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Special Project Specifications
for
Construction
of
Roads and Bridges

DIVISION 600 – Incidental Construction

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DIVISION 600 - Incidental Construction

Section 601 - Mobilization

Description

601.01 Work. Move personnel, equipment, material, and incidentals to the project, and perform all activities necessary to accomplish work at the project site. Obtain permits, insurance, and bonds.

Measurement

601.02 Method. Measure mobilization by the lump sum.

Payment

601.03 Basis. The accepted quantity, measured as provided above, will be paid at the contract price per unit of measurement for the PAY ITEM listed below that is DESIGNATED IN THE SCHEDULE OF ITEMS.

The mobilization lump sum will be paid as follows:

- (a) If applicable, bond premiums will be reimbursed according to FAR clause 52.232-5, Payment Under Fixed-Price Construction Contracts, after receipt of evidence of payment.
- (b) Fifty percent of the lump sum, not to exceed 5 percent of the original contract amount, will be paid following completion of 5 percent of the original contract amount, not including mobilization.
- (c) Payment of the remaining portion of the lump sum, up to 10 percent of the original contract amount, will be paid following completion of 10 percent of the original contract amount, not including mobilization.
- (d) Any portion of the lump sum in excess of 10 percent of the original contract amount will be paid after final acceptance.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
601(01) Mobilization	Lump Sum

Section 602 - Minor Concrete Structures

Description

602.01 Work. Construct reinforced or unreinforced minor concrete structures.

Materials

602.02 Requirements. Furnish materials that meet the requirements specified in the following subsections:

Air-Entraining Admixtures	711.02
Cement	701.01
Chemical Admixtures	711.03
Coarse Aggregate for Portland Cement Concrete	703.02
Curing Material	711.01
Fine Aggregate for Portland Cement Concrete	703.01
Fly Ash	725.04
High-Strength Nonshrink Grout	701.02
Latex Modifier	711.04
Reinforcing Steel	709.01
Water	725.01

602.03 Concrete Composition. Use the concrete composition method DESIGNATED IN THE SCHEDULE OF ITEMS.

(a) Method A. Furnish to the CO a mix design showing the proposed weights of aggregate, water, and cement per cubic yard of concrete a minimum of 7 days prior to beginning placement. Proportion the cement, aggregate, and water to obtain concrete with good workability. Ensure that slump is 4 inches or less, as determined by AASHTO T 119. Ensure that air-entrainment is 6 ± 1 percent, as determined by AASHTO T 152 or T 196.

Ensure that the concrete develops a 28-day minimum compressive strength of 3,000 psi, unless otherwise SHOWN ON THE DRAWINGS. Furnish concrete for specimens. Strength will be determined by test cylinders made and cured in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22.

Failure of any test cylinder to meet the required strength, for any structural element tested, will be considered evidence of noncompliance with the strength requirement of this specification.

(b) Method B. Submit for approval the following information a minimum of 7 days prior to beginning placement:

- (1) Type, grading, and sources of aggregate.
- (2) Type and source of cement, blended cement, or fly ash.

- (3) Saturated surface dry weights of the fine and coarse aggregate in pounds per cubic yard of concrete.
- (4) Weight of mixing water in pounds per cubic yard of concrete.
- (5) Weight of cement in pounds per cubic yard of concrete.
- (6) Admixture type, quantity, and certification by manufacturer.
- (7) Air content.
- (8) Slump.
- (9) 28-day compressive strength.

Ensure that the concrete contains not less than 611 pounds per cubic yard. Ensure that slump is 4 inches or less, as determined by AASHTO T 119.

When a commercial supplier is used, furnish a certification with each truckload of concrete certifying that the material and mix proportions used are in conformance with the approved mixture.

(c) Method C. Make the concrete using a dry, preproportioned, blended, and bagged mix meeting the requirements of ASTM C 387 and mixed at the jobsite in accordance with the manufacturer's recommendations.

(d) Fly Ash- or Pozzolan-Modified Concrete. Fly ash may be substituted for cement at the rate of 1.2 pounds of fly ash per 1.0 pound of Portland cement. After substitution, reduce the design aggregate volumes by an amount equal to the net increase in volume of the combined cement and fly ash. Replace no less than 10 percent and no more than 20 percent of the weight of Portland cement required with fly ash at the above rate. For purposes of controlling the maximum water/cement ratio of 0.49, make the water/cement ratio for fly-ash-modified concrete the ratio of the weight of water to the combined weights of Portland cement and 60 percent of the weight of the fly ash.

Extend the standard 28-day curing period for compressive-strength tests for fly-ash modified concrete by 1 day (rounded to the nearest whole day) for each 1.5 percent of Portland cement replaced with fly ash at the selected rate. (Example: If the maximum of 20 percent cement is replaced, the curing period for cylinders is 41 days.)

Construction

602.04 Forms. Design and construct forms so they can be removed without damaging the concrete. Make them free of bulge and warp, and constructed so that the finished concrete has the form and dimensions SHOWN ON THE DRAWINGS and is true to line and grade. Concrete may be placed without forms where SHOWN ON THE DRAWINGS.

Design forms for concrete that contains a retarding admixture, fly ash, or other pozzolan replacement for cement so that the lateral pressures exerted by the full anticipated height of fluidized concrete are contained, unless documented information in regard to initial set is provided by the manufacturer.

602.05 Placing Concrete. Place all reinforcing steel in position as SHOWN ON THE DRAWINGS, and ensure that it is securely held in place by approved supports during placing of concrete. Do not place concrete until the grading, forms, and steel reinforcements have been inspected and approved by the CO. Give the CO 24 hours written notice prior to placement of any concrete.

Ensure that reinforcing steel material and construction requirements are in accordance with Section 554.

Discharge all concrete prepared using methods A and B into the forms within the time limits shown in Table 602-1. These time limits are based on jobsite ambient air temperature, cement type, and admixture used. Begin counting time from when the cement is introduced into the aggregate. Discharge concrete prepared using method C into the forms within 1-1/2 hours after introducing water to the mixture. Do not retemper concrete. Cement must be added to the mixer at the jobsite when required in the SPECIAL PROJECT SPECIFICATIONS. Do not mix or place concrete when the daily minimum atmospheric temperature is, or is expected to be, less than 40 °F unless adequate provisions are made to protect the concrete.

Place concrete to avoid segregation. Use high-frequency internal vibrators for consolidating concrete in the forms. Operate vibrators to produce concrete free of voids, but do not hold them in one place long enough to result in segregation or formation of laitance on the surface.

Method C concrete may be rodded instead of internally vibrated as necessary to remove voids.

Do not use aluminum pipe, conduit, or troughs for transporting concrete. When concrete is pumped, take samples from the discharge stream at the point of placement.

602.06 Finishing. Perform finishing of concrete surfaces as follows:

(a) Formed Surfaces. Unless otherwise SHOWN ON THE DRAWINGS, remove all fins and irregular projections exceeding ¼ inch from the exposed surfaces. Fill holes produced by removing form ties with dry-pack mortar or other approved patching compounds.

(b) Unformed Surfaces. Strike off unformed surfaces with a straightedge, and finish them to a smooth uniform texture by floating and troweling. Prepare final finish of the surface as SHOWN ON THE DRAWINGS.

Table 602-1. - Concrete discharge time limits.		
Cement Type With and Without Admixtures	Time limit (hour)	
	< 86 °F ^a	≥ 86 °F ^a
Type I, IA, II, or IIA	2.0	1.5
Type I, IA, II, or IIA with water reducing or retarding admixture	3.0	2.0
Type III	1.5	1.0
Type III with water reducing or retarding admixture	2.0	1.5
^a . Ambient air temperature.		

602.07 Curing Concrete. Beginning immediately after finishing, cure all concrete a minimum of 7 days or, if high-early-strength cement is used, a minimum of 3 days. For fly-ash-modified concrete placed in structures, the required moisture-controlled curing period shall be:

Percentage of Cement Replaced by Weight	Required Curing Period
10%	9 days
11–15%	10 days
16–20%	11 days

For cold weather concreting, maintain a controlled temperature for the required curing period. The above requirement for an extended curing period may be waived if a compressive strength of 65 percent of the specified 28-day design strength is achieved in 6 days.

Cure by maintaining a minimum concrete temperature of 40 °F and keeping the concrete continuously moist. Keep moist by supplying additional moisture or preventing moisture loss.

Acceptable methods of supplying additional moisture are ponding or sprinkling, and covering with burlap cloth that is kept saturated. Surfaces SHOWN ON THE DRAWINGS may be covered with saturated sand or 6 inches of saturated hay or straw to retain moisture.

Acceptable methods of preventing moisture loss are applying liquid membrane forming compounds, or waterproof paper or polyethylene sheet materials. Apply liquid membrane forming compounds by spraying at the coverage rates and patterns recommended by the manufacturer. Ensure that sheet material has overlapped sealed joints and forms a complete waterproof cover over the entire concrete surface.

602.08 Backfilling. Backfill in accordance with Subsection 206A.10. Do not backfill concrete until it has completed the required curing period.

Measurement

602.09 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment

602.10 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
602(01) Concrete, method_____	Cubic Yard
602(02) Concrete, method_____	Lump Sum

Section 603 - Metal Pipe

Description

603.01 Work. Furnish and install, or install only, metal pipe and pipe appurtenances, including all bedding and backfilling required to complete the work. The term “metal” refers to aluminum and steel.

Materials

603.02 Requirements. Furnish materials that meet the requirements specified in the following subsections:

Aluminum-Alloy Corrugated Pipe	707.03
Aluminum-Alloy Spiral Rib Pipe	707.12
Asphalt-Coated Pipe	707.04
Concrete-Lined Corrugated Steel Pipe	707.13
Ductile Iron Culvert Pipe	707.01
Fiber-Bonded Bituminous-Coated Steel Pipe	707.09
Invert-Paved Corrugated Steel Pipe	707.14
Metallic-Coated Corrugated Steel Pipe	707.02
Metallic-Coated Spiral Rib Pipe	707.11
Polymer-Coated Steel Pipe	707.08
Repair of Damaged Coatings	707.15
Slotted Drain Pipe	707.10
Watertight Gaskets	712.03

Furnish bedding material that meets the requirements specified in Subsection 603.04.

Furnish backfill materials that meet the requirements specified in Subsection 603.08.

Clean and paint damaged spelter coating caused by welding, field cutting, or mishandling, as specified in Subsection 707.15.

To prevent electrolysis or physical failure, use materials in each pipe installation that are compatible with each other.

Either annular or helical pipe corrugations will be acceptable. Helical corrugated pipe containing annular rerolled ends may be used in conjunction with annular pipe of like or compatible materials.

Provide fabricator’s certification that the sheet and pipe fabrication are in accordance with AASHTO M 36, M 196, and M 245, as applicable. Submit the certification before installing the pipe.

The lengths and locations of individual pipe SHOWN ON THE DRAWINGS are approximate. Do not order pipe until culvert locations are DESIGNATED ON THE GROUND and a written list of the correct lengths is approved by the CO.

Construction

603.03 Excavation. Excavate in accordance with the requirements specified in Section 206A.

Specific pipe installation time restrictions and installation plan requirements are SHOWN ON THE DRAWINGS.

603.04 Bedding. Bed the pipe to a depth of not less than 10 percent of its total height. After excavating in accordance with Subsection 206A.04(b), compact the foundation surface in accordance with Subsection 603.08 and shape it to fit the pipe.

As bedding material, provide selected mineral soil that meets the requirements for backfill specified in Subsection 603.08. When SHOWN ON THE DRAWINGS, ensure that completed bedding has a longitudinal camber.

603.05 Laying Pipe. Lay the lower segment of the pipe so that it is in contact with the bedding for the required depth throughout its length. Place outside circumferential laps facing upstream.

Lay paved or partially lined pipe so the longitudinal centerline of the paved segment coincides with the flowline. Place elliptical pipe with the major axis within 5° of a vertical plane through the longitudinal axis of the pipe.

Ensure that the final installed alignment allows no reverse grades, and does not permit any point to vary from a straight line drawn from inlet to outlet by more than 2 percent horizontally and vertically of the culvert length, or 12 inches, whichever is less.

Do not place any pipe in service until a suitable outlet is provided.

Install helically corrugated lock-seam pipe with the seam at the inlet end placed below the horizontal centerline. This requirement applies to the outlet end when the outlet is less than 5 feet below subgrade.

Position longitudinal laps on riveted or spot-welded pipe at any location between 45° above or below horizontal.

603.06 Joining Pipes. Firmly join pipe using form-fitting coupling bands. Attach end sections to the pipe using connecting bands or other means, as recommended by the manufacturer. Install gaskets at each joint to form a watertight connection when SHOWN ON THE DRAWINGS. Do not use dimpled bands when the slope of the pipe is greater than 15 percent.

Ensure that coupling bands meet the strength requirements of field joints for Nonerodible Soil Condition—Special Joint Type, according to division II, Section 26, of the “Standard Specifications for Highway Bridges” by AASHTO.

When aluminum alloys come in contact with other metals, coat the contacting surfaces with an asphalt mastic or other impregnated caulking compound approved by the CO.

603.07 Shop Elongation. When SHOWN ON THE DRAWINGS, increase the vertical diameter of round pipe 5 percent by shop elongation.

603.08 Backfilling. Do not place or backfill pipe that meets any of the following conditions until the excavation and foundation have been approved by the CO:

- Embankment height greater than 10 feet at subgrade centerline.
- Installation in a live stream.
- Round pipe with a diameter of 48 inches or greater.
- Pipe arches with a span of 50 inches or greater.

After the bedding is prepared and the pipe is placed, place selected material in layers not exceeding 6 inches loose thickness, and compact the material under the haunches and alongside the pipe. Use material that is readily compactible and free of frozen lumps, chunks of highly plastic clay (with a plasticity index greater than 10), or other objectionable material. Do not use rocks larger than 3 inches in greatest dimension within 12 inches of the pipe. On each side of the pipe, place an area of compacted material at least as wide as the diameter of the pipe. Compact the backfill without damaging or displacing the pipe.

Continue backfilling and compacting until the backfill is a minimum of 12 inches above the top of the culvert.

After bedding and backfilling the pipe, protect it with an adequate cover of embankment before heavy equipment is permitted to cross during roadway construction.

Replace any pipe that is distorted by more than 5 percent of nominal dimensions, or that is ruptured or broken.

Compact backfill using method A, B, or C, as DESIGNATED IN THE SCHEDULE OF ITEMS.

(a) Method A. Ensure that backfill density exceeds the density of the surrounding embankment.

(b) Method B. Ensure that backfill density exceeds 95 percent of the maximum density as determined by AASHTO T 99, method C or D.

Determine density of the compacted material during the process of the work in accordance with AASHTO T 191, T 205, or T 238; and AASHTO T 217, T 239, or T 255. Corrections for coarse particles may be made in accordance with AASHTO T 224.

(c) **Method C.** Ensure a moisture content suitable for obtaining compaction. Compact each layer using compaction equipment designed for this purpose until visual displacement ceases.

Measurement

603.09 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

When DESIGNATED IN THE SCHEDULE OF ITEMS, measure backfill material adjacent to the pipe 12 inches horizontally and vertically from the outside dimensions of the pipe, with a deduction for the volume of the pipe along the full length of the backfill.

