption of base and prevent damage to underground structures.

At the beginning of the rubblizing operations, a 4 foot by 4 foot (1.2 m by 1.2 m) test pit shall be excavated in the middle of a lane at a location selected by the engineer to determine if the breaker is producing pieces of the specified sizes. Additional test pits may be required if directed by the engineer. The test pits shall be backfilled and compacted to the satisfaction of the engineer. The backfill material shall be base course aggregates as specified in Subsection 1003.03; backfilling with the rubblized material will not be

acceptable.

On projects that have a transition to a bridge or to an overpass, the test pit shall be made in the transition where the material will be totally removed. The transition where the test pit is to be located, shall be broken with the resonant breaker; the remainder of the transition shall be broken with any other equipment that the contractor elects to use.

Prior to rubblizing the pavement, the required shoulder drain system and outlets shall be completely installed and functioning. Care should be taken by the contractor not to damage the edge drain system.

Rubblizing shall begin at a free edge or previously broken edge and progress towards the opposite shoulder or longitudinal centerline of the road. In areas where the roadway must be overlaid one lane at a time, initial rubblizing will extend a minimum of 6 inches (150 mm) beyond the width of pavement to be overlaid.

Reinforcement in the rubblized pavement, if any, shall be debonded from the concrete and left in place. However, any reinforcement exposed at the surface during rubblizing or compacting operations shall be cut below the surface and removed.

The complete width of the rubblized pavement surface shall be compacted by vibratory steel-wheel and pneumatic-tired rollers in the following sequence as a minimum.

One pass with a vibratory steel-wheel roller

One pass with a pneumatic-tired roller

Two passes with a vibratory steel-wheel roller.

A pass shall be defined as forward and backward in the same path. The roller shall be operated at a speed not to exceed 4.5 feet per second (1.5 m/s).

Except at restricted crossover and ramp crossings, traffic will not be allowed on the rubblized pavement before the initial asphaltic concrete base and leveling courses, if required, are in place. Rubblized material dislodged by construction traffic shall be immediately removed from the roadway in front of the paver. In no instance shall more than 48 hours elapse between rubblizing the existing pavement and placing the initial pavement course. However, in the event of rain, this time limitation may be waived by the engineer to allow sufficient time for the rubblized pavement to dry to the satisfaction of the engineer. Crossover and ramp crossings shall be maintained in the same compacted state as other areas until the initial pavement course is placed.

The rubblizing operations shall not be performed until after any widening and/or shoulder work reaches the elevation of the existing pavement grade. Shoulders and widening can then be completed in conjunction with the

placement of pavement courses over the compacted rubblized pavement.

734.04 MEASUREMENT. Rubblizing portland cement concrete pavement will be measured by the square yard (sq m). The width will be the nominal width of the existing pavement, and the length will be measured along the centerline of each roadway or ramp.

734.05 PAYMENT. Payment for rubblizing portland cement concrete pavement will be made at the contract unit price per square yard (sq m) which includes furnishing all materials, labor, equipment and incidentals necessary to complete the work.

Payment will be made under:

Item No.	Pay Item	Pay Unit
734-01	Rubblizing Portland Cement Concrete Pavement	Square Yard (Sq m)

Section 735
Mailboxes and Mailbox Supports

735.01 DESCRIPTION. This work consists of removing and replacing mailboxes, newspaper delivery tubes, and mailbox supports in accordance with these specifications, the plans and as directed.

Mailboxes are privately owned although placed on public right-of-way. Coordination with the mailbox owner and the United States Postal Service (USPS) shall ensure the owner receives mail deliveries.

The contractor shall notify the property owners on a form furnished by the Department, a minimum of 10 calendar days before removal, that the mailbox and supports will be removed for construction and will be replaced using approved materials in accordance with these specifications. The contractor shall also notify the property owners that salvageable material will be placed on the owner's property for the owner's disposal if the owner so desires. The contractor shall give the engineer documentation that all property owners have been notified in accordance with these specifications.

735.02 MATERIALS. Mailboxes shall be fabricated of light sheet metal or plastic complying with the requirements of the USPS. The replacement mailbox shall be the same size as the existing mailbox. Newspaper tubes shall be furnished by the property owner. Names and numbers on mailboxes will be the responsibility of the property owner.

Mailbox supports shall be galvanized and shall be metal posts with a strength no greater than a 2-inch (50 mm) diameter standard-strength steel pipe or 2-pound per foot (3 kg/m) flanged channels. Mailbox supports shall include an anti-twist device.

735.03 CONSTRUCTION REQUIREMENTS. Mailbox supports shall be installed a maximum of 24 inches (600 mm) in the ground and shall not be set in concrete.

Existing mailboxes shall be used unless the existing mailboxes are hazardous, damaged or cannot be used as determined by the engineer.

Support-to-box attachment shall be sufficient to prevent the box from separating from the support if the support is struck by an automobile or light truck. Newspaper tubes shall be mounted below the mailbox on the side of the mailbox support.

Disposal of materials by the contractor shall be in accordance with

Sub 202.02 at no direct pay.
Sampling and testing of materials will not be required.

735.04 MEASUREMENT. Mailboxes will be measured per each and will include furnishing new mailboxes. Mailbox supports will be measured per each and will include all materials, bolts, nuts, washers and other components, equipment, and labor necessary to remove and replace mailbox supports, install mailboxes, and install newspaper delivery tubes.

735.05 PAYMENT. Payment will be made at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
735-01	Mailboxes	Each
735-02	Mailbox Supports (Single)	Each
735-03	Mailbox Supports (Double)	Each
735-04	Mailbox Supports (Multiple)	Each

Section 736
Traffic Signals

736.01 DESCRIPTION. This work consists of furnishing and installing necessary materials and equipment to complete new traffic signal systems or modify existing systems in accordance with plan details and these specifications.

Unless otherwise specified, all materials shall be new.

When existing systems are to be modified, the existing material shall be incorporated in the revised system, salvaged or abandoned, as specified.