Payment

603.10 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603(01) _____ -inch corrugated metal pipe, _____ -inch thickness for steel or _____ -inch thickness for aluminum, method _____	.....Linear foot
603(02) _____ -inch span, _____ -inch rise, corrugated metal pipe arch, _____ -inch thickness for steel or _____ -inch thickness for aluminum, method _____	.....Linear Foot
603(03) _____ -inch metal end section	Each
603(04) _____ -inch span, _____ -inch rise metal end section	Each
603(05) _____ -inch corrugated steel pipe, _____ -inch thickness, method _____	.....Linear Foot
603(06) _____ -inch span, _____ -inch rise corrugated steel pipe arch, _____ -inch thickness, method _____	.....Linear Foot

- 603(07) _____ -inch steel end sectionEach
- 603(08) _____ -inch span,
 _____ -inch rise steel end sectionEach
- 603(09) _____ -inch
 _____ -type
 _____ -coated corrugated steel pipe,
 _____ -inch thickness,
 method _____Linear Foot
- 603(10) _____ -inch
 _____ -type
 _____ -coated paved invert corrugated steel pipe,
 _____ -inch thickness,
 method _____Linear Foot
- 603(11) _____ -inch span,
 _____ -inch rise
 _____ -type
 _____ -coated corrugated steel pipe arch,
 _____ -inch thickness,
 method _____Linear Foot
- 603(12) _____ -inch
 _____ -type
 _____ -coated steel end sectionEach
- 603(13) _____ -inch span,
 _____ -inch rise
 _____ -coated steel end sectionEach
- 603(14) _____ -inch corrugated aluminum pipe,
 _____ -inch thickness,
 method _____Linear Foot
- 603(15) _____ -inch paved invert corrugated aluminum pipe,
 _____ -inch thickness,
 method _____Linear Foot
- 603(16) _____ -inch span,
 _____ -inch rise corrugated aluminum pipe arch,
 _____ -inch thickness,
 method _____Linear Foot
- 603(17) _____ -inch aluminum end sectionEach

- 603(18) _____-inch span,
 _____-inch rise aluminum end sectionEach
- 603(19) Pipe elbow,
 _____-inch diameter,
 _____-inch thicknessEach
- 603(20) Branch connection,
 _____-inch diameter,
 _____-inch thicknessEach
- 603(21) Furnishing and placing backfill material for pipe.....Cubic Yard

Section 603A - Concrete Pipe

Description

603A.01 Work. Furnish and install, or install only, concrete pipe and pipe appurtenances, including all bedding and backfilling required to complete the work.

Materials

603A.02 Requirements. Furnish materials that meet the requirements specified in the following subsections:

Nonreinforced Concrete Pipe	706.01
Precast Reinforced Concrete Box Sections	706.07
Reinforced Arch-Shaped Concrete Pipe	706.04
Reinforced Concrete Pipe	706.02
Reinforced D-Load Concrete Pipe	706.06
Reinforced Elliptical-Shaped Concrete Pipe	706.05
Watertight Gaskets	712.03

Furnish end sections constructed of the same material as the main section of the pipe.

Furnish bedding material that conforms to the requirements of Subsection 603A.04.
Furnish backfill material that conforms to the requirements of Subsection 603A.06, or as SHOWN ON THE DRAWINGS.

The lengths and locations of individual pipe SHOWN ON THE DRAWINGS are approximate. Do not order pipe until culvert locations are designated on the ground and a written list of the correct lengths is approved by the CO.

Construction

603A.03 Excavation. Conduct excavation in accordance with the requirements are specified in Section 206A. Excavate the trench a minimum of 4 inches below grade.

Specific pipe installation time restrictions and installation plan requirements are SHOWN ON THE DRAWINGS.

603A.04 Bedding. Unless otherwise SHOWN ON THE DRAWINGS, backfill the trench with bedding material to grade. Extend bedding material to a minimum height of one-sixth the pipe diameter above the bottom of the pipe, and compact it in accordance with Subsection 603A.06.

Bed pipe with select excavated material from the roadway in the vicinity of the pipe, or with material from the source SHOWN ON THE DRAWINGS. Use material that contains no rocks greater than 1 inch in size. Ensure that the bedding surface provides a foundation of uniform density and support throughout the entire length of the pipe;

provides for camber as SHOWN ON THE DRAWINGS; and has recesses shaped to receive the bell, of the bell and spigot pipe.

603A.05 Placing & Joining. Do not place or backfill any pipe until the excavation and foundation have been approved by the CO and a suitable outlet has been constructed. Ensure that the bell or groove ends face upstream. Join the pipe section so that the inner surfaces are reasonably flush and even, and the ends are entered as required. Make joints with a cold applied bituminous mastic, with rubber, or with plastic ring gaskets, as SHOWN ON THE DRAWINGS. When using mastic material, fill the joints with the material prior to joining the pipe.

603A.06 Backfilling. Furnish readily compactable backfill material that is free from frozen lumps and chunks of highly plastic clay or other objectionable material. Use no rock larger than 3 inches in greatest dimension within 12 inches of the pipe.

Place backfill material at or near optimum moisture content, and compact it in layers not exceeding 6 inches loose thickness on both sides, and to an elevation of 12 inches above the top of the pipe. Thoroughly compact the backfill under the haunches of the pipe. Bring the backfill up evenly on both sides of the pipe for the full length. Make the width of backfill on each side of the pipe equal to the diameter of the pipe.

Compact the backfill to at least 95 percent of the maximum density, as determined by AASHTO T 99, method C or D, unless otherwise SHOWN ON THE DRAWINGS.

Determine density of the compacted material during the process of the work in accordance with AASHTO T 191, T 205, or T 238; and AASHTO T 217, T 239, or T 255. Corrections for coarse particles may be made in accordance with AASHTO T 224.

Ensure that the final installed alignment of all pipe allows no reverse grades, and does not permit horizontal and vertical alignments to vary from a straight line drawn from center of inlet to center of outlet by more than 2 percent of pipe center length or 12 inches, whichever is less.

Measurement

603A.07 Method

Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

When DESIGNATED IN THE SCHEDULE OF ITEMS, measure backfill material adjacent to the pipe 12 inches horizontally and vertically from the outside dimensions of the pipe, with a deduction for the volume of the pipe along the full length of the backfill.

Payment

603A.08 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603A(01) _____ -inch reinforced concrete pipe, class _____	.....Linear Foot
603A 02) _____ -inch span, _____ -inch rise reinforced concrete pipe, class _____	.....Linear foot
603A(03) _____ -inch reinforced concrete end section	.....Each
603A(04) _____ -inch span, _____ -inch rise reinforced concrete end section	.....Each
603A(05) Furnishing and placing backfill material for pipe	.....Cubic Yard

Section 603B - Plastic Pipe

Description

603B.01 Work. Furnish and install, or install only, plastic pipe and pipe appurtenances, including all bedding and backfilling required to complete the work.

Materials

603B.02 Requirements. Furnish materials that meet the requirements specified in the following subsections:

Plastic Pipe	706.08
Watertight Gaskets	712.03

Furnish bedding material that meets the requirements specified in Subsection 603B.04, or as SHOWN ON THE DRAWINGS.

Furnish backfill materials that meet the requirements specified in Subsection 603B.06, or as SHOWN ON THE DRAWINGS.

The lengths and locations of individual pipe SHOWN ON THE DRAWINGS are approximate. Do not order pipe until culvert locations are designated on the ground and a written list of the correct lengths is approved by the CO.

Construction

603B.03 Excavation. Conduct excavation in accordance with the requirements specified in Section 206A. Excavate a minimum of 8 inches below the designed invert elevation.

Specific pipe installation time restrictions and installation plan requirements are SHOWN ON THE DRAWINGS.

603B.04 Bedding. Place bedding material in the excavated section, and compact the material to ensure a uniform foundation bed for the pipe.

As bedding material, use selected mineral soil that meets the requirements for backfill specified in Subsection 603B.06.

When SHOWN ON THE DRAWINGS, ensure that the completed bedding has a longitudinal camber.

603B.05 Placing & Joining. Join to form a watertight connection, when SHOWN ON THE DRAWINGS.

Protect portions of the pipe that will be exposed, when SHOWN ON THE DRAWINGS.

Ensure that the final installed alignment allows no reverse grades, and does not permit any point to vary from a straight line drawn from center of inlet to center of outlet by more than 2 percent horizontally and vertically of the culvert length, or 12 inches, whichever is less, unless otherwise SHOWN ON THE DRAWINGS.

603B.06 Backfilling. Furnish readily compactable backfill material that is free of frozen lumps and chunks of highly plastic clay (with a plasticity index greater than 10) or other objectionable material. Do not use rocks larger than 1 inch in greatest dimension within 12 inches of the pipe.

Place backfill material that is at or near optimum moisture content, and compact it in layers not exceeding 6 inches loose thickness on both sides, and to an elevation of 12 inches minimum above the top of the pipe. Thoroughly compact the backfill under the haunches of the pipe. Bring the backfill up evenly on both sides of the pipe for the full length. Extend the width of the compacted backfill a minimum of 12 inches on each side of the pipe.

Continue backfilling and compacting until the backfill is a minimum of 12 inches above the top of the culvert.

After bedding and backfilling the pipe, protect it with an adequate cover of embankment before heavy equipment is permitted to cross during roadway construction.

Replace any pipe that is distorted by more than 5 percent of nominal dimensions, or that is ruptured or broken.

Compact backfill using method A, B, or C, as DESIGNATED IN THE SCHEDULE OF ITEMS.

(a) Method A. Ensure that backfill density exceeds the density of the surrounding embankment.

(b) Method B. Ensure that backfill density exceeds 95 percent of the maximum density, as determined by AASHTO T 99, method C or D.

Determine density of the compacted material during the process of the work in accordance with AASHTO T 191, T 205, or T 238; and AASHTO T 217, T 239, or T 255. Corrections for coarse particles may be made in accordance with AASHTO T 224.

(c) Method C. Ensure a moisture content suitable for obtaining compaction. Compact each layer using compaction equipment designed for this purpose until visual displacement ceases.

Measurement

603B.07 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

When DESIGNATED IN THE SCHEDULE OF ITEMS, measure backfill material adjacent to the pipe 12 inches horizontally and vertically from the outside dimensions of the pipe, with a deduction for the volume of the pipe along the full length of the backfill.

Payment

603B.08 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603B(01) _____-inch plastic pipe, method _____	.....Linear Foot
603B(02) Furnishing and placing backfill material for pipe.....	Cubic Yard

Section 605 - Underdrains

Description

605.01 Work. Furnish and install underdrains, sheet drains, and pavement edge drains.

The term “metal” refers collectively to aluminum and steel.

Materials

605.02 Requirements. Furnish materials that meet the requirements specified in the following subsections:

Aluminum-Alloy Corrugated Pipe	707.03
Asphalt-Coated Pipe	707.04
Geocomposite Drains.....	714.02
Geotextile, Type I (A, B, C, D, E, or F)	714.01
Granular Backfill	703.03
Metallic-Coated Corrugated Steel Pipe	707.02
Perforated Concrete Pipe	706.03
Plastic Pipe	706.08
Repair of Damaged Coatings.....	707.15
Structural Backfill	704.04

Construction

605.03 General. Use the same material and coating on all contiguous drain sections, extensions, elbows, branch connections, and other special sections.

Type of backfill material and underdrain pipe material, orientation of geosynthetic material, and approximate location are SHOWN ON THE DRAWINGS. Determine the final location and length in the field.

Conduct excavation in accordance with the requirements specified in Section 206A.

If geotextile or geocomposite is used, smooth the trench surfaces by removing all projections that may damage the geotextile or geocomposite. Replace geotextile or geocomposite damaged during installation. Make repairs to geocomposites in accordance with the manufacturer’s recommendations.

Do not permit soil materials or other foreign matter to enter the drain systems. Plug the upgrade end of installations.

Backfill in 6-inch layers by first dampening the granular backfill and then compacting each layer with two or more passes of a mechanical tamper.

Furnish nonperforated pipe for outlet pipe. Install outlet pipe as specified in Sections 603, 603A, and 603B. Immediately place and secure a screen made of 0.055-inch diameter

galvanized wire with approximately ½ inch by ½ inch mesh openings over the outlet ends of all exposed pipes and weep holes.

605.04 Underdrain & Trench. Place a layer of granular backfill at least 4 inches in thickness in the bottom of the trench.

Furnish a collector pipe at least 5 inches in diameter with all underdrains.

Join pipe sections securely with coupling fittings or bands. Join PVC and acrylonitrile-butadiene-styrene (ABS) pipe using either a flexible elastomeric seal or solvent cement. Join polyethylene pipe with snap-on, screw-on, or wrap-around coupling bands, as recommended by the manufacturer.

When underdrain is placed in drainages, prevent infiltration of surface water by placing material conforming to AASHTO M 145 classifications A-4, A-5, A-6, or A-7 in the top 12 inches of the trench.

(a) Standard Underdrain. When geotextile is required, place the long dimension of the geotextile parallel to the centerline of the trench. Position the geotextile, without stretching, such that it lies smoothly in contact with the trench surface. Overlap the joints a minimum of 24 inches with the upstream geotextile placed over the downstream geotextile.

Place collector pipe with the perforations down. Firmly embed the underdrain pipe in granular backfill material.

Place granular backfill to a height of 12 inches above the top of the collector pipe and compact. Do not displace the collector pipe. Place and compact the remainder of the granular backfill material as specified in Subsection 603.08, method A or B.

Fold the geotextile over the top of the granular backfill with a minimum overlap of 12 inches.

(b) Geocomposite Underdrain or Sheet Drain. Extend the geotextile from the bottom of the drainage core around the collector pipe.

Construct splices, joints, and outlet fittings as recommended by the manufacturer and in a manner that prevents infiltration of soil into the geocomposite core and does not impede flow through the geocomposite core or damage the core.

Place the assembled geocomposite in the trench with the geocomposite placed against the inflow side of the trench. If the trench wall is irregular such that flow along or through the geocomposite may be impeded, smooth the trench or place a layer of granular backfill between the geocomposite and the trench wall.

Temporarily support the drain against the trench side while backfilling.

When the trench is less than 18 inches in width, backfill the trench using fine granular backfill. Except as otherwise indicated, backfilling in layers and compacting are not required. After the backfill is in place, densify by wheel rolling, vibrating, tamping with a mechanical tamper, or flooding with water.

When the trench is 18 inches or more in width, place granular coarse or fine backfill to a height of 12 inches above the top of the collector pipe and compact the material. Finish backfilling the trench as indicated in Subsection 605.03.

605.05 Geocomposite Sheet Drain. Do not place sheet drain against a mortar course less than 4 days old.

When a geocomposite is used in conjunction with a waterproof membrane, install drainage panels compatible with the membrane using methods recommended by the membrane manufacturer. Assemble and place the geocomposite drain against the surface to be backfilled according to the manufacturer's recommendations.

Splice geocomposite drains so the flow across the edges is continuous. Overlap the geotextile a minimum of 3 inches in the direction of waterflow. For vertical splices, overlap the geotextile in the direction that backfill proceeds.

Connect the drainage core to the collector pipe or weep holes so the flow is continuous through the system. Extend the geotextile from the bottom of the drainage core around the collector pipe.

Backfill with structural backfill material, and compact it as specified in Subsection 605.03.

605.06 Geocomposite Pavement Edge Drain. Assemble the geocomposite pavement edge drain and outlet material according to the manufacturer's recommendations and place them in the trench. If the trench is irregular such that flow along or through the geocomposite may be impeded, smooth the trench or place a layer of fine granular backfill between the geocomposite and the trench wall.

Temporarily support the drain against the trench while backfilling.

When the trench is less than 18 inches in width, backfill the trench using fine granular backfill. Backfilling in layers and compacting are not required. After the backfill is in place, densify by wheel rolling, vibrating, tamping with a mechanical tamper, or flooding with water.

When the trench is 18 inches or more in width, place coarse or fine backfill to a height of 12 inches above the top of the collector pipe and compact. Finish backfilling the trench as indicated in Subsection 605.03.

When underdrain is placed in drainages, prevent infiltration of surface water by placing material conforming to AASHTO M 145 classifications A-4, A-5, A-6, or A-7 in the top 12 inches of the trench.

Measurement

605.07 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure geotextile material on surface area covered according to the dimensions, as SHOWN ON THE DRAWINGS.

Payment

605.08 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
605(01) Standard underdrain system	Linear Foot
605(02) Geocomposite underdrain system	Linear Foot
605(03) Geocomposite sheet drain system	Square Yard
605(04) Geocomposite pavement edge drain system	Linear Foot
605(05) _____ -inch collector pipe	Linear Foot
605(06) _____ -inch outlet pipe	Linear Foot
605(07) Coarse granular backfill	Cubic Yard
605(08) Fine granular backfill	Cubic Yard
605(09) Geotextile material	Square Yard
605(10) Structural backfill	Cubic Yard

Section 606 - Guardrail

Description

606.01 Work. Construct guardrail systems, and/or modify, remove, reset, and/or raise existing guardrail systems.

(a) Guardrail systems are designated as follows:

G1	Cable guardrail
G2	W-beam (weak post)
G3	Box beam
G4	Blocked-out W-beam standard barrier
G9	Blocked-out thrie-beam standard barrier
MB4	Blocked-out W-beam median barrier
SBTA	Steel-backed timber guardrail/timber posts and blackout
SBTB	Steel-backed timber guardrail/timber posts and no blackout
CRT	W-beam guardrail and no blackout
STLG	Steel-backed log rail

(b) Steel guardrail types are designated as follows:

I	Zinc-coated, 1.80 ounces per square foot
II	Zinc-coated, 3.60 ounces per square foot
III	Painted rails
IV	Corrosion-resistant steel

c) Steel guardrail classes are designated as follows:

A	Metal thickness	0.105 inches
B	Metal thickness	0.135 inches

(d) Terminal section types are designated as follows:

BCT	Breakaway cable terminal
CRT	Cable releasing terminal
MELT	Modified eccentric loader terminal
G4-BAT	Back slope anchor terminal

Materials

606.02 Requirements. Furnish materials that meet the requirements specified in the following section and subsections:

Box Beam Rail	710.07
Corrosion-Resistant Steel Rail	710.06(b)
Galvanized Steel Rail.....	710.06(a)
Guardrail Hardware	710.10

Guardrail Hardware (Reflector Tabs)	710.10
Guardrail Posts.....	710.09
Minor Concrete Structures.....	602
Precast Concrete Units (Precast Anchors)	725.11
Retroreflective Sheeting, Type I or Type II.....	718.01
Steel-Backed Timber Rail	710.08
Treated Structural Timber & Lumber	716.03
Welding.....	555.18
Wire Rope or Wire Cable	709.02

Construction

606.03 Posts. When pavement is within 3 feet of the guardrail, set posts before placing the pavement.

Do not shorten guardrail posts unless the cut end is set in concrete. Do not shorten posts in terminal sections.

Drive posts into pilot holes that are punched or drilled. The dimensions of the pilot hole shall not exceed the dimensions of the post by more than 9/16 inch. Set posts plumb, backfill, and compact in accordance with Subsection 206A.10.

When longer posts are specified, do not use them in the terminal sections.

Alternate hole arrangements, when specified, do not apply to posts in the anchorage assembly.

Protect posts from traffic at all times by attaching rail elements and all associated hardware, or by other approved methods.

606.04 Rail Elements. Install the rail elements after the pavement adjacent to the guardrail is complete. Do not modify specified hole diameters or slot dimensions. Install guardrail systems of the type and class SHOWN ON THE DRAWINGS.

(a) Steel Rail. Shop bend all curved guardrail with a radius of 150 feet or less.

Erect rail elements in a smooth continuous line with the laps in the direction of traffic flow. Use bolts that extend at least ¼ inch, but not more than 1 inch beyond the nuts. Tighten all bolts.

Paint all scrapes on galvanized surfaces that are through to the base metal with two coats of zinc-oxide paint.

Where installation of the rail elements interferes with paving operation, rail elements may be temporarily attached directly to the posts without blockouts. Install blockouts within 15 days following the paving operation. Securely bolt a Type 1 end section assembly to the last post at the end of each day on guardrail sections that have an exposed end toward oncoming traffic. Diaphragms are optional in the end section assembly.

(b) Timber Rail. Align timber guardrail along the top of the rail.

Field cut timber rails to produce a close fit at joints. Treat field cuts with two coats of the preservative originally used for treatment.

(c) Log Rail. Construct log rail as SHOWN ON THE DRAWINGS.

606.05 Terminal Sections. Construct terminal sections at the locations shown. Terminal sections consist of posts, railing, hardware, and anchorage assembly necessary to construct the type of terminal section specified.

Where concrete anchors are installed, construct either cast-in-place or precast units. Do not connect the guardrail to cast-in-place anchors until the concrete has cured 7 days. Install end anchor cables tightly, without slack.

Use either the steel tube anchor or the concrete anchor in the construction of the anchorage assembly for the Type BCT terminal section.

When required, construct earth berms as specified in Section 203.13.

606.06 Connection to Structure. Construct connection to structure and, where required, reinforced concrete transition as SHOWN ON THE DRAWINGS.

606.07 Removing & Resetting Guardrail. Remove and store the existing guardrail, posts, and appurtenances. Remove and dispose of posts that are set in concrete. Replace all guardrail, posts, and hardware damaged during removal, storage, or resetting. Backfill all holes resulting from the removal of guardrail posts and anchors with granular material as specified in Subsection 206A.10.

606.08 Raising Guardrail. Remove the existing guardrail and appurtenances. Replace and reset posts as needed. Replace all guardrail, posts, and hardware damaged during the removal and raising.

Measurement

606.09 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure guardrail, except steel-backed timber guardrail and steel-backed log rail, by the foot along the face of the rail, excluding terminal sections. Measure steelbacked timber guardrail and steel-backed log rail by the foot along the face of the rail, including terminal sections. Measure transition sections from G9 rail to G4 rail as G9 rail.

Measure terminal sections, except steel-backed timber guardrail terminal sections and steel-backed log rail terminal sections, by the each.

Measure removing and resetting guardrail and raising guardrail by the foot along the face of the rail, including reset terminal sections.

Measure replacement posts (except replacement posts for posts damaged by construction operations) used in removing, resetting, or raising guardrail by the each.

Measure reinforced concrete flared back parapet wall and safety shape transition by the each.

Payment

606.10 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
606(01) Guardrail system _____, type _____, class _____	Linear Foot
606(02) Terminal section, _____ <i>Description</i>	Each
606(03) Removing and resetting guardrail	Linear Foot
606(04) Raising guardrail.....	Linear Foot
606(05) Replacement posts	Each
606(06) Connection to structure.....	Each
606(07) Reinforced concrete transition	Each

Section 607 - Fences, Gates, & Cattleguards

Description

607.01 Work. Furnish and install, or install only, fences, gates, and cattleguards.

Materials

607.02 Requirements. Furnish materials that meet the requirements specified in the following sections and subsections:

Barbed Wire	710.01
Chain Link Fence	710.03
Fence Posts	710.04
Material for Timber Structures	716
Precast Concrete Units	725.11
Reinforcing Steel	709.01
Structural Metal	717
Timber Rails	710.13
Woven Wire	710.02

Furnish materials for gates and cattleguards that meet the requirements as SHOWN ON THE DRAWINGS. Concrete for cattleguard units may be cast-in-place or precast. Furnish concrete that meets the requirements specified in Subsection 602.03, method A or B, as SHOWN ON THE DRAWINGS.

Construction

607.03 Fences & Gates. Remove trees, brush, and other obstacles along the fence line that interfere with the fence. Do not perform continuous grubbing or grading along the fence line. Where possible, erect the fence on natural ground. Establish clearing width and dispose of materials as SHOWN ON THE DRAWINGS.

When drilling into solid rock is required to set a post, the post may be shortened, provided a minimum of 12 inches of post is grouted into the rock.

Where breaks in a run of fencing are required, or at intersections with existing fences, adjust post spacing to meet the requirements for the type of closure.

When posts, braces, or anchors are to be embedded in concrete, install temporary guys or braces as required to hold the posts in proper position until the concrete has set. Install no materials on posts, and place no strain on guys and bracing set in concrete, until 7 days have elapsed from the time the concrete was placed.

Set all posts vertically and to the grade and alignment SHOWN ON THE DRAWINGS. Do not cut tops of posts unless approved by the CO.

Stretch wire or fencing taut, and firmly attach it to the posts and braces, as SHOWN ON THE DRAWINGS.

At each location where a high-voltage overhead electric transmission line crosses a fence containing metal, ground the fencing by installing a galvanized or copper coated steel grounding rod 8 feet long, with a minimum diameter of ½ inch, directly below the point of crossing. Drive the rod vertically until the top is 6 inches below the ground surface. Use a number 6 solid copper conductor or equivalent to connect each metal fence element to the grounding rod. Braze the connections or fasten them with noncorrosive clamps approved by the CO.

When a power line is within 500 feet and runs parallel or nearly parallel to the fence, ground the fence at each end, at gateposts, and at intervals not to exceed 1,500 feet.

When acceptable vertical penetration of the grounding rod cannot be obtained, submit an equivalent horizontal grounding system for approval by the CO.

Ensure that the bottom of the fence fabric generally follows the contour of the ground. Grade where necessary to provide a neat appearance. Where abrupt changes in the ground profile make it impractical to maintain the specified ground clearance, longer posts may be used and multiple strands of barbed wire stretched between them. Make the vertical spacing between strands of barbed wire 6 inches, unless otherwise SHOWN ON THE DRAWINGS. At grade depressions, where stresses tend to pull posts from the ground, install sag bracing, as SHOWN ON THE DRAWINGS.

Splice wire as SHOWN ON THE DRAWINGS.

Repair all posts in accordance with approved procedures after cutting or drilling.

607.04 Cattleguards. Complete work required under Section 203 or 306 at the location of the cattleguard before beginning excavation for the cattleguard. Install the cattleguard at the grade elevation that is SHOWN ON THE DRAWINGS or as staked on the ground. Provide drainage at time of installation so the cattleguard will drain. Construct the bypass and gate as SHOWN ON THE DRAWINGS.

Conduct excavation and backfill in accordance with Section 206A.

After cattleguard is bedded, place selected material in layers not exceeding 6 inches loose thickness, uniformly compacted on all sides, along the cattleguard. Use readily compactible backfill material that is free of frozen lumps, chunks of highly plastic clay, or other objectionable material. Compact the backfill without damaging or displacing the cattleguard. Continue backfilling and compacting to the top of the cattleguard foundation.

Raise cattleguards by modifying the cattleguard base as SHOWN ON THE DRAWINGS. Replace or recondition cattleguard wings, posts, or decks as SHOWN ON THE DRAWINGS.

After bedding and backfilling, protect the cattleguard with adequate ramps on each side before heavy equipment is permitted to cross during roadway construction.

Measurement

607.05 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure the length of the fence along the top of the fence between the outsides of the end posts for each continuous run of fence.

When brace panels and bypass gates are SHOWN ON THE DRAWINGS, payment for cattleguards will include these items.

Payment

607.06 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
607(01) Cattleguard, _____ foundation, loading _____, width _____	Each
607(02) Fence _____, type _____, height _____	Linear Foot
607 03) Gate _____, type _____, size _____	Each
607(04) Cattleguard modification	Each
607(05) Recondition	Each
607(06) Replace	Each

Section 609 - Curb or Curb & Gutter

Description

609.01 Work. Construct or reset curb, gutter, or combination curb and gutter.

Materials

609.02 Requirements. Furnish materials that meet the requirements specified in the following sections and subsections:

Aggregate for Lean Concrete Backfill.....	703.13
Curing Material	711.01
Emulsified Asphalt (for Tack Coat)	702.03
Joint Mortar	712.02
Precast Concrete Curbing	725.06
Reinforcing Steel	709.01
Sealants, Fillers, Seals, & Sleeves	712.01
Stone Curbing	705.06

Furnish concrete that meets the requirements of Subsection 602.03, method A or B, as SHOWN ON THE DRAWINGS.

Furnish bituminous mixtures that meet the requirements as SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS.

Concrete, bituminous mixes, and manufactured curbing materials will be subject to inspection and tests at the plants for compliance with quality requirements.

Construction

609.03 Cast-in-Place Portland Cement Concrete Curbing or Curb & Gutter.

For cast-in-place Portland cement concrete curbing or curb and gutter, meet the requirements in the following subsections:

(a) Excavation. Excavate to the depth SHOWN ON THE DRAWINGS. Compact the foundation to a firm, even surface. Remove all soft, yielding material and replace it with acceptable material.

(b) Forms. Use forms of wood, metal, or other suitable material and extend them to the full depth of the concrete. Ensure that all forms are straight, free of warp, and of sufficient strength to resist the pressure of the concrete without displacement. Brace and stake the forms to keep them in both horizontal and vertical alignment until their removal. Clean all forms and coat them with an approved form-release agent before concrete is placed. Use divider plates made of metal. After the forms have been set to line and grade, bring the foundation to the grade required, and wet it well approximately 12 hours before placing the concrete. Machine slip forming may be used.

(c) *Mixing & Placing.* Proportion, mix, and place the concrete in accordance with the requirements specified in Subsection 602.03, method A or B, and as SHOWN ON THE DRAWINGS. Deposit the concrete without segregation in a single course. Use vibration or other acceptable methods to consolidate concrete placed in the forms. Leave forms in place for 24 hours or until the concrete has set sufficiently so that forms can be removed without damage to the curbing. Strike off the concrete to the cross section SHOWN ON THE DRAWINGS, then finish the concrete smooth and even by means of a wooden float.

For the purpose of matching adjacent concrete finishes or for other reasons, the CO may permit other methods of finishing. No plastering shall be permitted.

(d) *Contraction Joints.* Construct curbing in sections of a uniform length of 10 feet, unless otherwise approved by the CO. Separate sections by open joints approximately 1/8 inch wide and at least 1 inch deep, except at expansion joints. Where the curb is constructed adjacent to concrete pavement, match the contraction or open joints in the curb to the contraction joints in the pavement.

(e) *Expansion Joints.* Form expansion joints at the intervals SHOWN ON THE DRAWINGS using a preformed expansion joint filler with a thickness of 1/2 inch. When the curb is constructed adjacent to or on concrete pavement, locate expansion joints at expansion joints in the pavement.

(f) *Curing.* Immediately upon completion of the finishing, moisten the curb and keep it moist for 3 days, or use membrane-forming material to cure the curbing. Ensure that all materials meet the requirements specified in Subsection 711.01.

(g) *Backfilling.* After the concrete has set sufficiently, backfill the curb to the required elevation with suitable material, and compact the material in accordance with Subsection 203.16(b), method 4, in layers of not more than 6 inches loose thickness.

(h) *Curb Machine.* The curb or curb and gutter may be constructed using a curb-forming machine that meets the requirements of Subsection 609.06(c).

(i) *Curb Template.* Exposed curb face may be constructed and finished using trowel-type templates shaped to produce the desired contours when operated along approved forms set to the established lines and grades.

While the concrete is green, float the top, front, or other exposed surfaces of the curb or combined curb and gutter with a moist wooden float. Remove form marks and any other irregularities.

609.04 Precast Concrete Curbing. Set the curb so that the top surfaces of adjoining sections are true and even. Fill all spaces under the curbing with material that meets the requirements of the material for bed course, and compact this material.

609.05 Reflecting Concrete Curbing. Use construction methods for this item that meet the requirements specified in Subsection 609.03, with the following exceptions:

- (a) Use a mortar mix consisting of one part white Portland cement to 1.75 parts light-colored washed mortar sand to create the reflecting surface of the curbing. Make this mortar mix approximately 1 inch thick.
- (b) Alternatively, construct the entire curbing of concrete with white Portland cement.

Use washed mortar sand that meets all the requirements for mortar sand and is light in color. Place the reflecting surface mortar immediately after the base concrete. Never let more than 20 minutes elapse between placing the base concrete and the reflecting surface.

Perform scoring or surface deformation and finishing of the reflecting surface in accordance with the details SHOWN ON THE DRAWINGS.

609.06 Bituminous Concrete Curbing. For bituminous concrete curbing, meet the requirements in the following specifications:

(a) Excavation. Excavate as specified in Subsection 609.03(a).

(b) Preparation of Bed. When curbing is to be constructed on a cured or aged Portland cement concrete base, on bituminous pavement, or on a bituminous-treated base, thoroughly sweep the bed and clean it using compressed air. Thoroughly dry the surface, and immediately before placing the bituminous mixture, apply a tack coat of bituminous materials of the Type and grade SHOWN ON THE DRAWINGS. Apply the tack coat material at a rate between 0.05 and 0.15 gallons per square yard of surface area. Prevent the tack coat from spreading to areas outside of the area to be occupied by the curb.

(c) Placing. Construct bituminous curbing using a self-propelled automatic curber or curb machine, or a paver with curbing attachments. Use an automatic curber or machine that meets the following requirements:

- (1) The weight of the machine must provide compaction without the machine riding above the bed on which curbing is constructed.
- (2) The machine must form curbing of uniform texture, shape, and density.
- (3) The construction of curbing by means other than the automatic curber or machine is acceptable when short sections or sections with short radii are required. Ensure that the resulting curbing conforms in all respects to the curbing produced by using the machine.