Incidental parts which are not shown on the plans, specified herein or in the project specifications, and which are necessary to complete the traffic signal or other electrical systems or required for modifying existing systems, shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the engineer at the time of final acceptance.

736.02 MATERIALS. Materials shall comply with the following Sections and Subsections:

Usable Soil	203.06
Portland Cement Concrete, Class M	901
Reinforcing Steel	1009
Precast Reinforced Concrete Junction Boxes and Manholes	1016
Manhole Frames and Covers	1018.04
Ground Rods	1018.05
Rigid Metal Electrical Conduit	1018.09
Electrical Conductors	1018.10
Traffic Signal Heads	1020.01
Traffic Detectors and Associated Equipment	1020.02
Traffic Signal Hardware and Equipment	1020.03
Pedestal Anchor Bolts	1020.03(c)
Support Cable	1020.03(d)
Guy Components	1020.03(e)
Traffic Signal Cable	1020.03(f)
Electrical Junction Boxes	1020.03(g)
Poles for Traffic Signal Systems	1020.04
Steel Standards and Mast Arms	1020.04(c)

Controllers shall comply with the supplemental specifications entitled "Traffic Signal Control System, Traffic Control Standards.

Traffic detectors and associated equipment shall be included in the Traffic Signal Control System, Traffic Control Standards, unless otherwise noted on the plans.

736.03 REGULATIONS AND CODE. Electrical equipment shall comply with the latest standards of the NEMA or the RMA, whichever is applicable. In addition to the requirements of these specifications, the plans, and the project specifications, material and work shall comply with the latest requirements of NFPA No. 70 National Electrical Code and ANSI C2 National Electrical Safety Code, the Standards of ASTM, ANSI, MUTCD, ITE and IMSA. The term code as referred to in this Section shall be the NFPA No. 70, National Electrical Code, and ANSI C2, National Electrical Safety Code. Discrepancies between codes or standards and these specifications, shall be resolved in accordance with Subsection 105.04.

736.04 GENERAL REQUIREMENTS. The contractor shall verify the location of existing utilities prior to construction. The contractor shall verify the practicality of the location, elevation, and orientation of foundations for poles and pedestals prior to ordering materials.

Traffic control equipment to be salvaged shall be protected during removal and delivery to the specified location. Equipment not to be salvaged shall become the property of the contractor and shall be disposed of in accordance with Subsection 202.02.

The contractor shall use the existing equipment or provide traffic signal equipment during the period of construction for continuous operation of the signal system at no direct pay. Traffic control operations and construction shall be in accordance with the plans or these specifications. Operational differences shall be submitted in writing and approved in advance by the Traffic Engineer.

The contractor shall provide police supervision of traffic at any time the traffic signal system is not in operation at no direct pay.

Minimum clearances for traffic signal supports and apparatus shall be in accordance with the MUTCD. Poles shall be located a minimum of 24 inches (600 mm) outside the shoulder or a minimum of 10 feet (3 m) outside the edge of the travelway whichever is greater.

The contractor shall provide drawings and equipment submittals in accordance with Subsection 730.04, except that the submittal shall be to the Traffic Services and Operations Engineer instead of the Bridge Design

Engineer. Shop drawings and submittals shall include cam breakout details and circuit identifications.

Upon completion of signal and controller work, each cabinet shall contain a plastic envelope with a completed copy of the Traffic Signal Inventory Form, LA. DOTD TSI-1 and a copy of the field wiring terminations pertaining to that intersection. The contractor shall submit to the District Traffic Engineer related documents including equipment manuals, traffic studies, copies of wiring diagrams, and manufacturer's certification letters, for each intersection prior to the new signals or signal modifications becoming operational.

736.05 ELECTRICAL SERVICE. The contractor shall verify the location of the power source and arrange for electrical service in accordance with Subsection 730.09. Existing power service shall be used unless a new power source is indicated on the plans. The traffic signal control equipment shall be in the same quadrant as the power source. If the power source is not in the same quadrant, the contractor shall submit a detailed drawing of proposed changes for approval.

At each power source, a 1-inch (25 mm) diameter conduit with conductors shall be attached to the service pole and terminated with a threaded service entrance fitting (weatherhead) at a height designated by the power company. The wires shall extend a minimum of 24 inches (600 mm) beyond the weatherhead.

736.06 FOUNDATIONS. Excavation for mast arm and strain pole foundations shall be drilled with an auger. Excavation for pedestal poles and controller foundations may be made with an approved auger or by hand. When a cave-in occurs during excavation, the contractor may continue excavating using casing or sleeving. Cave-ins shall be repaired before the foundation is placed. When subsurface obstructions are encountered, the contractor shall remove the obstructions or replace the excavated material and relocate the foundation, as directed, at no direct pay. Forms and ground which will be in contact with concrete shall be thoroughly moistened before placing concrete.

Foundations shall be cast monolithically. The exposed portions shall be formed to present a neat appearance. The bottom and sides of concrete foundations shall rest on firm undisturbed ground. Pole foundations shall be placed with the bored hole as the form. Backfill around a cast-in-place foundation will not be allowed.

Tops of foundations for poles and signal supports, except special

foundations, shall be finished at grade of curb top or sidewalk or as directed. Conduit ends and anchor bolts shall be placed in correct position and shall be held in place by a template.

Exposed surfaces of concrete shall receive a Class 1, Ordinary Surface Finish in accordance with Subsection 805.13 except when the edge of a concrete foundation is within 18 inches (450 mm) of a sidewalk, the sidewalk section shall be in accordance with Section 706.

The tops of mast arm foundations shall be level so the pole base will be in full contact and the pole will be vertical without the use of shims. Anchor bolts shall extend a minimum of 1/4 inch (6 mm) above the nut.

Conduits which terminate in anchor base type poles and pedestals shall extend approximately 3 inches (75 mm) above the foundation and shall be aligned toward the handhole opening.

An additional 2-inch (50 mm) diameter conduit stub-out shall be installed in foundations for future use. The foundation shall be marked as shown on the plans to indicate the location of the additional conduit and grounding conduit.

736.07 PEDESTAL POLES. The pedestal poles shall be installed plumb within 1 inch (25 mm) at the top. Pedestal poles not constructed within the 1 inch (25 mm) tolerance shall be removed and the foundation reconstructed at no direct pay. Shims will not be permitted on a new pedestal foundation. A total of 1/4 inch (6 mm) of shims will be permitted on existing foundations. When an existing pedestal pole cannot be shimmed within tolerance through no fault of the contractor, the existing foundation shall be replaced in accordance with Subsection 109.04.

736.08 MAST ARMS. After installation and loading, mast arm shaft shall be plumb within 1 inch (25 mm) at the top. The end of the mast arm shall be a minimum of 5 feet (1.5 m) above the top of the shaft. The end of the mast arm shall be a minimum of 21 feet (6.4 m) above the bottom of the transformer base. The mast arms shall be installed with compression grommet bushing (CGB) connectors in bosses utilized for cabling.

736.09 STRAIN POLES. Strain poles for the attachment of support cables shall be the anchor base type. Support cable shall be attached in accordance with Subsection 736.12. Poles shall be plumb within 6 inches (150 mm) at the top after support cable tensioning in accordance with the plans.

736.10 TIMBER POLES. Poles shall be set in holes drilled by an auger to a minimum depth of 6 feet (1.8 m). Auger diameter shall be approximately 4

inches (100 mm) greater than the pole butt diameter. The poles shall be embedded in the ground a minimum of 20 percent of the pole length. The poles shall be plumb within 6 inches (150 mm) at the top after support cable tensioning in accordance with the plans. Backfill material shall be provided and compacted as directed.

Holes for the attachment of support cables shall be fitted with 5/8-inch (16 mm) diameter thimble-eye through-bolts and 2 1/2 inch (65 mm) square curved washers.

Each pole shall have a continuous length of No. 8 AWG copper wire along the length of the pole. A minimum of 6 feet (1.8 m) of the copper wire shall be coiled and attached to the bottom of the pole forming a coil ground. The copper wire shall extend a minimum of 6 inches (150 mm) above the top of the pole. The wire shall be stapled with galvanized 1 1/2 inch (40 mm) staples at approximately 6-inch (150 mm) intervals beginning at the butt, then at approximate 12-inch (300 mm) intervals beginning at 12 feet (3.6 m) from the butt and continuing to the top of the pole.

Anchors shall be installed on new poles in accordance with the plans.

736.11 GUY WIRE ASSEMBLIES. Guy wire shall be attached to the pole with a 5/8-inch (16 mm) diameter angle thimble-eye bolt of appropriate length through a lift plate fastened to the pole by two 3/8-inch (9.5 mm) diameter lag screws. The opposite side of the pole shall have a 2 1/2 inch (65 mm) square curved washer, a square nut, and a thimble-eye nut for termination of support cable. An additional square nut shall be used as a locking nut against the thimble-eye nut.

Hardware shall be tightened against the pole. Excess bolt length shall be sawn to within 1/4 inch (6 mm) of the nut and the galvanized coating repaired in accordance with Subsection 811.12.

The guy assembly shall have strain insulator, thimble eye anchor rod, service sleeves, and screw-type anchors as shown on the plans. Installed anchors shall develop holding strength and be properly aligned to provide permanent stability to the installation.

Guy assemblies shall be installed and tensioned before erection of signals so that they will resist the major portion of the horizontal loading.

736.12 SUPPORT CABLE. Support cable with accessories shall be installed between two or more poles to provide support and attachment for traffic control equipment. Support cables shall be grounded. Accessories used with support cables shall include strain insulators and three-bolt clamps. Long strain insulators shall be used as needed for safety clearance and shall

require approval when not shown on the plans. Attachments of the support cable shall be made with standard thimble-type hardware.

736.13 VEHICLE AND PEDESTRIAN SIGNAL HEADS. Signals shall be vertical unless otherwise specified. Cable suspended heads shall be fitted with a universal hanger. Drop pipes will be allowed only when necessary to provide proper roadway clearance. Disconnect hangers shall be required for cable suspended heads.

Mast arm mounted signals shall be installed using an approved adjustable rigid bracket.

Each bulb in the signal head shall be connected to an individual wire from the controller. Lamp sockets shall be rotated to position the open portion of the lamp filament upward.

Each signal head shall be oriented to its lane or crosswalk and secured in place by a serrated or other locking device incorporated in signal housing and support hardware. Supporting brackets on trunnions shall be used at the top and bottom of the section assembly to rigidly support all faces. Openings not used for mounting purposes shall be closed with approved threaded weatherproof plugs.

A minimum of 8 feet (2.4 m) between signal heads is required, measured between imaginary lines centered on each signal head parallel to the approach. The signal head shall be aimed within 3 degrees of parallel to the approach lane to which it applies, or as directed.

Vehicular signal heads shall be covered with a sturdy opaque material until placed in service.

A 12-inch (300 mm) light emitting diode (LED) traffic signal lamp unit shall be provided as part of a new traffic signal head or as a retrofitted replacement into a new or existing signal housing.

Installation of a retrofitted replacement LED traffic signal lamp unit into a new or existing signal housing shall only require removal of the existing lens and incandescent lamp, fitting of the new unit securely in the housing door, and connecting the new unit to existing electrical wiring or terminal block by means of simple connectors. The LED retrofit will not require removal of the reflector. The existing wiring for the incandescent socket shall remain in place, but shall be disconnected from the terminal block, and neatly coiled adjacent to the terminal block with connectors taped with electrical tape to prevent accidental short circuits.

If proper orientation of the LED traffic signal lamp unit is required for optimum performance, prominent and permanent directional marking(s), such as an “UP arrow”, for correct indexing and orientation shall be clearly

displayed on the unit.

The contractor shall neatly inscribe the installation date on the back of each LED traffic signal lamp unit.