Place the mixture only when the bed is dry and weather conditions are suitable for properly handling and finishing the mixture.

Place the bituminous mixture at a workable temperature of not less than 225 °F. Place the curbs to an accurate alignment and with a high density such that material is free of honeycombs. When joining to a section of curb that has become cold, give the contact surface of the cold curb a thin uniform tack coat of bituminous material prior to placing

the fresh bituminous mixture against the cold joint. Protect the curb from traffic using barricades or other suitable methods until the curb has hardened.

(d) *Painting & Sealing.* Seal or paint only on a curbing that is clean and dry and has reached an ambient temperature.

(e) *Backfilling.* Backfill as specified in Subsection 609.03(g).

609.07 Resetting Curb. In resetting curb, meet the requirements in the following specifications.

(a) *Salvage of Curbing.* Carefully remove, store, and clean curbing that is specified for resetting. Replace any curbing to be reset that is lost from storage or damaged through improper handling.

(b) *Excavation.* Excavate and provide bedding as specified in Subsection 609.03(a).

(c) *Resetting Curb.* Set the curb on a firm bed with the top surface of adjoining sections true and even. Set all sections of curbing so that the maximum opening between adjacent sections is not more than $\frac{3}{4}$ inch wide for the entire exposed top and face. Dress the ends of the curbing as necessary to meet this requirement.

After the curb has been set, completely fill the joints with mortar as SHOWN ON THE DRAWINGS.

(d) *Backfilling.* Backfill the curb with suitable material to the required elevation. Thoroughly tamp backfill material in layers of not more than 6 inch loose thickness.

(e) *Cutting & Fitting.* Cut or fit as necessary to install the curbing.

Measurement

609.08 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure curbing along the front face of the section at the finished grade elevation. Measure the length of combination curb and gutter along the face of the curb. Make no deduction in length for drainage structures installed in the curbing section, or for driveway openings where the gutter is carried across the drive.

Payment

609.09 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
609(01) Portland cement concrete curb, _____ -inch depth, type	Linear Foot
609(02) Portland cement concrete gutter, type	Linear Foot
609(03) Portland cement concrete curb and gutter, _____ -inch depth, type	Linear Foot
609(04) Bituminous concrete curb, _____ -inch depth	Linear foot
609(05) Reset curb.....	Linear Foot
609(06) Bed course material.....	Ton
609 07) Bed course material.....	Cubic Yard

Section 610 - Stone Masonry Structures

Description

610.01 Work. Construct stone masonry structures and stone masonry portions of composite structures.

610.02 Classes of Masonry. The class of masonry required for each part of a structure will be SHOWN ON THE DRAWINGS.

- (a) *Cement rubble masonry* shall consist of roughly dressed stones of various sizes and shapes laid in random courses in cement mortar.
- (b) *Class A and class B masonry* shall consist of stones shaped, dressed, and laid broken-coursed in cement mortar.
- (c) *Dimensioned masonry* shall consist of broken-coursed ashlar masonry composed of stones with two or more dimensions SHOWN ON THE DRAWINGS.

Materials

610.03 Stone. Furnish stone that is sound and durable. Use stone for dimensioned masonry that is free of reeds, rifts, seams, laminations, and minerals that, by weathering, would cause discoloration or deterioration.

(a) **Sizes & Shapes.** Furnish stones in the sizes and face areas necessary to produce the general characteristics and appearance SHOWN ON THE DRAWINGS.

In general, furnish stones with a thickness of not less than 5 inches, a width not less than 12 inches and one and one-half times the thickness of the stones, and a length not less than one and one-half times their width. Where headers are required, use stones with lengths not less than the width of the bed of the widest adjacent stretcher, plus 12 inches.

Ensure that at least 50 percent of the total volume of the masonry is made up of stones with a volume of at least 1 cubic foot each.

(b) **Dressing.** Dress the stone to remove any thin or weak portions. Dress face stones to provide bed and joint lines with a maximum variation from true line as follows:

Type of Masonry	Maximum Variation
Cement rubble masonry	1-½ inches
Class A masonry	¾ inch
Class B masonry	¼ inch
Dimensioned masonry	Reasonably true

(c) **Bed Surfaces.** Ensure that bed surfaces of face stones are normal to the faces of the stones for about 3 inches. From this point, they may depart from normal, not to exceed

1 inch in 12 inches for dimensioned masonry, and 2 inches in 12 inches for all other classes.

(d) Joint Surfaces. In all classes of masonry except dimensioned masonry, construct joint surfaces of face stones to form an angle with the bed surfaces of not less than 45°.

In dimensioned masonry, ensure that joint surfaces are normal to the bed surfaces, and normal to the exposed faces of the stone for at least 2 inches. From this point, they may depart from normal by not more than 1 inch in 12 inches.

Do not round the corners at the meeting of the bed and joint lines in excess of the following radii:

Type of Masonry	Dimensions
Cement rubble masonry	1-½ inches
Class A masonry	1 inch
Class B masonry	No Rounding
Dimensioned masonry	No Rounding

(e) Arch Ring Stone Joint Surfaces. Ensure that arch ring stone joint surfaces are radial and at right angles to the front faces of the stones. Dress them for a distance of at least 3 inches from the front faces and soffits. From these points, they may depart from a plane normal to the face, not to exceed ¾ inch in 12 inches. Ensure that the back surface is in contact with the concrete of the arch barrel parallel to the front face, and dress it for a distance of 6 inches from the intrados. Cut the top perpendicular to the front face, and dress it for a distance of at least 3 inches from the front.

When concrete is to be placed after the masonry has been constructed, place adjacent ring stones to vary at least 6 inch in depth.

(f) Stratification. Ensure that stratification in arch ring stones is parallel to the radial joints, and in other stones parallel to the beds.

(g) Finish for Exposed Faces. Pitch face stones to the line along all beds and joints. The kind of finish for exposed faces will be SHOWN ON THE DRAWINGS. The following symbols will be used, representing the type of surface or dressing specified below:

(1) *Fine Pointed (F.P.).* Make the point depressions approximately ¾ inch apart with surface variation not to exceed 1/8 inch from the pitch line.

(2) *Medium Pointed (M.P.).* Make the point depressions approximately 5/8 inch apart with surface variations not to exceed ¼ inch from the pitch line.

(3) *Coarse Pointed (C.P.).* Make the point depressions approximately 1 to 1-¼ inches apart, with surface variations not to exceed 3/8 inch from the pitch line.

(4) *Split or Seam Faced (S.)*. Make the surface present a smooth appearance without tool marks, without depressions below the pitch line, and with no projection exceeding $\frac{3}{4}$ inch beyond the pitch line.

(5) *Rock Faced (R.F.)*. Make the face an irregular, projecting surface without indications of tool marks, without concave surfaces below the pitch line, and with projections beyond the pitch line, when measured in inches, not exceeding the figure preceding the symbol as SHOWN ON THE DRAWINGS (for example, “1- $\frac{1}{2}$ R.F.” means projections beyond the pitch line not exceeding 1- $\frac{1}{2}$ inch). Where a variable rock face is specified, distribute stones of the same height of projection.

Removal of drill and quarry marks from the faces of stones in cement rubble masonry shall not be required.

610.04 Quarry Operations. Organize quarry operations and delivery of stone to the point of use to ensure that deliveries are well ahead of masonry operations. Keep a sufficiently large stock of stone on the site at all times to permit adequate selection of stone by the masons.

610.05 Mortar. Use mortar that meets the requirements specified in Subsection 712.05.

Construction

610.06 Excavation & Backfill. Excavate and backfill as specified in Section 206A, modified as follows:

For filled spandrel arches, carefully place the backfill to load the ring uniformly and symmetrically. Use backfill material approved by the CO. Place it in horizontal layers, carefully tamp it, and bring it up simultaneously from both haunches. Do not place wedge-shaped sections of backfill material against spandrels, wings, or abutments.

610.07 Falsework. Construct arch centering in accordance with construction drawings submitted. Provide wedges for raising or lowering the forms to the exact elevation for taking up any settlement that occurs during loading. Lower the centering gradually and symmetrically to avoid overstresses in the arch.

Rest centering upon jacks in order to take up and correct any slight settlement that may occur after the placing of masonry has begun. In general, strike the centering and make the arch self-supporting before the railing or coping is placed. For filled spandrel arches, leave these portions of the spandrel walls for construction subsequent to the striking of centers as necessary to avoid jamming of the expansion joints.

610.08 Sample Section. When SHOWN ON THE DRAWINGS, build an L-shaped sample section of wall not less than 5 feet high and 8 feet long, showing examples of face wall, top wall, method of turning corners, and method of forming joints. The sample section will be subject to the CO's approval. Do not lay any masonry other than the foundation masonry before such samples are approved.

610.09 Arch Ring Template. Lay out a full-size template of the arch ring near the quarry site, showing face dimensions of each ring stone and thickness of joints. Do not begin shaping any ring stone before the template is approved by the CO, and do not place any ring stone in the structure that does not correspond to approved configuration.

610.10 Selection & Placing. When the masonry is to be placed on a prepared foundation bed, make the bed firm and normal to, or in steps normal to, the face of the wall. Do not place any stone before the bed is approved by the CO. When stone is to be placed on foundation masonry, thoroughly clean the bearing surface of this masonry thoroughly and wet it immediately before the mortar bed is spread.

Set face stones in random bond to produce the effect SHOWN ON THE DRAWINGS and to correspond with the sample section approved by the CO.

Prevent small stones or stones of the same size from bunching. When weathered or colored stones or stones of varying texture are used, uniformly distribute the various kinds of stones throughout the exposed faces of the work. Use large stones for the bottom courses and large selected stones in the corners. In general, ensure that the stones decrease in size from the bottom to the top of work.

Thoroughly clean all stones and wet them immediately before they are set. Clean and moisten the bed before the mortar is spread. Lay the stones with their longest faces horizontal in full beds of mortar, and flush the joints with mortar.

610.11 Beds & Joints. Ensure that the exposed faces of individual stones are parallel to the faces of the walls in which the stones are set.

Do not jar or displace stones already set. Provide equipment for setting stones larger than those that can be handled by two people. Do not roll or turn stones on the walls. If a stone is loosened after the mortar has taken initial set, remove it, clean off the mortar, and relay the stone with fresh mortar.

Carefully set arch ring stone to exact positions, and hold the stone in place with hardwood wedges until the joints are packed with mortar.

Ensure that the thickness of beds and joints of face stones are as follows:

Type of Masonry	Beds (inches)	Joints (inches)
Cement rubble masonry	1/2 to 2 1/2	1/2 to 2 1/2
Class A masonry	1/2 to 2	1/2 to 2
Class B masonry	1/2 to 2	1/2 to 1 1/2
Dimensioned masonry	(See note)	3/4 to 1

Note: The thickness of beds in dimensioned masonry may vary from 3/4 to 1 inch from the bottom to the top of the work. However, make the beds of uniform thickness throughout in each course.

Do not allow beds to extend in an unbroken line across more than 5 stones, and joints across more than 2 stones.

Make joints in dimensioned masonry vertical. In all other masonry, joints may be at angles with the vertical from 0° to 45°.

Bond each face stone with all contiguous face stones at least 6 inches longitudinally and 2 inches vertically.

Do not make the corners of four stones adjacent to each other.

Make cross beds for vertical walls level. For battered walls, cross beds may vary from level to normal to the batter line of the face of the wall. Completely fill all arch ring joints with mortar.

610.12 Headers. Uniformly distribute headers throughout the walls of structures to form at least one-fifth of the faces.

610.13 Backing. Build the backing chiefly of large stones and in a workmanlike manner. Ensure that the individual stones composing the backing and hearting are well bonded with the stones in the face wall and with each other. Completely fill all openings and interstices in the backing with mortar, or with spalls completely surrounded by mortar.

610.14 Coping. Prepare copings as SHOWN ON THE DRAWINGS. If copings are not SHOWN ON THE DRAWINGS, finish the top of the wall with stones wide enough to cover the top of the wall, from 1-1/2 to 5 feet in length, and of random heights, with a minimum height of 6 inches. Lay stones so the top course is an integral part of the wall. Align the tops of the top courses of stone in both vertical and horizontal planes.

610.15 Parapet Walls. Use selected stones, squared and pitched to line and with heads dressed, in the ends of parapet walls and in all exposed angles and corners. Interlock headers well, and extend as many as possible entirely through the wall. Ensure that both the headers and stretchers in the two faces of the wall are well interlocked in heart and comprise practically the whole volume of the wall. Completely fill all interstices in the wall with cement grout, or with spalls completely surrounded with mortar or grout.

610.16 Facing for Concrete. Construct the stone masonry before placing concrete. Concrete may be placed before constructing the stone masonry if approved by the CO.

(a) Stone Masonry Constructed Prior to Placing Concrete. Ensure that hooked steel anchors, consisting of number 4 bars each bent into an elongated “S” shape, are spaced 2 feet apart both horizontally and vertically, unless closer spacing is SHOWN ON THE DRAWINGS. To improve the bond between the stone masonry and the concrete backing, make the back of the former as uneven as the stones will permit. Rigidly embed each anchor in a horizontal joint of the masonry, with one end 2 inches from the faces of the stones. Project the other end approximately 10 inches into the concrete backing.

When the stone facing has been laid and the mortar has attained sufficient strength, carefully clean all surfaces against which concrete is to be placed and remove all dirt, loose material, and accumulations of mortar droppings. If necessary, use picks, scrapers, and wire brooms for this purpose. If compressed air is available, use it to blow out the

dust and dirt. Just before the concrete is placed, wash the surfaces thoroughly. Forcibly dash water against the stones and into the joints, preferably using a hose. In depositing concrete, hold the top surface immediately adjacent to the stones, slightly low, and carry a neat cement grout of the consistency of cream on top of the concrete and against the masonry at all times, coating the entire exposed areas of all the stones with grout. Fill all interstices of the masonry, and thoroughly spade the concrete, working it until it is brought into intimate contact with every part of the back of the masonry.

(b) Concrete Placed Before Constructing Masonry. Except where otherwise SHOWN ON THE DRAWINGS, allow a thickness of 9 inches for facing. Set galvanized metal slots with anchors for the stonework, or other approved type of metal anchor, vertically in the concrete face at a horizontal spacing of no more than 24 inches. Temporarily fill the slots with felt or other material to prevent them from being filled with concrete. During the setting of the stone facing, fit the metal anchors tightly in the slots at an average vertical spacing of 24 inches. The CO will mark on the concrete backing the approximate location of the anchors. Place the anchor in the stone joint nearest to the mark. Ensure that at least 25 percent of the metal anchors have a short right-angle bend to engage a recess to be cut into the stone. Extend the anchors to within 3 inches of the exposed face of the stone work.

Where the shape of the concrete face is unsuitable for the use of metal slots, place ties consisting of U.S. Standard Gauge number 9 galvanized iron wire, as approved by the CO, with not less than one wire tie for each 1-1/2 square feet of exposed stone surface. In laying the stone, continuously keep the concrete face wet for 2 hours before placing the stone, and thoroughly fill all spaces between the stone and concrete with mortar. Immediately after laying, clean all exposed stone surfaces, and keep them clean of loose mortar and cement stains.

610.17 Pointing. Point or finish all joints as SHOWN ON THE DRAWINGS.

When raked joints are called for, rake out all mortar in exposed faced joints and beds to the depth SHOWN ON THE DRAWINGS. Clean stone faces in the joints free of mortar.

When weather joints are called for, weather strike the bed. Slightly rake the joints to conform to the bed weather joint. Never make the mortar flush with the faces of the stones.

To provide drainage, slightly crown the mortar in joints on top surfaces at the center of the masonry.

610.18 Weep Holes. Provide all walls and abutments with weep holes, as SHOWN ON THE DRAWINGS.

610.19 Cleaning Exposed Faces. Immediately after being laid and while the mortar is fresh, thoroughly clean all face stone of mortar stains, and keep it clean until the work is completed. Before the final acceptance, clean the surface of the masonry using wire brushes and acid, if necessary.