Each LED traffic signal lamp unit shall be provided with a complete and accurate installation wiring guide and the name, address, and telephone number for the representative, manufacturer, or distributor for warranty replacement.

Each LED traffic signal lamp unit shall be individually packaged and delivered securely bound on pallets. Each package shall be labeled with the manufacturer's name, individual serial number, manufactured date, model, and batch or lot number.

736.14 VEHICLE LOOP DETECTOR INSTALLATION. Slots shall be sawed in the pavement for installation of vehicle detector loop wire in the configuration, dimensions, and combinations as shown on the plans. An extension from the loop to the pavement edge shall be cut to permit wire routing to an adjacent pullbox or condulet through a 1/2-inch (13 mm) conduit.

Slots shall be cleaned of loose material. The engineer shall examine and approve the depth of each loop slot for conformance with the plans before the contractor places the loop wires in the slot. Wires shall be carefully placed in the slot. The number of turns of wire installed for each loop shall be as required. The wire shall be pushed carefully into the slots with a blunt tool to avoid damaging the insulation. No splices will be permitted in the loop installation except in the pull-box, conduit fittings or pole. Wires from the pavement to the controller box shall be installed inside a conduit as shown on the plans. Wire installed from the pavement edge to the splice shall be twisted uniformly at 2 to 5 turns per foot (7 to 16 turns/m). The loop ends shall be spliced to a lead-in cable. The lead-in cable shall be connected inside the controller cabinet. The wires shall be spliced using an approved connector and by soldering, then encapsulated with an approved electrically insulating waterproof epoxy as shown on the plans. The condulet shall not be filled with the approved insulating waterproof epoxy.

The slots shall be completely filled to within 1/8 inch (3 mm) of the pavement surface with an approved sealant.

736.15 PEDESTRIAN PUSHBUTTON. Pushbuttons shall be installed on poles or pedestals at locations where the signal head is visible from the pushbutton location. Push-buttons mounted on steel poles shall be serviced by wiring inside the poles. Wires shall be installed through a 3/4-inch (20 mm)

diameter hole in the pole and through the back of housing and shall be installed with a rubber grommet. Unused conduit attachment holes shall be plugged. The housing shall be attached to the pole using machine or selftapping screws.

Pushbuttons mounted on wood poles shall be wired through conduit. Pedestrian pushbutton signs shall be installed above the pushbutton.

736.16 ELECTRICAL. Wires in cabinets shall be neatly laced into cables with nylon lacing or plastic straps.

Conductors shall be installed in conduit except where the run is inside poles or suspended from support cable.

After completion of field wiring, the conduit entering cabinets, pole bases, or junction boxes shall be sealed with a removable sealing material compatible with the cable jacket, insulation and conduit material.

Support cable, metallic cable sheaths, conduit, transformer cases, metal poles and pedestals shall be made mechanically and electrically secure and grounded. Bonding and grounding jumpers shall be No. 6 AWG copper wire. Equipment on wood poles shall be grounded.

Cable from the circuit breaker at the service to the controller shall consist of a minimum of three No. 6 AWG THWN stranded copper wires.

Six feet (2 m) of spare signal, loop lead-in and communication cable shall be installed in each base-mounted cabinet. Field wiring shall be connected to terminals by one piece, screw-tightened lugs.

Aerial signal cable shall have a drip loop extending at least 6 inches (150 mm) below the entrance. The aerial signal cable and drip loop shall not chafe on the equipment.

Signal cable shall be installed between signal heads and controller cabinets. When specified, interconnect and/or communication cable shall be installed between controller cabinets of different intersections. Signal, interconnect, and/or communication cable may be lashed to support cable or installed in underground conduit as shown on the plans. Lashing material shall be stainless steel for interconnect and aluminum for signal cable.

736.17 CONDUIT INSTALLATION. Underground wiring shall be enclosed in conduit. Conduit connections shall use threaded couplers and shall be sealed with a waterproof sealant. Coupling of new conduit to existing conduit shall be with a three-piece coupling.

Threads shall be clean cut, straight and true, and of sufficient length to permit full-depth coupling. Excessive threads will not be permitted. Ends of conduit installed for future connections shall be threaded, reamed and capped.

Couplings shall be tightened until the conduit ends are together. Damaged coatings in exposed threads shall be repaired in accordance with Subsection 811.12. Exposed threaded ends of conduit shall be terminated with an insulated-throat, ground-type bushing.

Backfilling shall be with usable soil, placed and compacted to at least the density of the surrounding ground at no direct pay. After installation, conduits shall be tested for clearance with a 2 inch (50 mm) long mandrel having a diameter 1/4 inch (6 mm) smaller than the inside diameter of the conduit. Conduits not allowing passage of the mandrel will be rejected.

The contractor may install larger size conduit at no direct pay. No reducing couplings will be permitted in a conduit run.

Underground conduits shall be buried a minimum of 18 inches (450 mm) below the surface. Conduits for loop detectors shall be installed parallel to existing or proposed curbs and a maximum of 24 inches (600 mm) behind the back of curb or as directed. Conduit shall be jacked or bored under existing pavements and within the drip line of trees in accordance with Section 728.

736.18 CONTROL EQUIPMENT. Field wiring in controller cabinets and bases shall be neatly arranged, lashed into cables, routed to the appropriate terminal blocks, and permanently identified near the terminal.

Controller equipment programming shall be provided by the contractor. When the information supplied by the Department is insufficient for functional operation of the installed equipment, the contractor shall notify the engineer in writing of the problem identifying discrepancies, and proposing specific remedies or corrections. After programming, controller equipment operations shall be tested with the signals off, using the signal shutdown switch.

736.19 JUNCTION BOXES. Junction boxes, when shown on the plans, are required a minimum of every 150 feet (45 m) in a conduit run. Backfilling shall be with usable soil, shall conform to Subsection 701.08, and shall be placed and compacted to the density of the surrounding ground at no direct pay. All metal covers and conduits shall be bonded together.

Electrical conductors shall be installed clear of the metal frames and covers.

Pull box fittings shall be used on conduit longer than 180 feet (55 m). Pull box fittings shall be installed at a minimum spacing of 90 feet (27 m).

736.20 EQUIPMENT TESTING.

(a) Manufacturer's Tests: When design tests are specified herein, additional tests will not be required if documentation is provided indicating that such tests have been previously completed. Equipment shall be subject to factory demonstration tests and design approval tests at a location agreed upon by the contractor and the Department. The Department reserves the right to have its representative witness all factory demonstration tests and design approval tests.

Performance tests may be required on equipment not previously tested or approved. The Department will not be responsible for time lost or delays caused by sampling and testing prior to final approval of any item.

The contractor shall conduct special tests when equipment or systems are suspected of improper operation, or when additional data is necessary to determine proper operation or conformance with specifications.

A test shall be performed on the completely assembled equipment, cabinet, and control equipment by the manufacturer prior to shipment. Malfunctions or defects shall be corrected and the equipment retested. The complete log beginning with the first test, showing the results of the test shall be delivered with the equipment. The test shall require the operation of the equipment with each signal circuit connected to an incandescent load of a minimum of 600 watts. The equipment shall operate sequentially and continuously for a minimum of 48 hours as stated above in an environment having a minimum temperature of 140°F (60°C).

(b) Insulation Tests: Insulation tests shall be made between conductors and ground and between conductors. Tests shall be made after the conductors are installed and before connecting equipment that may be damaged by the tests. Readings below 50 megohms, when measured with a 1000 volt D.C. insulation tester, will be considered defective.

(c) Test Documentation: Documentation shall include a Certificate of Compliance, two sets of cabinet wiring drawings, and technical manuals for the control equipment. Cabinet drawings shall be DOTD standard blue line copies, with the manufacturer's name, equipment model number, project number, sheet number, date and revision block.

736.21 MEASUREMENT.

(a) Trenching and Backfilling: Trenching and backfilling will be measured by the linear foot (lin m) of excavated trench backfilled and accepted.

(b) Conduit with Conductors: Conduit with conductors will be measured by the linear foot (lin m) of conduit with conductors installed and

accepted. Measurement will include conduit, conductors, clamps, fittings, above ground junction boxes, and miscellaneous hardware required for a complete conduit installation.

(c) Jacked or Bored Conduit: Jacked or bored conduit will be measured by the linear foot (lin m) of conduit furnished and installed. Measurement will include the conduit, fittings, excavation, backfilling and duct markers.

(d) Signal Support: Signal supports will be measured per each signal or strain pole installed and accepted. Measurement will include the pole, mast arm, base assembly, guy wires and hardware, signal support cables and hardware, traffic signal cables inside pole, concrete foundation, reinforcing steel, conduits in foundation, ground rod, ground wires, ground clamp, hardware, drilled excavation, backfill, grout, electrical oxide-inhibiting compound and disposal of excess excavated material.

(e) Signal Heads: Signal heads will be measured per each head installed and/or retrofitted, and accepted. Measurement will include disconnect hangers, traffic signal wiring attached to overhead span, closure caps, mounting hardware, LED traffic signal lamp units, head programming, mounting connections and hardware.

(f) Signal Service: Signal service will be measured per each service assembly installed and accepted. Measurement will include pole, disconnect, ground rod, wire and conduit on service pole, conduit and conductors on utility company pole, and connections and hardware required.

(g) Traffic Signal System: Traffic signal systems will be measured on a lump sum basis, which will include furnishing and installing all equipment and apparatus, and performing work required for a complete system.

(h) Signal Controller: Signal controllers will be measured per each controller installed and accepted. Measurement will include all electronic control equipment specified, prewired cabinet, foundation, conduits in foundation, ground rod assembly, anchor bolts and hardware, connections, documentation, programming, and testing.

(i) Loop Detector: Detectors will be measured by the linear foot (lin m) of sawn slot. Measurement will include sawing, installed wire and sealing. Measurement will be made from the edge of the pavement and once around each loop perimeter.

(j) Underground Junction Box: Underground junction boxes will be measured per each box installed and accepted. Measurement will include the box, cover, excavation, backfill and any concrete patching required.

(k) Conduit: Conduit will be measured by the linear foot (lin m) point to point of conduit installed and accepted. Measurement will include conduit

(including conduit within junction boxes), clamps, fittings, above ground junction boxes, and all miscellaneous hardware required for a complete conduit installation.

(l) Conductors: Conductors will be measured by the linear foot (lin m) of conductor installed and accepted. Measurement will include conductor, clamps, connectors, and all miscellaneous hardware required for a complete conductor installation.

(m) Cable: Cable will be measured by the linear foot (lin m) of cable installed and accepted. Measurement will include cable, clamps, connectors, and all miscellaneous hardware required for a complete cable installation.

736.22 PAYMENT. Payment for traffic signal work will be made at the contract unit prices, which include all materials, tools, equipment, labor and incidentals necessary to complete the work.

The concrete in foundations for signal supports, signal controllers, and other signal equipment will be identified by lots and shall be subject to pay adjustments in accordance with Table 901-6 and Note 1 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

Payment will be made under:

Item No.	Pay Item	Pay Unit
736-01	Trenching and Backfilling	Linear Foot (Lin m)
736-02	Conduit with Conductors (Size & Type)	Linear Foot (Lin m)
736-03	Jacked or Bored Conduit (Size & Type)	Linear Foot (Lin m)
736-04	Signal Support (Size & Type)	Each
736-05	Signal Heads (Type)	Each
736-06	Signal Service	Each
736-07	Traffic Signal System	Lump Sum
736-08	Signal Controller	Each
736-09	Loop Detector	Linear Foot (Lin m)
736-10	Underground Junction Box	Each
736-11	Conduit (Size & Type)	Linear Foot (Lin m)
736-12	Conductor (Size & Type)	Linear Foot (Lin m)
736-13	Cable (Size & Type)	Linear Foot (Lin m)

Section 737
Painted Traffic Striping

737.01 DESCRIPTION. This work consists of furnishing and applying reflective white or yellow paint for pavement striping in accordance with plan details, the MUTCD and these specifications.