610.20 Weather Limitations. Do not lay stone in freezing weather unless the CO approves in writing, and then only using precautionary methods prescribed for doing the work and protecting it at all times. This permission and the use of the prescribed methods shall not release the Contractor from the obligation to build a satisfactory structure. Remove and replace all work damaged by cold weather. In hot or dry weather, use satisfactory means to protect the masonry from the sun, and keep it wet for at least 3 days after completion.

Measurement

610.21 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Do not include sample sections of wall, unless they are permitted to be incorporated in the work.

When computing quantities, use the dimensions determined by the lines SHOWN ON THE DRAWINGS. Make no deductions for weep holes, drain pipes, or other openings of less than 2 square feet in area, or for chamfers or other ornamental cuts that amount to 5 percent or less of the volume of the stone in which they occur.

Payment

610.22 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
610(01) Cement rubble masonry	Cubic Yard
610(02) Class A masonry	Cubic Yard
610(03) Class B masonry	Cubic Yard
610(04) Dimensioned masonry	Cubic Yard

Section 610A - Simulated Stone Masonry Surface

Description

610A.01 Work. Design, furnish, and install textured form liners. Apply a surface finish (color/stain application) that will duplicate the unique coloring and mottled appearance of stone masonry. Prepare a simulated stone masonry test wall and demonstrate the surface finish before beginning production work.

In accordance with the intent of the contract, simulate the texture and color of native stone masonry. Construct the simulated stone masonry stone pattern as SHOWN ON THE DRAWINGS.

Materials

610A.02 Requirements. Furnish material as specified in the following subsections:

Form Liner	725.26
Low-Strength Grout (Plaster Mix)	701.03(b)
Penetrating Stain	708.05
Preformed Expansion Joint Fillers	712.01(b)

Construction

610A.03 Form Liner Fabrication. Take an impression of the stone shape, texture, and mortar joints from a designated location. Design form liners from the impressions according to the stone pattern, as SHOWN ON THE DRAWINGS.

610A.04 Form Liner Installation. Attach the form liners to the form. Attach adjacent form liners to each other, with less than a 1/8-inch seam. Do not repeat the form liner pattern between expansion joints or within 20-foot intervals, whichever is greater.

Form expansion joints at the intervals as SHOWN ON THE DRAWINGS. Blend the butt joints into the pattern and the final concrete surface.

Coordinate the forms with wall ties. Place form tie holes in the high point of rustication or in the mortar joint.

Clean off buildup before reusing form liners. Visually inspect each liner for blemishes and tears. Repair the liner before installation.

610A.05 Top Surface. Emboss the plastic concrete in the exposed top surface by stamping, tooling, troweling, or hand shaping, or a combination thereof, to simulate the stone masonry texture and mortared joints. Match the side pattern of the formed mortared joints. Immediately after the free surface water evaporates and the finish embossing is complete, cure the concrete for 7 days, as specified in Subsection 552.17(b). Do not use liquid membrane curing compounds.

610A.06 Form Liner Removal. Within 24 hours after placing concrete, remove or break free the form liners without causing concrete surface deterioration or weakness in the substratum. Remove all form tie material to a depth of at least 1 inch below the concrete face without spalling and damaging the concrete.

Cure the concrete for 7 days, as specified in Subsection 552.17(b). Do not use liquid membrane curing compounds.

610A.07 Preparation of Concrete Surface. Finish all exposed formed concrete surfaces as specified in Subsection 552.18(a). Finish so that vertical seams, horizontal seams, and butt joint marks are not visible. Keep grinding and chipping to a minimum to avoid exposing aggregate.

Provide a completed surface free of blemishes, discolorations, surface voids, and conspicuous form marks. Make the finished texture and patterns continuous without visual interruption.

610A.08 Color/Stain Application. Age concrete, including patches, a minimum of 30 days. Use approved methods to clean the surface of all latency, dirt, dust, grease, and any foreign material.

Remove efflorescence with a pressure water wash. Use a fan nozzle held perpendicular to the surface at a distance from 2 to 3 feet. Use a minimum 2,900-pounds per square inch water pressure at a rate of 3 to 4 gallons per minute. Do not sandblast any surface that will receive color or stain.

Correct any surface irregularities created by the surface cleaning.

Maintain the concrete temperature between 40 °F and 85 °F when applying color or stain, and for 48 hours after applying color or stain.

Color or stain all exposed concrete surfaces. Use a color or stain application suitable to obtain the appearance of the native stone masonry. Use a minimum of three colors or stains.

When required at boundaries between two color tones or between surfaces that receive color at different times, take care to provide protection to avoid overspray and color overlap.

Apply grout of a natural cement color to each form joint. Use sufficient grout so the overspray of the color or stain is not visible. Give the form pattern grout joint the appearance of mortared joints in completed masonry.

Recoat any areas that lack a uniform appearance or are inconsistent in appearance with the approved test wall.

Treat expansion joints with caulk or grout to blend with the appearance of the adjacent stone or mortar joint.

610A.09 Test Wall. Before beginning production work on the simulated stone masonry, construct a test wall with a minimum size of 3-foot height by 2-foot width by 10-foot length, in accordance with Section 552 and these specifications.

Cast the test wall on site, using the same forming methods, procedures, form liner, texture configuration, expansion joint, concrete mixture, and color or stain application proposed for the production work. Demonstrate the quality and consistency of joint treatment, end treatment, top embossing methods, back treatment, and the color or stain application on the test wall. Construct a new test wall if results are not acceptable.

Begin production structural concrete work only after the test wall is approved. Begin production color or stain application only after the color or stain application on the test wall is approved. Dispose of the test wall after use as SHOWN ON THE DRAWINGS.

Measurement

610A.10 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure simulated stone masonry surface treatment by the square yard.

Measure the simulated stone masonry test wall, including concrete and surface finish, by the each.

Do not measure form liners.

Payment

610A.11 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
610A(01) Simulated stone masonry surface treatment	Square Yard
610A(02) Simulated stone masonry test wall	Each

Section 611 - Development of Pits & Quarries

Description

611.01 Work. Clear, grub, strip topsoil, remove overburden, construct access roads, conduct restoration activities, and perform other incidental work required for pit or quarry development.

Construction

611.02 General. Perform all work in accordance with Sections 201, 203, and 625; landscape preservation requirements; and the pit and quarry development and/or restoration plan, as SHOWN ON THE DRAWINGS.

611.03 Source. Develop designated sources in accordance with requirements SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS.

611.04 Clearing, Grubbing, & Slash Cleanup. Meet clearing, grubbing, and slash cleanup requirements as specified in Section 201 and as SHOWN ON THE DRAWINGS.

611.05 Access Roads. Construct or recondition access roads to the pit or quarry as specified in Section 203 or 306, and as SHOWN ON THE DRAWINGS.

611.06 Topsoil. Strip, stockpile, and place topsoil obtained from the site as specified in Section 203 and as SHOWN ON THE DRAWINGS.

611.07 Overburden. Remove overburden to expose rock material for aggregate production, and stockpile or place the overburden in the embankment within the limits of the pit or quarry, as specified in Section 203 and as SHOWN ON THE DRAWINGS.

611.08 Ground Control & Haulways. Perform the work in accordance with MSHA 30 CFR, part 56, as related to ground control and haulways. Immediately correct any deterioration of overburden slopes, safety benches, or protective berms, or any encroachment on clearing limits.

611.09 Oversize Material. Use all suitable material for aggregate, regardless of size, that is developed in stripping, overburden removal, and excavation of rock material, unless other disposition is SHOWN ON THE DRAWINGS. 440

611.10 Restoration. After excavation has been completed in part or all of the area, slope and grade the sides, and smooth the general pit area as SHOWN ON THE DRAWINGS.

Rip and drain access roads that are marked on the drawings for obliteration; block them to traffic; and seed them in accordance with Section 625.

Measurement

611.11 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment

611.12 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
611(01) Pit development	Each
611(02) Quarry development	Each

Section 617 - Structural-Plate Structures

Description

617.01 Work. Furnish and install, or install only, structural-plate pipes, pipe arches, arches, boxes, and underpasses. Include joints and connections to pipes, catch basins, headwalls, stiffening ribs, thrust beams, and other appurtenances required to complete the structure.

Materials

617.02 Requirements. Ensure that materials meet the requirements specified in the following subsections:

Aluminum-Alloy Structural-Plate Structures	707.06
Asphalt-Coated Structural-Plate Structures	707.07
Backfill Material	704.03
High-Strength Nonshrink Grout	701.02
Reinforcing Steel	709.01
Repair of Damaged Coatings	707.15
Steel Structural-Plate Structures	707.05

Furnish concrete that meets the requirements specified in Subsection 602.03, method A or B, or as SHOWN ON THE DRAWINGS.

Construction

617.03 Excavation & Bedding. Excavate to the limits SHOWN ON THE DRAWINGS and in accordance with the requirements of Sections 206 and 206A.

Specific structure installation time restrictions and installation plan requirements are SHOWN ON THE DRAWINGS.

Provide bedding material that meets the same requirements as backfill material.

Bed the culvert in a compacted layer of bedding material with a thickness equal to at least 10 percent of the culvert height. Place the bedding material in layers that do not exceed 6 inches in depth when compacted. Shape and compact the bed to fit the culvert. Where applicable, recess the shaped foundation to receive the joints.

Do not place or backfill structure until the CO has approved the excavation and foundation.

617.04 Design & Fabrication. Submit four sets of shop drawings of the plate structure to the CO at least 21 days before planned construction. Accompany shop drawings with all calculations used to determine the size, shape, location, and spacing of stiffening ribs, thrust beams, or other special structural features.

Fabricate plates in accordance with AASHTO M 167 or M 219.

Form plates to provide lap joints. Stagger joints so that not more than three plates come together at any one point. Punch the bolt holes so that all plates with like dimensions, curvature, and the same number of bolts per foot of seam are interchangeable. Curve each plate to the proper radius so that the cross-sectional dimensions of the finished structure are as SHOWN ON THE DRAWINGS.

Cut plates for forming skewed or sloped ends to give the angle of skew or slope as SHOWN ON THE DRAWINGS. Place legible identification numerals on each plate to designate its proper position in the finished structure.

617.05 Erection. Provide a copy of manufacturer's assembly instructions before assembly. The instructions shall show the position of each plate and the assembly order.

Assemble the structural plates according to the manufacturer's instructions. Exercise care in the use of drift pins and pry bars to prevent damage to the structural plate and its coating. Torque all bolts before beginning the backfill. Repair damaged coatings according to Subsection 707.15. Ensure that the plates have a proper fit-up.

When aluminum alloys come in contact with other metals, coat the contacting surfaces with asphalt mastic according to Subsection 707.07 or a preapproved asphalt-impregnated caulking compound.

Torque steel bolts on steel plates to a minimum of 100 foot-pounds and a maximum of 300 foot-pounds.

Torque steel and aluminum bolts on 1/16-inch thick aluminum plates to a minimum of 90 foot-pounds and a maximum of 115 foot-pounds.

Torque steel bolts and aluminum bolts on 1/8-inch thick and heavier aluminum plates to a minimum of 115 foot-pounds and a maximum of 135 foot-pounds.

For long-span structures:

- (a) Tighten the longitudinal seams when the plates are assembled unless the plates are held in shape by cables, struts, or backfill. Properly align plates circumferentially to avoid permanent distortion from the design shape. Before backfilling, do not exceed 2 percent variation from the design shape.
- (b) Do not distort the shape of the structure by operating equipment over or near it.
- (c) Provide survey control on the structure to check structure movement when SHOWN ON THE DRAWINGS.
- (d) Check and control the deflection movements of the structure during the entire backfilling operation. Do not exceed the manufacturer's recommended limits.

- (e) Provide a manufacturer's representative onsite to assist in the erection and backfilling of the structure when SHOWN ON THE DRAWINGS.

617.06 Backfilling. Provide backfill meeting the material and placement requirements of Section 206 or 206A.

After preparing bedding and placing the structure, place backfill in layers not exceeding 6 inches loose thickness, and compact it under the haunches and alongside the structure. The material shall be readily compactible and free of frozen lumps, chunks of highly plastic clay, or other objectionable material. Do not use rocks larger than 3 inches in greatest dimension within 12 inches of the structure. Ensure that there is an area of compacted material at least as wide as one diameter of the structure or 12 feet; whichever is less, on each side of the structure. Compact the backfill without damaging or displacing the structure.

When filling around and over arches before headwalls are in place, place the first embankment material midway between the ends of the arch, forming as narrow a ramp as possible, until reaching the top of the arch. Build the ramp evenly from both sides, and compact the embankment material as it is placed. After building the two ramps to the top of the arch, deposit the remainder of the embankment material from the top of the arch in both directions from the center to the ends, and as evenly as possible on both sides of the arch.

If headwalls are built before any embankment material is placed around and over the arch, first place the embankment material adjacent to one headwall until reaching the top of the arch. Then dump the embankment material from the top of the arch toward the other headwall, depositing the material evenly on both sides of the arch.

Follow the procedures specified above in multiple installations. Bring up the embankment material evenly on each side of each arch to avoid unequal pressure.

Ensure that backfill density exceeds 95 percent of the maximum density as determined by AASHTO T 99, method C or D.

Continue backfilling and compacting until the backfill is 12 inches above the top of the structure.

After bedding and backfilling, protect the structure with an adequate cover of compacted embankment, as indicated by manufacturer's recommendation. Do this before permitting heavy equipment to cross during roadway construction.

Replace structure that is distorted by more than 5 percent of nominal dimensions, or is ruptured or broken.

Ensure that backfilling materials, methods, and procedures meet the manufacturer's requirements.

Measurement

617.07 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS. The quantity of concrete or reinforcing steel used in thrust beams or additional structural metal or plates used in stiffening ribs or other special structural features will not be included in the quantities for payment.

Payment

617.08 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
617(01) _____ structural-plate pipe, size _____, <i>Material</i> _____ - coated, _____ -thickness.....	Linear Foot
617(02) _____ structural-plate pipe arch, _____ span, <i>Material</i> _____ rise, _____ - coated, _____ thickness	Liner Foot
617(03) _____ structural-plate arch, _____ span, <i>Material</i> _____ rise, _____ -coated, _____ thickness	Linear Foot
617(04) _____ structural-plate underpass, _____ size , <i>Material</i> _____ -coated, _____ thickness.....	Linear Foot
617(05) _____ structural-plate box culvert, _____ span, <i>Material</i> _____ rise, _____ -coated, _____ thickness	Linear Foot
617(06) _____ long-span structure, plate _____ -coated, <i>Material</i> <i>Type</i> _____ span, _____ rise, _____ thickness.....	Linear Foot
617(07) Installation only	Each

Section 618 - Cleaning & Reconditioning Existing Drainage Structures

Description

618.01 Work. Clean and recondition existing pipe and appurtenant structures.

Materials

618.02 Requirements. Ensure that the materials used for repair or replacement meet the applicable requirements of sections SHOWN ON THE DRAWINGS or specified in the SPECIAL PROJECT SPECIFICATIONS.

Construction

618.03 Pipe Removed & Cleaned. Carefully remove the pipe and appurtenant structures and clean foreign material out of the barrel and at the jointed ends.

618.04 Pipe Cleaned in Place. Remove all foreign material inside the barrel by methods that do not damage the pipe. Take adequate measures to protect the drainage and prevent stream siltation or increased turbidity when hydraulically cleaning pipe in place.

If approved by the CO, all or part of the pipe designated to be cleaned in place may be removed, cleaned, and re-laid in accordance with Sections 603, 603A, and 603B. In these cases, furnish all material required to replace damaged pipe and joints, perform all excavation and backfill, and relay the pipe.

618.05 Relaying or Stockpiling Salvaged Pipe. The locations of pipe and appurtenant structures to be removed, cleaned, and re-laid will be SHOWN ON THE DRAWINGS. Relay the pipe in accordance with Sections 603, 603A, and 603B. Furnish all jointing material, and replace pipe that has been damaged during removing or handling, in sufficient lengths to complete the designated length to be re-laid, without added compensation. Place salvaged pipe designated to be stockpiled where SHOWN ON THE DRAWINGS. Carefully remove and handle all pipe to avoid breaking or damaging it. Do not place pipe that has been structurally damaged in stockpiles. Dispose of damaged pipe at an approved location in accordance with Subsection 202.04.