737.02 MATERIALS. Traffic paint shall be either quick dry alkyd or waterbased traffic paint complying with Subsection 1015.12. Glass beads for drop-on application shall comply with Subsection 1015.13.

737.03 EQUIPMENT. Selection of proper equipment to produce satisfactory results within the following requirements shall be the responsibility of the contractor.

(a) Equipment shall permit traffic to pass safely within the limits of the roadway surface and shoulder while operating.

(b) Equipment shall be designed for placement of both solid and broken line stripes of the spacing shown on the plans with square, neat stripe ends.

(c) Equipment shall provide a method for cleaning the surface of dust immediately prior to placement of striping materials.

(d) Equipment shall provide a gravity bead dispenser for drop-on application of glass beads.

(e) The equipment shall provide accurate regulation of the application rate and shall have a tachometer or other approved device to ensure uniform paint application at the designated rate. The equipment shall be adjustable for applying one, two or three adjacent lines simultaneously at the specified spacing and be equipped with a device capable of following a control line. Operation of the unit shall be such that paint will not be spattered or blown on another stripe. The unit shall be designed to properly agitate the paint while in operation.

(f) The equipment may be equipped with a heat exchanger to heat the paint to reduce drying time.

(g) The operation shall include a trailing vehicle equipped with a flashing arrow board.

737.04 CONSTRUCTION. Yellow centerline striping shall be used to delineate traffic moving in opposite directions. White lane line striping, shall be used to delineate traffic moving in the same direction. These stripings shall

be broken lines and solid lines as required by Part 3 of the MUTCD. Edge lines shall be solid lines, the color of which shall be determined from Part 3 of the MUTCD.

Pavement striping shall be 4 inches (100 mm) in width on all routes. Striping widths for gore markings and turning lanes shall be 8 inches (200 mm) unless noted otherwise in the plans. All lines shall have clean edges with a width tolerance in accordance with Subsection 737.08. The project engineer may waive the tolerance when deviations are caused by undulation in the pavement surface.

Broken lines shall be constructed with a stripe-to-gap ratio of a 10-foot (3 m) paint stripe to a 30-foot (9m) gap. The length of the stripe shall be 10 feet (3 m) minimum and 10 1/2 feet (3.2 m) maximum. The stripe-gap cycle shall be 40 feet (12 m) minimum and 40 1/2 feet (12.3 m) maximum.

The contractor shall apply all striping on new pavement prior to opening to traffic, except when rain or other unavoidable occurrences prevent marking the pavement, in which case the pavement shall be marked as soon as conditions permit.

737.05 SURFACE PREPARATION. Surfaces to be striped shall be cleaned of materials that may reduce adhesion of paint to pavement. Surfaces shall be kept clean and dry at the time of application of paint.

737.06 WEATHER LIMITATIONS. No paint striping shall be done when the pavement surface is not thoroughly dried, when the air is foggy or misty, when the air or surface temperature is below 50°F (10°C), or when wind or other condition causes a film of dust to be deposited on the surface after cleaning and before striping can be done or causes displacement of striping material.

737.07 APPLICATION. The longitudinal joint or existing centerline stripe shall be used in determining the location of the centerline of new striping. In the absence of a longitudinal joint or existing stripe, the location of the centerline of new striping shall be located by the contractor with the approval of the engineer. Broken line individual intervals will not be marked. No striping material shall be applied over a guide stringline.

(a) Paint Preparation: Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned without approval.

Paint may be heated in heat exchangers to accelerate drying, to a

temperature between 110°F and 130°F (43°C and 54°C) for waterbased paint, and between 120°F and 150°F (49°C and 66°C) of solvent based paint.

(b) Application Rate: Paint shall be applied at the rate of 25 gallons per mile (59 L/km) at a thickness of 22 wet mils (560 wet µm) and 15 dry mils (380 dry µm) to produce a 4-inch (100 mm) wide solid line. Temporary paint shall be applied at a thickness of 15 wet mils (380 wet µm).

Glass beads, complying with Subsection 1015.13, shall be applied at the same time as the paint but in a separate operation at the rate of 10 pounds of beads per gallon of paint (1.2 kg/L).

737.08 TOLERANCES. A tolerance of +1/2 inch and -1/8 inch (+13 mm and -3 mm) from the specified width will be allowed, provided the variation is gradual. Segments of broken line may vary ±6 inches (150 mm) from the specified length provided it is not consistently short. Segments shall be squared off at each end without mist or drip. Longitudinal painted lines shall not deviate from established alignment by more than 1 inch (25 mm) provided the variation does not increase or decrease at the rate of more than 1/2 inch in 25 feet (15 mm in 10 m). Lines not meeting these tolerances shall be removed by abrasive blasting or grinding and replaced at no direct pay.

737.09 PROTECTION OF MARKINGS. Traffic shall be prevented from crossing a wet stripe. The contractor shall use flaggers or other methods to prevent traffic from crossing the wet stripe or adjust the operation. Stripes that have been marred or picked up by traffic before they have dried shall be repaired by the contractor at no direct pay. The pavement shall be cleaned outside the stripe at no direct pay.

The contractor is not required to maintain striping which has been accepted and opened to traffic.

737.10 PROTECTION OF TRAFFIC. The contractor shall furnish and place all necessary temporary warning and directional signs to direct and protect the traveling public during striping operations.

The pavement striping equipment shall move in the direction of normal traffic flow. The trailing vehicle shall be equipped with an approved flashing arrowboard for directing traffic to the appropriate side during striping operation, when required. Temporary signs, cones and equipment shall be removed from the roadway when striping equipment is not in operation.

Protective and traffic marking devices shall comply with Section 713.

The contractor shall be responsible for resolving all issues related to paint on private vehicles at no direct pay.

737.11 FIELD TESTING OF PAINTED TRAFFIC STRIPING: The Department will field test the pavement markings in accordance with Subsection 1015.12 and Table 737-1. Failure to meet these requirements will require the contractor to replace the portion of the material shown to be out of specifications as directed by the engineer.

737.12 CORRECTIVE WORK: Any line found to be defective shall be restriped or replaced as directed by the engineer. The corrective work shall also be subject to these requirements. The contractor shall replace the painted traffic striping material at no cost to the Department.

737.13 GUARANTEE: The contractor shall provide the Department with a guarantee stating that if the painted traffic striping fails to comply with the stated performance requirements, the contractor shall take the remedial action required. Replacement striping shall carry the unexpired guarantee of the striping it replaces.

737.14 MEASUREMENT. Painted Traffic Striping will be measured by the mile (km) or linear foot (lin m) as specified.

(a) Mile (km): Measurement will be by the mile (km) of single stripe per roadway. No deduction will be made for the standard 30-foot (9 m) design gaps in broken-line striping; however, deductions will be made for the length of other omitted sections.

(b) Linear Foot (Lin m): Measurement will be by the linear foot (lin m), exclusive of gaps.

737.15 PAYMENT. Payment for painted traffic striping will be made at the contract unit prices.

Payment will be made under:

Item No.	Pay Item	Pay Unit
737-01	Painted Traffic Striping (Solid Line)	Mile (km)
737-02	Painted Traffic Striping (Broken Line)	Mile (km)
737-03	Painted Traffic Striping (Solid Line)	Linear Foot (Lin m)

Table 737-1
Field Testing of Painted Traffic Striping

Length of Roadway	Number of Random Test Segments	Length of Test Segments
Less than 1 mile (1.5 km)	3 segments per line type	250 feet (75 m)
1 mile (1.5 km) to 9 miles (14.5 km)	3 segments per line type	1000 feet (300 m)
Greater than 9 miles (15 km)	1 segment per every 3 miles (4.8 km) per line type	1000 feet (300 m)

Measurements

1. Test segments will be selected randomly by the engineer unless night reviews or other knowledge supersedes a random selection process.
2. Each line type will be measured separately.
3. Measurements will be taken on dry, clean roadways.
4. Data will be collected in direction of traffic flow.
5. A minimum of 10 readings will be taken in each test segment line type.
6. On broken lines (skip striping), no more than two readings will be taken per stripe, with readings 20 inches (0.5 m) from ends of marking.
7. For solid lines, the test segment will be divided into ten locations of 100 feet (30 m) each; readings will be spaced a minimum of 25 feet (7.5 m) and a maximum of 150 feet (45 m) apart.
8. The Department may take additional readings or test segments.
9. Acceptance will be based on the average of the readings for each test segment for each line type.
10. Failure of the average reading for any segment to meet the specified minimum values will require replacement.
11. Limits of replacement will be determined by the engineer.

Section 738
Mulch Sodding

738.01 DESCRIPTION. This work shall consist of furnishing, hauling, spreading, fertilizing and liming (if required), rolling, watering and maintaining live bermuda grass roots and topsoil at locations shown on the plans or as directed.

738.02 MATERIALS. Mulch sod shall consist of a combination of grass roots and topsoil. Mulch sod shall be predominately bermuda grass or other approved grass roots reasonably free of weeds and debris.

Topsoil shall comply with Subsection 715.02.

Fertilizer and agricultural lime shall comply with Section 718.

Water may be obtained from any source except brackish, chemically contaminated, or oily water shall not be used.

738.03 EQUIPMENT. A single or double type soil roller or cultipacker weighing not less than 500 pounds (225 kg) and not more than 1500 pounds (680 kg) will be required.

Water wagons, tanks or sprinkling devices will be required.

738.04 CONSTRUCTION REQUIREMENTS.

(a) Digging: The source of mulch sod approved by the Roadside Development Specialist shall be mowed and raked when necessary. Mulch sod shall not be stockpiled for more than 48 hours.

Mulch sod shall be free of tree roots, tops, branches or other debris. Such foreign material shall be removed prior to the sod being stockpiled or delivered.

When agricultural lime is necessary to adjust the soil pH to between 5.5 and 8.0, it shall be done on sod field prior to stockpiling and delivery at no direct pay.

(b) Hauling: Mulch sod shall be loaded with suitable equipment, hauled and spread on the areas designated on the plans or as directed.

(c) Surface Preparation: Fertilizer shall be broadcast over the entire area to be mulch sodded before mulch sodding is placed and disked. When required, agricultural lime or other treatment to adjust pH to between 5.5 and 8.0 shall be applied to the area to be mulch sodded prior to scarifying. Areas to receive mulch sod shall be scarified and pulverized to a depth of

approximately 3 inches (75 mm) and dressed to grade at no direct pay.

(d) Spreading: The mulch sod shall be spread to a depth of approximately 6 inches (150 mm) in such a manner that a minimum amount of roots are exposed. Spike tooth harrows or drags shall not be used to spread mulch sod. The mulch sod shall be dressed to grade.

(e) Rolling: The mulch sod shall be rolled with a cultipacker or soil pulverizer as directed. Locations inaccessible to rolling equipment shall be hand tamped.

(f) Watering: Mulch sod shall be watered and kept moist as directed until satisfactory growth is established at no direct pay.

738.05 MEASUREMENT. Mulch sod will be measured by the cubic yard (cu m) in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01.

Fertilizer will be measured and paid for in accordance with Section 718. Agricultural lime, when specified, will be measured and paid for in accordance with Section 718.

738.06 PAYMENT. Payment for mulch sod will be made at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
738-01	Mulch Sodding	Cubic Yard (Cu m)

Section 739
Hydro-Seeding

739.01 DESCRIPTION. This work consists of preparing seed beds and sowing grass seed utilizing hydro-seeding equipment and methods in order to establish a turf grass cover to areas designated on the plans or as directed.