618.06 Reconditioning Drainage Structure. Remove all debris, repair leaks, and replace broken or missing metalwork on all structures, such as manholes and inlets, that are SHOWN ON THE DRAWINGS as needing reconditioning. Leave these structures in operating condition.

Measurement

618.07 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

The quantity of pipe and appurtenant structures removed, cleaned, and re-laid is the length in final position.

The quantity of pipe and appurtenant structures removed, cleaned, and stockpiled is the total length of all pipe acceptably removed, cleaned, and placed in the stockpile.

The quantity of pipe and appurtenant structures cleaned in place is the length along the flow line.

No additional payment will be made for material to replace damaged pipe and joints, excavation, relaying pipes, or backfill if pipe is removed for cleaning, when damage is the result of operation.

Payment

618.08 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
618(01) Removing, cleaning, and stockpiling salvaged _____	.....Linear Foot
618(02) Removing, cleaning, and relaying salvaged _____	.....Linear Foot
618(03) Cleaning _____ in place.....	.....Linear foot
618(04) Cleaning _____ in place.....	.....Each
618(05) Reconditioning drainage structures.....	.....Each

Section 621 - Corrugated Metal Spillways

Description

621.01 Work. Furnish and install, or install only, corrugated metal spillway inlet assemblies, outlet pipes, half-round outlet pipe, rectangular flumes, and other appurtenances for downdrains.

Materials

621.02 Requirements. Ensure that spillway inlet assemblies, outlets, and connectors are of the type and thickness SHOWN ON THE DRAWINGS and are constructed of corrugated sheet metal that meets the requirements specified in Subsection 603.02. Fillet weld or rivet bulkheads and connections for outlet pipes to the inlet chamber to form watertight joints. Rivet or weld anchors, lips, and skirts so they are secure. Ensure that connections for outlet pipes meet the requirements specified in Subsection 603.06.

Ensure that outlets are the type, size, and arrangement SHOWN ON THE DRAWINGS, and that they meet the requirements for corrugated metal pipe specified in Subsection 603.02. Furnish half-round pipe with end sections punched so that joints can be riveted in the field. Furnish elbows of the full-circle type.

Ensure that anchor assemblies for the downdrains and other components are as SHOWN ON THE DRAWINGS.

Ensure that coating for spillway inlet assemblies and outlet pipes meets the requirements for coated corrugated pipe specified in Subsection 603.02.

Install a gasket or equivalent material on circular pipe at the joints on each side of elbows and at each joint on the downdrain to make the connections watertight. Install gaskets on the entire circumference. Use gasket material of sponge rubber or synthetic rubber compound specifically designed for such installations and recommended by the coupling band fabricator. Approved joint compounds, such as Thiocaulk or Plastiflex, may be used instead of gaskets.

Construction

621.03 Performance. Place spillway inlets where SHOWN ON THE DRAWINGS. Compact the earth backfill in accordance with Subsection 603.08, method B.

Install outlet pipes in accordance with Section 603. Place outside laps so they face upstream.

Repair damaged coating on the inlet assemblies or pipe and all field rivet heads as required in Subsection 707.15.

Ensure that there are no reverse grades, and that no point varies from a straight line drawn from inlet to outlet by more than 2 percent horizontally and vertically of the

spillway length, or 12 inches on the final installed alignment, whichever is less, unless otherwise SHOWN ON THE DRAWINGS.

Measurement

621.04 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

The quantity of outlet pipes shall be the length from end to end of each outlet pipe, excluding elbows and spillway assemblies.

Payment

621.05 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
621(01) Spillway inlet assemblies	Each
621(02) Spillway inlet assemblies with _____ coating.....	Each
621(03) _____ -inch half-round outlet pipe	Linear Foot
621(04) _____ -inch half-round outlet pipe with _____ coating.....	Linear foot
621(05) _____ -inch flexible downpipe	Liner foot
621(06) Anchors for downdrains for _____ -inch pipe.....	Each
621(07) _____ -inch full-circle outlet pipe.....	Linear Foot
621(08) _____ -inch full-circle outlet pipe with _____ coating	Linear Foot
621(09) Pipe elbow	Each
621(10) Pipe elbow, _____ coated	Each
621(11) _____ -inch pipe end section	Each
621(12) Starter section, type	Each
621(13) Flume, type	Linear Foot

- 621(14) Anchor stakes _____.....Each
- 621(15) Energy dissipater, type _____.....Each

Section 622 - Paved Waterways

Description

622.01 Work. Pave ditches, gutters, spillways, and other similar waterways with concrete, grouted rubble, ungrouted rubble, mortared rubble, concrete and rubble, or a mixture of aggregate and bituminous material. Also construct a bed course.

Materials

622.02 Requirements. Furnish concrete that meets the requirements specified in Subsection 602.03, method A or B, as SHOWN ON THE DRAWINGS.

Ensure that materials meet the requirements specified in the following sections or subsections:

Bed Course	704.09
Bituminous Material	702
Cold Asphalt Concrete Pavement Aggregate	703.08
Low-Strength Grout	701.03
Reinforcing Steel	709.01

Ensure that materials and proportions for bituminous mixtures are as SHOWN ON THE DRAWINGS.

Provide rubble for pavement that is approved, sound, durable rock of the sizes SHOWN ON THE DRAWINGS. Inspect all rock before and after laying it, and remove all rejected material immediately.

Construction

622.03 Bed Course. Form the bed course to the required depth below and parallel with the finished surface of the waterway. Replace all soft, yielding, or otherwise unsuitable material with suitable material. Compact and finish the bed course to a smooth, firm surface.

Do not construct the paved waterway until the CO gives written approval of the bed.

622.04 Grouted Rubble. Place and compact bed course material to the required thickness when SHOWN ON THE DRAWINGS.

Place the pavement stones on the bed course with flat faces up and their longest dimensions at right angles to the centerline of the waterway.

Break joints so they are not wider than 1 inch. Ram the rocks until the surface is firm and reasonably true to the finished surface in grade, alignment, and cross section. Relay or replace any rock that causes an irregular or uneven surface. After the rocks are rammed

into place and the surface is satisfactory, fill the spaces or voids between and around the stones with filler aggregate to within 4 inches of the surface. Then pour and broom cement grout into the spaces between the stones. Continue this operation until the grout is about 1 inch below the tops of the stones. Ensure that the grout flows readily into the spaces between the rocks, but is not so wet that solid matter separates from the water.

622.05 UngROUTED Rubble. Place the pavement rocks on the bed course with flat up and their longest dimensions at right angles to the centerline of the waterway. Break joints so they are not wider than ½ inch. Ram the rocks until the surface is firm and reasonably true to the finished surface in grade, alignment, and cross section. Relay or replace any rock that causes an irregular or uneven surface, or any rock that is not in reasonably close contact with adjacent rocks.

622.06 Mortared Rubble. Lay the pavement rocks with flat faces up and their longest dimensions parallel to the gutter line.

Break joints so they are not wider than 1 inch. After each rock is rammed into place and the surface is satisfactory, apply enough mortar on the exposed side so that when the adjacent rock is rammed into position, the mortar fills the interstices between the rocks to within 1 inch of the surface and does not protrude above their tops. Ensure the finished rock surface is free from mortar stain.

622.07 Reinforced Concrete & Rubble. Construct a reinforced concrete foundation upon a repaired foundation as SHOWN ON THE DRAWINGS. Construct it progressively by laying surface rocks and bedding them securely in the concrete before it hardens. Ensure that the faces of the rocks in contact with the concrete are clean and free of any defects that will impair their bond with the concrete.

Thoroughly wet rocks before laying them, allowing ample time for them to become nearly saturated. Fill joints between rocks with mortar. Keep the bedded reinforcement steel within the middle third of the depth of the concrete during construction.

622.08 Bituminous Mixture. Prepare the bituminous mixture, stake forms, and place the mixture as specified below.

(a) Preparing Mixture. Prepare the bituminous mixture by using either a rotary mixer or a pugmill, or by spreading the aggregate on a flat, firm surface off the area to be surfaced, and mix it using road-mix methods. Either batch- or continuous-type pugmills may be used.

Except when emulsified asphalt is used, ensure that the aggregate does not have a moisture content of more than 2 percent at the time it is mixed with the bituminous materials. However, if an approved additive is used, the aggregate may have a moisture content of up to 5 percent.

Apply bituminous material to the aggregate or introduce it into the mixture at the temperature at which the aggregate will be coated uniformly and completely.

When mixing is done in a mixer, mix for no less than 40 seconds from the time all materials are in the mixer until they are discharged. When road-mix methods are used, continue the mixing until all aggregate particles are uniformly coated with bituminous material.

(b) Forms. Securely stake all forms approved by the CO into position at the correct line and elevation.

(c) Placing Mixture. Place the mixture on the prepared bed only when the bed is sufficiently dry and weather conditions are suitable. Place and compact the mixture in one or more courses to the thickness SHOWN ON THE DRAWINGS. Smooth each course by raking or screeding and compact it thoroughly by rolling with a hand-operated roller weighing no less than 300 pounds, or with an approved small power roller. Compact areas that cannot be reached with rollers by using hand tampers. Ensure that the surface is smooth and even, and that it has a dense texture after it is compacted.

622.09 Concrete Paving. Ensure that concrete paving is plain or reinforced, as SHOWN ON THE DRAWINGS, and that it meets the requirements specified in Section 602.

622.10 Finishing Work. Remove forms from paved waterways, and make necessary repairs to edges. Shape and compact the adjacent slopes and shoulders to the cross section SHOWN ON THE DRAWINGS.

Measurement

622.11 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Base area computations upon surface measurements.

Payment

622.12 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
622(01) Grouted rubble paved waterway	Square Yard
622(02) UngROUTED rubble paved waterway	Square Yard
622(03) Mortared rubble paved waterway	Square Yard
622(04) Concrete and rubble paved waterway	Square Yard
622(05) Bituminous paved waterway	Square Yard

- 622(06) Concrete paved waterwaySquare Yard
- 622(07) Bed course materialTon

Section 623 - Monuments & Markers

Description

623.01 Basis. Furnish and install right-of-way monuments, milepost markers, underdrain markers, and culvert markers.

Materials

623.02 Requirements. Furnish materials for the various types of monuments and markers as SHOWN ON THE DRAWINGS.

Construction

623.03 Performance. Fabricate and install the various types of monuments and markers as SHOWN ON THE DRAWINGS, and also paint the posts, if required. Set each monument and post accurately at the required location and elevation.

Measurement

623.04 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment

623.05 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
623(01) Right-of-way monument	Each
623(02) Milepost marker	Each
623(03) Underdrain marker	Each
623(04) Culvert marker	Each

Section 624 - Topsoiling

Description

624.01 Work. Furnish, excavate, or remove topsoil from stockpiles; then haul, deposit, and spread it.

Materials

624.02 Source. Obtain topsoil from sources SHOWN ON THE DRAWINGS or specified in the SPECIAL PROJECT SPECIFICATIONS.

624.03 Quality. Ensure that topsoil meets the requirements specified in Subsection 713.01.

Construction

624.04 Spreading. Spread the topsoil to the depth and at the locations SHOWN ON THE DRAWINGS.

Do not spread topsoil when the ground or topsoil is frozen, excessively wet, or in a condition detrimental to the work.

Remove and dispose of large clods, rocks larger than 2 inches in any dimension, roots, stumps, and other litter as SHOWN ON THE DRAWINGS.

624.05 Hauling. Keep the roadbed surfacing clean during hauling operations. Remove topsoil or other soil from the surfacing before traffic compacts it.

624.06 Source Area Other Than Roadway. After stripping operations have been completed, rough grade the source area and remove refuse. Leave the area in a neat condition. Leave a minimum 3 inches of topsoil on the source, and seed the area as SHOWN ON THE DRAWINGS.

Measurement

624.07 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure the topsoil provided by the Contractor and paid for by cubic yard in the vehicles at the point of delivery. Measure the volume of topsoil from designated stockpiles in the original stockpile.

When topsoil is paid for by the square yard, compute its quantity along slope dimensions.

Payment

624.08 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
624(01) Furnishing and placing topsoil	Square Yard
624(02) Furnishing and placing topsoil	Cubic Yard
624(03) Placing topsoil	Square Yard
624(04) Placing topsoil	Cubic Yard

Section 625 - Seeding & Mulching

Description

625.01 Work. Prepare seedbeds, and furnish and place required seed, fertilizer, limestone, mulch, net, and blanket material.

Materials

625.02 Requirements. Ensure that materials meet the requirements specified in the following subsections:

Agricultural Limestone	713.02
Erosion Control Mats, Roving, & Geocell	713.07
Fertilizer	713.03
Mulch	713.05
Seed	713.04
Stabilizing Emulsion Tackifiers	713.12
Water	725.01(b)

Construction

625.03 Seeding Seasons. Observe the normal seasonal dates for seeding, as shown in the SPECIAL PROJECT SPECIFICATIONS. Do not apply seeding materials during windy weather or when the ground is excessively wet or frozen.

625.04 Soil Preparation. Finish the areas to be seeded, as required by other applicable sections, to the lines and grades SHOWN ON THE DRAWINGS. Restore areas that are damaged by erosion or other causes. Ensure that the surface soil is in a roughened condition favorable for germination and growth. When required, apply limestone uniformly at the rate given in the SPECIAL PROJECT SPECIFICATIONS, either before or after soil preparation.

625.05 Application Methods for Seed, Fertilizer, & Limestone. To control erosion, apply seed to disturbed soil and slopes within 30 days of disturbance. If the slopes have not been finished, apply the seed by the dry method as an interim erosion control measure. Apply fertilizer with the seed when specified in the SPECIAL PROJECT SPECIFICATIONS.

The following methods may be used to place material:

(a) Hydraulic Method. Mix the seed or seed and fertilizer with water in the amounts and mixtures shown in the SPECIAL PROJECT SPECIFICATIONS to produce a slurry, then apply it under pressure at the rates specified in the SPECIAL PROJECT SPECIFICATIONS. When wood cellulose or grass straw mulch materials are to be incorporated as an integral part of the slurry mix, add them after all other materials have been thoroughly mixed in the tank.

Use an inoculum for hydraulic seeding that is four times what is recommended for dry seeding.

(b) Dry Method. Use mechanical, landscape, or cultipacker seeders, seed drills, fertilizer spreaders, or other approved mechanical seeding equipment to apply the seed or seed and fertilizer in the amounts and mixtures shown in the SPECIAL PROJECT SPECIFICATIONS.

Spread dry fertilizer and ground limestone separately at the rates given in the SPECIAL PROJECT SPECIFICATIONS. Incorporate them in a single operation to the required depth in the areas SHOWN ON THE DRAWINGS.

Hand-operated seeding devices may be used to apply dry seed, fertilizer, and ground limestone.

625.06 Application of Mulch. The following methods may be used to apply mulch:

(a) Hydraulic Method. Hydraulic equipment that uses water as the carrying agent may be used to apply wood cellulose or grass straw fiber mulch, tackifier, and fertilizer in a single operation. Continuously agitate the materials to keep them in uniform suspension throughout the distribution cycle. Ensure that the discharge line evenly distributes the solution to the seedbed. Do not mulch where there is free surface water. Start application to areas SHOWN ON THE DRAWINGS at the top of the slope and work downward. If necessary, use extension hoses to reach the extremities of slopes. Apply at the rate specified in the SPECIAL PROJECT SPECIFICATIONS.

(b) Dry Method. After completion of seeding and fertilizing, unless otherwise indicated in the SPECIAL PROJECT SPECIFICATIONS, apply mulch uniformly at the rate specified in the SPECIAL PROJECT SPECIFICATIONS.

When a tackifier is used for mulch, apply the material at the rate specified in the SPECIAL PROJECT SPECIFICATIONS. Immediately distribute it evenly over the mulch. Prevent asphalt adhesive materials from marking or defacing structures, appurtenances, pavements, utilities, or plant growth.

625.07 Installation of Netting & Erosion Control Blankets. Install nettings and erosion control blankets as SHOWN ON THE DRAWINGS and in accordance with the manufacturer's recommendations.

625.08 Care During Construction. Protect and care for seeded areas until the work is finally accepted. Repair all damage to seeded areas caused by construction, without additional compensation.

Measurement

625.09 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Base area computations on surface measurements.

Seed used for interim erosion control will be paid for as Seed Mix and will be measured by the pound. When fertilizer is used for interim erosion control, it will be measured by the ton.

Payment

625.10 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
625(01) Seeding, _____ method (without mulch)	Acre
625(02) Seeding, _____ method (with mulch)	Acre
625(03) Mulch (supplemental application)	Ton
625(04) Fertilizer (supplemental application)	Ton
625(05) Seed mix (supplemental application)	Pound
625(06) Netting, type _____	Square Yard
625(07) Erosion control blanket, type _____	Square Yard

Section 626 - Trees, Shrubs, Vines, & Ground Cover

Description

626.01 Work. Furnish and plant trees, shrubs, vines, and ground cover plants.

Materials

626.02 Requirements. Ensure that materials meet the requirements specified in the following subsections:

Topsoil	713.01
Fertilizer	713.03
Mulch	713.05
Plant Materials	713.06
Miscellaneous Planting Material	713.08
Water.....	725.01(b)

Construction

626.03 Performance. Follow the specifications below.

(a) Planting Seasons. Plant during the seasons indicated in the SPECIAL PROJECT SPECIFICATIONS. Do not plant in frozen ground, when snow covers the ground, or when the soil is in an unsatisfactory condition for planting.

(b) Delivery & Inspection. Notify the CO not less than 15 days before plants are delivered. Inform the CO about the source of supply and the shipping dates for all plant material. Ensure that all plant materials comply with State and Federal laws applicable to inspection for plant diseases and insect infestations. Deliver all required certificates of inspection to the CO.

(c) Protection & Temporary Storage. Keep all plant material moist. Protect plants when they are in transit, in temporary storage, or on the project site awaiting planting.

(d) Layout. Designate the locations of plant material and bed outlines on the project site so they conform to the lines, grades, and elevations SHOWN ON THE DRAWINGS. The CO may adjust plant material locations to meet field conditions.

(e) Excavation for Plant Pits & Beds. Do not excavate plant pits and beds until the layout is approved. Remove and dispose of all sod, weeds, roots, and other objectionable material that is unsuitable for backfill.

For root spreads from 2 to 4 feet, make pit diameters 2 feet greater than the root spread. For root spreads over 4 feet, make pit diameters one and one half times the root spread.

Ensure that all pits are deep enough to permit a minimum of 6 inches of loam– humus backfill under all roots or balls. Excavate to sufficient depth to plant at the root collar.

Loosen the soil at the bottom of the plant pit to a depth of at least 6 inches before backfilling or planting begins.

(f) Prepared Backfill Soil. Prepare the backfill soil to consist of a mixture of four parts topsoil, loam, or selected soil, and one part peat moss or peat humus.

(g) Setting Plants. Set all plants approximately plumb and at the same level, or not more than 1 inch lower than the depth at which they were grown in the nursery or collecting field.

(1) Bare Root Stock. Place prepared backfill soil in the plant pit to the required depth. Then place bare-rooted plants in the center of the plant pit and spread out the roots in a natural position. Cleanly cut back all broken or damaged roots to sound root growth.

Carefully work backfill soil around and over the roots, then settle it by firming or tamping. Thoroughly water or puddle around bare-rooted plants. Form earth saucers or water basins with a diameter equal to the plant, at least 4 inches deep for trees, and 3 inches deep for shrubs, around individual plants.

(2) Balled & Burlapped Stock. Carefully place balled and burlapped plants in the prepared pits on the required depth of tamped backfill soil so they are in a firm, upright position. Put backfill soil around the plant ball to half the depth of the ball, then tamp and thoroughly water. Cut away the burlap and remove it from the upper half of the ball, or loosen and fold it back. Place the remainder of the backfill. Provide earth saucers or water basins, and thoroughly water the plant.

(h) Fertilizing. Use the types and rates of fertilizer application for the different plants that are shown in the SPECIAL PROJECT SPECIFICATIONS. Uniformly apply fertilizer within 5 days after planting, and cultivate it into the top 2 inches of the plant pit area or shrub bed. Work the proper amount of fertilizer for each type of plant into the prepared backfill material. Apply fertilizer before mulching plant pits or shrub beds.

(i) Watering. Water all plants during and immediately after planting, and at intervals specified in the SPECIAL PROJECT SPECIFICATIONS. Ensure that water does not contain elements toxic to plant life. Thoroughly saturate the soil around each plant at each watering.

(j) Guying & Staking. Immediately after planting, guy and stake all trees as SHOWN ON THE DRAWINGS. Do not contact the roots when staking.

(k) Wrapping. Wrap deciduous trees only. Completely wrap tree trunks that are 2 inches in diameter or larger with burlap or other approved material. Begin wrapping at the base of the tree, extend it to the first branches, and tie it adequately. Do not wrap tree trunks until they have been inspected and approved. Finish wrapping tree trunks within 24 hours after approval.

(l) Antidesiccant Spray. An approved antidesiccant spray may be used in place of wrapping.

(m) Pruning. Prune plants before or immediately after planting in a manner that will preserve their natural character. Employ experienced personnel who use proper equipment and accepted horticultural practices when pruning. Paint cuts that are over 3/4-inch in diameter with an approved tree wound dressing.

(n) Mulching. Furnish and place mulch over all pit or saucer areas of individual trees and shrubs, and completely over shrub beds to the depth SHOWN ON THE DRAWINGS. Ensure that mulch is as SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS. Put 6 pounds of nitrogen per cubic yard of mulch material around plants to be mulched with wood chips, in addition to the normal dressing of commercial fertilizer. Mulch the plantings within 24 hours after fertilizing is completed.

626.04 Restoration & Cleanup. Restore grass areas that have been damaged or scarred during planting to their original condition. Clean up debris, spoil piles, containers, and so forth.

626.05 Plant Establishment Period & Replacement. During the plant establishment period, which is one full growing season, use all possible means to keep the plants in a healthy growing condition. There will be a semifinal inspection 15 days before the end of the full growing system. At the end of the establishment period, the CO will determine if the plantings are acceptable. Water, cultivate, prune, repair and adjust guys and stakes, and perform other maintenance during the establishment period. Promptly remove dead or unsatisfactory plants. During the next planting season, replace all dead and unsatisfactory plants in kind with robust, healthy plants. Use alternative or substitute varieties only if approved. There will be a final inspection of these plants within 15 days after planting is completed.

Measurement

626.06 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Include in the quantities only living plants that are in healthy condition at the time of final inspection, as specified in Subsection 626.05.

Payment

626.07 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Section 628 - Sprigging

Description

628.01 Work. This work consists of furnishing and planting living grass plants. Sprigging is designated as broadcast, row, or spot, according to Subsection 628.06.

Materials

628.02 Requirements. Provide material that meets requirements specified in the following subsections:

Agricultural Limestone	713.02
Fertilizer	713.03
Mulch	713.05
Sprigs	713.09
Water.....	725.01(b)

Construction

628.03 General. Do not sprig during windy weather or when the ground is dry, excessively wet, frozen, or otherwise untillable.

628.04 Harvesting Sprigs. Provide at least 5 days notice before harvesting sprigs. Before harvesting, mow grass and weeds to a height of 2-1/2 inches \pm 1/2-inch and remove all clippings.

Loosen sprigs by cross disking, shallow plowing, or other acceptable methods. Gather the sprigs in small piles or windrows, water, and keep moist until planting. Dispose of sprigs that freeze or dry out.

628.05 Preparing the Soil. Clear and grade the area to be sprigged. Cultivate, disk, harrow, or otherwise loosen the grade to a depth of not less than 4 inches. Remove stones larger than 2 inches in any diameter, sticks, stumps, and other debris that might interfere with proper placement or subsequent growth.

Place topsoil according to Section 624.

Apply fertilizer and agricultural limestone uniformly over the sprigging area at the application rates SHOWN ON THE DRAWINGS. Mechanical spreaders or blower equipment may be used. Disk or till the fertilizer and limestone into the soil to a depth of 4 inches.

Moisten the prepared soil.

628.06 Planting Sprigs. Plant the sprigs within 24 hours after harvesting.

(a) Broadcast Sprigging. Broadcast sprigs by hand or using suitable equipment in a uniform layer over the prepared surface, with spacing between sprigs not to exceed 6 inches. Force the sprigs into the soil to a depth of 3 inches ± 1 inch with a straight spade, disk harrow, or other equipment.

(b) Row Sprigging. Open furrows along the approximate contour of slopes. Place sprigs in a continuous row in the open furrow, with successive sprigs touching. Cover the sprigs immediately.

(c) Spot Sprigging. Spot sprig according to Subsection 628.06(b), except that instead of planting in a continuous row, group four or more sprigs 18 inches apart in the rows.

After planting, clear the surface of stones larger than 1 inch, large clods, roots, and other litter brought to the surface during sprigging. Lightly compact the sprigged area within 24 hours. Do not compact when the soil is so wet that it is picked up by the equipment. Do not compact clayey soils.

When mulch is required, cover the sprigged area with mulch within 24 hours, in accordance with Subsection 625.06.

628.07 Maintaining Sprigged Areas. Keep the sprigged areas moist. Water carefully to avoid erosion. Erect warning signs and barriers to protect newly sprigged areas. Regrade and resprig all areas damaged.

Measurement

628.08 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure sprigging by the acre or square yard on the ground surface. Measure topsoil under Subsection 624.07.

Payment

628.09 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
628(01) _____ sprigging	Acre
628(02) _____ sprigging	Square Yard

Section 629 - Sodding

Description

629.01 Work. Prepare the sod bed, and furnish, cut, haul, and lay live sod of perennial turf-forming grasses.

Materials

629.02 Requirements. Ensure that materials meet the requirements specified in the following subsections:

Agricultural Limestone	713.02
Fertilizer	713.03
Pegs for Sod	713.11
Sod	713.10
Water.....	725.01(b)

Construction

629.03 Season. Sod during the season SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS.

629.04 Sources of Sod. The CO will approve sod obtained from other than commercial sources, in the original position, before cutting and delivery to the project. Notify the CO at least 5 days before cutting begins.

629.05 Soil Preparation & Cleanup. Bring areas to be sodded to the lines and grades SHOWN ON THE DRAWINGS, then plow, disk, harrow, or otherwise loosen them before sod is delivered. Remove stones larger than 2 inches in diameter, sticks, stumps, and other debris that might interfere with the proper laying or subsequent growth of sod.

629.06 Topsoiling. Place topsoil where SHOWN ON THE DRAWINGS. Remove and dispose of large clods, stones larger than 2 inches in any dimension, roots, stumps, and other litter at locations SHOWN ON THE DRAWINGS.

629.07 Applying Fertilizer & Ground Limestone. After soil preparation, cleanup, and topsoiling, uniformly spread fertilizer and ground limestone, when specified, at the rate SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS. Use mechanical spreaders, blower equipment, or other approved methods to spread fertilizer and ground limestone. Incorporate these materials into the soil by disking or other tillage.

629.08 Laying Sod. Lay sod on the prepared bed within 24 hours after cutting, except when stored in stacks or piles, grass to grass and roots to roots, for not more than 5 days. Protect sod from drying by sun or wind and from freezing. Move and lay sod when weather conditions and soil moisture are favorable.

Lay sod according to one or more of the following methods, as DESIGNATED IN THE SCHEDULE OF ITEMS:

- (a) Lay solid sodding when soils are moist. Thoroughly moisten dry sod bed areas before laying sod. Lay sections of solid sod edge to edge with staggered joints. Plug openings with sod or fill them with acceptable loamy topsoil. After laying and filling joints, roll or tamp the sod to eliminate air pockets and make an even surface. On slopes of 2:1 or steeper and in channels, peg sod on approximate 2-foot centers after tamping. Drive pegs flush with the sod bed surface.
- (b) Lay strip sod in parallel rows of the width SHOWN ON THE DRAWINGS. Lay sod in a shallow trench and firmly roll or tamp it until the surface is level with or below the adjacent soils. If SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS, seed the ground between strips of sod with grass seeds of the kind and at the rates specified. Then rake or drag the seeded areas to cover the seed.
- (c) Perform spot sodding by laying sod blocks as SHOWN ON THE DRAWINGS. Firmly roll or tamp the pieces into the soil until the surfaces of sod blocks are slightly below the surrounding ground surface.

629.09 Care During Construction, Watering, & Temporary Maintenance of Sodded Areas. Water the sod when it is laid and keep it moist until final acceptance of the contract. Distribute water evenly at a measured rate per unit of area. Water to avoid erosion and prevent damage to sodded areas.

Erect necessary warning signs and barriers; mow sodded areas; repair or replace sodded areas that fail to show a uniform growth of grass or are damaged by construction operations; and otherwise maintain the sod until final acceptance of the contract.

Replace dried-out or damaged sod at no charge to the Government.

Measurement

629.10 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Base area computations upon surface measurement.

Payment

629.11 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
629(01) Solid sodding	Square Yard
629(02) Strip sodding.....	Square Yard
629(03) Spot sodding.....	Square Yard

Section 633 - Signs

Description

633.01 Work. Install only, or furnish and install, delineators, markers, signs, sign supports, panels, and posts; or remove and dispose of existing signs, posts, and hardware.

633.02 Traffic Control Sign Details. Ensure that traffic control signs meet the requirements of the MUTCD and details as SHOWN ON THE DRAWINGS.

Materials

633.03 Requirements. Furnish materials that meet the requirements specified in the following subsections:

Aluminum Panels	718.05
Conventional Traffic Paint	718.16
Delineator & Object Marker Retroreflectors	718.15
Edge Film	718.10
Epoxy Markings.....	718.18
Epoxy Resin Adhesives	718.26
Extruded Aluminum Panels	718.07
Glass Beads	718.22
Hardware.....	718.13
Letters, Numerals, Arrows, Symbols, & Borders	718.14
Object Marker & Delineator Posts	718.12
Paint	718.08
Plastic Panels	718.06
Plywood Panels	718.03
Polyester Markings	718.19
Preformed Plastic Markings.....	718.21
Raised Pavement Markers	718.23
Retroreflective sheeting	718.01
Signposts	718.11
Silk Screen Inks	718.09
Steel Panels	718.04
Temporary Pavement Markings	718.24
Temporary Traffic Control Devices	718.25
Test Procedures	718.02
Thermoplastic Markings	718.20
Waterborne Traffic Paint	718.17

Furnish certification to the CO that all materials comply with the specified requirements.

Ensure that all concrete meets the requirements specified in Section 602, or as SHOWN ON THE DRAWINGS.

Furnish reinforcing steel as SHOWN ON THE DRAWINGS that meets the requirements specified in Subsection 709.01.

Construction

633.04 Fabrication of Sign Panels. Fabricate all parts in a uniform manner. Complete all panel fabrication, including cutting, punching, and drilling of holes, prior to final surface preparation and application of reflective sheeting, except where required for the fabrication of die cut or sawed letters on processed and mounted signs. Ensure that workmanship is of high quality, and that there are non-visible defects in the finished product.

(a) Sign Panel Preparation. Cut sign panel from the specified substrate material. Ensure that it is flat and free of warp and any defects that interrupt smooth continuity of the panel surface. Prepare all panels precisely as described in writing by the substrate and sheeting manufacturers.

For sign panels smaller than 4 foot by 8 foot, cut them from a single sheet of substrate material without joints.

For high-density overlay (HDO) substrate sign panels larger than 4 foot by 8 foot, fabricate in sections using $\frac{3}{4}$ -inch thick material. Prepare individual panel sections to be joined using doweled butt joints. Use dowels that are $\frac{3}{8}$ inch threaded bolt stock and 4- $\frac{1}{2}$ inches in length. Place them 2 inches from each side, and every 12- to 15 inches along the joint. Do not actually join the individual panels until sign installation.

Make panels of the dimensions that are SHOWN ON THE DRAWINGS, with a tolerance of $\pm \frac{1}{4}$ inch.

(b) Beveling. Slightly round or bevel all edges of sign panels to eliminate edge sharpness.

(c) Drilling. Drill holes at the locations and to the sizes that are SHOWN ON THE DRAWINGS. Debur all holes. Do not field drill holes in any part of the structural assembly without the approval of the CO.