739.02 BED PREPARATION. Seed beds shall be prepared in accordance with Subsection 717.04.

739.03 HYDRO-SEEDING GENERAL. Hydro-seeding shall consist of mixing and applying seed, commercial fertilizer, water management gel, polyacrylamide tackifier, and mycorrhizal inoculum with paper or wood fiber and water. Seed and commercial fertilizer shall be uniformly spread over the area at the rates specified in Table 717-1 and Table 718-1. Paper or wood fiber shall be mixed and applied with the seed in accordance with the manufacturer's recommendations and as approved by the engineer. The contractor will be permitted to include fertilizer and lime in the seeding slurry for application during hydro-seeding operations.

The application rate for pellet-inoculated seed shall be determined using the seed mass exclusive of inoculant materials.

The materials and the quantities thereof to be mixed with water will be specified. The quantity of water shall be as needed for application.

Mixing of materials for application with hydro-seeding equipment shall be performed in a tank with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous mixture and a discharge system which will apply the mixture at a continuous and uniform rate. The tank shall have a minimum capacity of 962 gallons (3700 L). The engineer may authorize use of equipment of smaller capacity if it is demonstrated that the equipment is capable of performing all operations satisfactorily.

A dispersing agent may be added to the mixture provided the contractor furnishes evidence that the additive will not affect germination. Any material considered detrimental, as determined by the engineer, shall not be used.

Any mixture containing polyacrylamide tackifier shall not be applied during any rainy weather or when soil temperatures are below 41°F (5°C) or if the wind speed is above 20 miles per hour (32 km/h). Pedestrian traffic or equipment shall not be permitted to enter areas where hydro-seeding has been applied.

Prior to planting, the engineer will contact the Department's roadside development personnel to select the varieties of seed to be used.

739.04 MEASUREMENT. Quantities for hydro-seeding will be measured by the acre (ha).

739.05 PAYMENT. Payment for hydro-seeding will be made by the acre (ha) and shall include the seed, mulch, tackifier, lime, fertilizer, water and bed preparation as a system.

Payment will be made under:

Item No.	Pay Item	Pay Unit
739-01	Hydro-Seeding	Acre (ha)

Section 740
Construction Layout

740.01 DESCRIPTION. This section sets forth requirements for all construction layouts. The work consists of establishing lines and grades, taking all cross sections, and staking out the construction work in accordance with these specifications, plan details, and as directed. This work also includes but is not limited to, the layout of pavement striping and raised pavement markers, setting of line and grade for construction of superelevated curves or other applicable work items, and providing assistance in the coordination of utility relocation activities to ensure that the placement of relocated facilities will not conflict with required construction.

740.02 CONSTRUCTION REQUIREMENTS. The contractor shall establish all lines and grades and stake out all work on this project, including sufficient vertical and horizontal points for utility relocations for use by the Department and others.

The project survey control and horizontal alignment are based on the Louisiana State Plane Coordinate System (NAD-83--92), as determined by GPS observation. The construction plans and/or right-of-way map depicts the coordinates of sufficient survey control points to establish or re-establish horizontal control throughout the length of the project. The contractor shall employ such methods as approved by the project engineer for the location of the project alignment and other necessary survey control points in accordance with currently acceptable surveying standards and practices. When required, the Department will also provide one bench mark on or near the project for vertical control. The contractor shall verify the values of any intermediate bench marks shown on the plans, by checking against the bench mark established by the Department for vertical control.

The contractor shall employ qualified engineering and surveying personnel experienced in layout and construction of highways and bridges to correctly establish and keep complete and comprehensive notebook records (field books) of all lines and grades necessary from initial layout to final acceptance. The contractor shall provide sufficient qualified staff, of at least one employee, on site during utility relocation periods. The contractor shall provide any necessary survey work to ensure there are no utility conflicts with required construction. The contractor shall provide daily documentation of utility relocation activities for incorporation into the project diaries.

The contractor shall be liable for the accuracy of the initial layout and all subsequent alignment and elevations and shall, at no additional pay, rebuild, repair or make good any portion of the work found to be incorrectly positioned either horizontally or vertically at any time before final acceptance. The contractor shall notify the engineer immediately of any apparent errors in the plans. The contractor shall compute and provide template grades to the engineer. In order to obtain pipe order lengths, the appropriate grades shall be provided to the engineer two weeks in advance of the work.

Numbered notebooks for recording of all lines and grades will be provided by the Department and shall be properly indexed and cross referenced by the contractor before return to the engineer for submittal with the final estimate. Computer generated printouts will be allowed when approved.

Stationing for overlay projects shall be set using an approved measuring device that is accurate to 0.1 percent. Stakes shall be placed every 100 linear feet (50 lin m) and maintained by the contractor throughout construction.

Layout of striping, raised pavement markers, and signs shall be done by methods approved by the engineer prior to placement.

740.03 MEASUREMENT. Measurements for determination of pay quantities will be made by the Department. Construction layout and utility oversight and coordination will be measured per lump sum, which will include all labor, materials and incidentals required to complete the work.

No changes in the lump sum contract price will be made for minor additions or deletions to the scope of work.

740.04 PAYMENT. Payment for construction layout, and utility oversight and coordination will be made at the contract lump sum price in accordance with Table 740-1 and Table 740-2, respectively.

Table 740-1
Construction Layout Payment Schedule

Percent of Total Contract Amount Earned	Allowable Percent of Lump Sum Price for Construction Layout
Staffed	25
25	50
50	80
75	95
100	100

Table 740-2
Utility Oversight and Coordination Payment Schedule

Percent of Utility Relocation Complete	Allowable Percent of Lump Sum Price for Construction Layout
Staffed	25
25	50
50	65
75	80
100	85
Project Completion	100

Payment will be made under:

Item No.	Pay Item	Pay Unit
740-01	Construction Layout	Lump Sum
740-02	Utility Oversight and Coordination	Lump Sum

Section 741
Water Distribution Systems

(Supplemental Specification)
(Under Separate Cover)

Section 742
Sanitary Sewer Systems

(Supplemental Specification)
(Under Separate Cover)

Section 743
Airport Pavement Markings

(Supplemental Specification)
(Under Separate Cover)