(d) Surface & Edge Finishing. Fill all core-cap holes on HDO plywood signs with an exterior wood dough, sanded with medium grit (50–60) sandpaper to produce a smooth surface. Apply one coat of paint to the edges prior to application of background sheeting.

(e) Sheeting, Legend, Border, & Symbol Application. Apply all sheeting, legend, border, and symbols precisely as prescribed in writing by the sheeting manufacturer. Either pressure-sensitive or heat-activated material may be used, as SHOWN ON THE DRAWINGS. Cover the entire face of the sign panel with one unspliced sheet if the panel is less than 4 feet in either dimension. On each section, use horizontal splicing only. Color match materials, and ensure that splices do not coincide with any legend. Ensure that the top piece overlaps the bottom piece by at least $\frac{1}{2}$ inch.

Ensure that all letters, layout, and spacing are as specified in the Federal Highway Administration's (FHWA's) "Standard Alphabets for Highway Signs," current edition, and as SHOWN ON THE DRAWINGS. Apply the following tolerances:

- (1) Horizontally align letters, numerals, and symbols to a tolerance of $\pm 1/8$ -inch.
- (2) Vertically align letters, numerals, and symbols to a tolerance of $\pm 1/16$ -inch.
- (3) Ensure that spacing between lines does not exceed a tolerance of $\pm 1/8$ -inch.

(f) Silk-Screening. Perform all silk-screening operations precisely as prescribed in writing by the manufacturers of the ink and the sheeting. Use direct screen process to apply messages and borders that are darker in color than the sign background. Use the reverse screen process to produce messages and borders that are lighter in color than the sign background. Screen to produce uniform colors and tone, with sharply defined edges of legend and border, and without blemishes on the sign background.

Color-match silk-screened inks to eliminate any visual difference between silk-screened material and applied material of the same color on the same sign.

(g) Trimming & Edge Finishing. After all sheeting, legends, borders, and symbols have been applied to the substrate, trim all excess material flush with the edge of the sign panel. Sheeting may overlap HDO plywood substrate sign edges by $1/8$ -inch. Finish the edges of HDO substrate panels with a second coat of paint applied in accordance with the recommendation of the paint manufacturer.

(h) Edge Film. When SHOWN ON THE DRAWINGS, apply edge tape over the entire top edge of the panel precisely as prescribed in writing by the manufacturer of the material being used.

(i) Maker's Mark. Install a decal showing the Contractor's identification or trademark and the date of manufacture on the back upper left-hand corner of each sign.

633.05 Delineator Posts & Housing. Drive delineator posts at locations and to the depth SHOWN ON THE DRAWINGS. Attach the delineator housing to the post, in accordance with the manufacturer's direction.

633.06 Sign Erection. Erect sign supports plumb and in accordance with the details SHOWN ON THE DRAWINGS. Make length of supports as SHOWN ON THE DRAWINGS, and in accordance with MUTCD, or as described in the SCHEDULE OF ITEMS.

Securely fasten the sign panels to the posts, as SHOWN ON THE DRAWINGS.

To reduce specular glare, erect the sign panel face in accordance with MUTCD, Section 2A-26.

633.07 Sign Removal. Remove sign assemblies that are to be replaced, as SHOWN ON THE DRAWINGS. Ensure that sign replacement assemblies are replaced within 24 hours. Dispose of all removed sign material as SHOWN ON THE DRAWINGS. Remove signposts to a minimum of 3 inches below natural ground line. Backfill and compact remaining post holes with suitable material. When regulatory and warning signs are removed, immediately place replacement signs.

Measurement

633.08 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Compute quantities of sign face area using the dimensions SHOWN ON THE DRAWINGS.

Make no deduction for rounded corners.

Compute the area for irregularly shaped signs, such as “Stop” signs, by multiplying the extreme width by the extreme height of the sign face.

For sign removal, treat an assembly of posts and signs as only one sign when these materials are integrally connected and standing at one location.

Payment

633.09 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
633(01) Wood posts	Linear Foot
633(02) Steel posts	Linear Foot
633(03) Aluminum posts	Linear foot
633(04) Plastic posts	Each
633(05) Fiberglass-reinforced plastic posts	Each
633(06) Aluminum sign panels	Square Foot
633(07) Plywood sign panels	Square Foot
633(08) Steel sign panels	Square Foot

633(09)	Plastic sign panels	Square Foot
633(10)	Fiberglass-reinforced plastic sign panels	Square Foot
633(11)	Delineators	Each
633(12)	Sign	Each
633(13)	Sign removal	Each
633(14)	Sign and post(s), installation only	Each
633(15)	Regulatory signs	Each
633(16)	Warning signs and markers	Each
633(17)	Object markers	Each

Section 634 - Painted Traffic Markings

Description

634.01 Work. Apply permanent pavement markings and raised pavement markers on the completed pavement.

Pavement markings are designated as follows:

Type A	Conventional traffic paint with Type 1 glass beads
Type B	Waterborne traffic paint with Type 1 glass beads
Type C	Waterborne traffic paint with Type 3 glass beads
Type D	Epoxy markings with Type 1 glass beads
Type E	Epoxy markings with Type 1 and Type 4 glass beads
Type F	Polyester markings with Type 1 glass beads
Type G	Polyester markings with Type 1 and Type 4 glass beads
Type H	Thermoplastic markings with Type 1 glass beads
Type I	Thermoplastic markings with Type 1 and Type 5 glass beads
Type J	Preformed plastic markings
Type K	Nonreflectorized markings

Materials

634.02 Requirements. Furnish material that conforms to the MUTCD and the following subsections:

Conventional Traffic Paint	718.16
Epoxy Markings	718.18
Epoxy Resin Adhesives	718.26
Glass Beads	718.22
Polyester Markings	718.19
Preformed Plastic Markings	718.21
Raised Pavement Markers.....	718.23
Thermoplastic Markings	718.20
Waterborne Traffic Paint	718.17

Construction

634.03 Performance. Where existing and final pavement marking locations are identical, stake the limits of all existing pavement markings (no-passing zones, edge stripes, etc.) before any pavement work. Upon completion of the final surface course, establish line limits for the new pavement for approval before marking. Establish markings according to the MUTCD.

Remove loose particles, dirt, tar, grease, and other deleterious material from the surface to be marked. Where markings are placed on Portland cement concrete pavement less than 1 year old, clean the pavement of all residue and curing compounds. Remove

temporary pavement markings the same day permanent pavement markings are applied. Apply markings to a clean, dry surface according to the MUTCD.

Furnish a written copy of the manufacturer's marking recommendations to the CO at least 7 days before starting pavement marking application. A field demonstration may be required to verify the adequacy of recommendations.

Ship marking material in appropriate containers plainly marked with the following information, as appropriate for the material being furnished:

- (a) Manufacturer's name and address.
- (b) Name of product.
- (c) Lot/batch numbers.
- (d) Color.
- (e) Net weight and volume of contents.
- (f) Date of manufacture.
- (g) Date of expiration.
- (h) Statement of contents, if mixing of components is required.
- (i) Mixing proportions and instructions.
- (j) Safety information.

Apply pavement markings in the direction of traffic according to the manufacturer's recommendations. Apply all markings to provide a clean-cut, uniform, and workmanlike appearance by day and night.

Make lines 4 inches wide. Make broken lines 10 feet long, with 30-foot gaps. Make dotted lines 2 feet long, with 4-foot gaps. Separate double lines with a 4-inch space.

Protect marked areas from traffic until the markings are dried to no-tracking condition. Remove all tracking marks, spilled marking material, markings in unauthorized areas, and defective markings.

634.04 Conventional Traffic Paint (Type A). Apply paint when the pavement and air temperatures are above 40 °F. Spray paint at a 15 mil minimum wet film thickness before glass beads, or at a rate of 107 square feet per gallon. Immediately apply glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

Apply two coats with glass beads to all centerline stripes. Coats are applied in opposite directions on bituminous surface treatment or chip seal surfaces. Second coats are applied from 4 to 48 hours after the first coat.

634.05 Waterborne Traffic Paint (Types B & C). Apply paint when the pavement and air temperatures are above 50 °F. Spray paint at 15 mil minimum wet film thickness before glass beads, or at a rate of 107 square feet per gallon.

(a) Type B. Immediately apply Type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

(b) Type C. Immediately apply Type 3 glass beads on the paint at a minimum rate of 12 pounds per gallon of paint.

Apply two coats with glass beads to all centerline stripes. Coats are applied in opposite directions on bituminous surface treatment or chip seal surfaces. Second coats are applied from 4 to 48 hours after the first coat.

634.06 Epoxy Markings (Types D & E). Heat components A and B separately at 110 ± 30 °F and mix. Discard all material heated over 140 °F. Apply epoxy when the pavement and air temperatures are above 50 °F. Apply as a spray at 110 ± 30 °F (gun tip temperature) at a 15 mils minimum dry film thickness, or a rate of 107 square feet per gallon.

(a) Type D. Immediately apply Type 1 glass beads on the epoxy at a minimum rate of 15 pounds per gallon of epoxy.

(b) Type E. Use two bead dispensers. Immediately apply Type 4 glass beads on the epoxy at a minimum rate of 12 pounds per gallon of epoxy, immediately followed by an application of Type 1 glass beads at a minimum rate of 12 pounds per gallon.

634.07 Polyester Markings (Types F & G). Apply polyester when the pavement and air temperatures are above 50 °F. Spray at 128 ± 7 °F (gun tip temperature) at a 15 mil minimum dry film thickness, or at a rate of 107 square feet per gallon. Discard all material heated over 150 °F. Do not use fast-dry polyester markings on hot asphalt concrete pavements that are less than 1 year old.

(a) Type F. Immediately apply Type 1 glass beads on the polyester at a minimum rate of 15 pounds per gallon of polyester.

(b) Type G. Use two bead dispensers. Immediately apply Type 4 glass beads on the polyester at a minimum rate of 12 pounds per gallon of polyester, immediately followed by an application of Type 1 glass beads at a minimum rate of 12 pounds per gallon.

634.08 Thermoplastic Markings (Types H & I). On areas to be marked on

Portland cement concrete pavements and old asphalt pavements, apply an epoxy resin primer/sealer according to the thermoplastic manufacturer's recommendations. Allow the primer/sealer to dry.

Apply thermoplastic when the pavement and air temperatures are above 50 °F. Spray or extrude the thermoplastic at 430 ± 5 °F. For centerlines and lane lines, spray or extrude a 90 mil minimum dry film thickness, or at a rate of 17.8 square feet per gallon. For edge lines, spray or extrude a 60 mil minimum dry film thickness, or at a rate of 26.7 square feet per gallon.

(a) Type H. Immediately apply Type 1 glass beads on the thermoplastic at a minimum rate of 12 pounds per 100 square feet.

(b) Type I. Use two bead dispensers. Immediately apply Type 5 glass beads on the thermoplastic at a minimum rate of 12 pounds per 100 square feet, immediately followed by an application of Type 1 glass beads at a minimum rate of 12 pounds per 100 square feet.

Ensure that the minimum bond strength of the thermoplastic is 175 pounds per square inch on Portland cement concrete pavements.

634.09 Preformed Plastic Markings (Type J). Install to form a durable, weather-resistant bond to the pavement. Apply preformed plastic markings according to the manufacturer's recommendation.

Where applied during final compaction of asphalt pavement, apply preformed plastic when the pavement temperature is about 140 °F. Roll the marking onto the surface with a steel-wheeled roller. The finished pavement marking may extend approximately 10 mil above the final surface.

634.10 Nonreflectorized Markings (Type K). Apply conventional traffic paint, waterborne traffic paint, epoxy markings, polyester markings, or thermoplastic markings as described above, but with no glass beads added.

634.11 Raised Pavement Markers. Install raised pavement markers when the pavement and air temperatures are above 50 °F. Apply raised pavement markers with epoxy resin or asphalt adhesive.

Heat epoxy components A and B separately with indirect heat; mix, and apply at 70 ± 10 °F. Discard all material heated over 120 °F or stiffened by polymerization.

Heat and apply asphalt adhesives at 412 ± 12 °F. Discard all material heated over 450 °F.

Space and align the markers to within 1/2 inch of the required location. Do not place raised pavement markers over pavement joints.

Make the minimum bond strength 1.75 pounds per square inch, or a total tensile strength of 25 pounds.

Measurement

634.12 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure pavement markings by the linear foot, mile, gallon or square foot.

When pavement markings are measured by the linear foot or mile, measure the length of line applied along the centerline of each 4 inch-wide line applied, regardless of color. Measure broken or dotted pavement lines from end to end of the line, including gaps. Measure solid pavement lines from end to end of each continuous line. For line widths other than 4 inches, the measured length of line is adjusted in the ratio of the required width to 4 inches.

When pavement markings are measured by the square foot, measure the number of square feet of symbol or letter marking based on the marking area shown in the contract or, if not shown, the area of each marking measured in place to the nearest square foot.

Measure raised pavement markers by the each.

Payment

634.13 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
634(01) Pavement markings, type _____, color _____	Linear Foot
634(02) Pavement markings, type _____, color _____	Mile
634(03) Pavement markings, type _____, color _____	Square Foot
634(04) Pavement markings, type _____, color _____	Gallon
634(05) Raised pavement markers, type _____, color _____	Each

Section 637 - Equipment Rental

Description

637.01 Work. Furnish and operate equipment for construction work ordered by the CO and not otherwise provided for under the contract.

Equipment

637.02 Requirements. The CO will order in writing rental equipment for use on the project. Submit the model number and serial number for each piece of equipment before use. Make equipment available for inspection and approval before use.

Furnish and operate equipment with such auxiliary attachments, oilers, and so forth, as are usually needed for efficient operation of the equipment. Keep the equipment in good repair and capable of operating 90 percent of the working time.

Obtain approval for the length of workday and workweek before beginning work. Keep daily records of the number of unit-hours of operation. Submit the records along with certified copies of the payroll.

Measurement

637.03 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Measure rental equipment by the hour. When the equipment is operated part-time in any half shift and is operative and not used on other work during the half shift, measure the full half shift. Measure time in excess of 40 hours per week at the same rate as the first 40 hours.

Do not make deductions for nonoperating time for reasonable interruptions for minor repairs if the nonoperating time does not exceed one-half hour per workday. Do not measure nonoperating time in excess of the one-half hour per workday. Do not measure equipment dependent upon another piece of nonoperable equipment.

Do not measure standby time, or time for moving equipment to or from the project or between project worksites.

Measure quantities to include the actual hours, to the nearest half hour, that the equipment is in operation performing the required work. Each day, record the actual hours that the equipment is in operation on the required work.

Payment

637.04 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
637(01) _____ <i>Type and size of equipment</i>	.....Hour

Section 640 - Road Closure Devices

Description

640.01 Work. Furnish and install, or install only, road closure devices using fabricated gates and accessories, combination post and rail barriers, concrete barriers, earth mound barriers, and other devices as SHOWN ON THE DRAWINGS.

Materials

640.02 Requirements. Furnish materials to be used in fabricating gates and barriers as SHOWN ON THE DRAWINGS.

Furnish metal beam elements, steel posts, structural steel, and steel pipe that meet the requirements SHOWN ON THE DRAWINGS.

Ensure that all hardware is galvanized in accordance with AASHTO M 232 and meets the requirements of ASTM A 307. Furnish plain or cut washers that are American Standard Washers.

Furnish timber posts, rails, and lumber that meet the requirements of AASHTO M 168. Provide timber of the species and type, and rate of preservative treatment, that are SHOWN ON THE DRAWINGS.

Furnish concrete that meets the requirements of Subsection 602.03, method B or C, as SHOWN ON THE DRAWINGS.

Construct earth mound barriers as SHOWN ON THE DRAWINGS from excavated material adjacent to the barrier location, or from other locations as SHOWN ON THE DRAWINGS.

Construction

640.03 Performance. Place road closure devices at the location SHOWN ON THE DRAWINGS. Construct all devices to the dimensions SHOWN ON THE DRAWINGS.

In assembling gates, perform required welding in accordance with the best modern practice and the applicable requirements of AWS D1.1.

After assembly, clean nongalvanized steel pipe gates and paint them with one coat of zinc-rich primer and two coats of exterior enamel of the type and color SHOWN ON THE DRAWINGS or in the SPECIAL PROJECT SPECIFICATIONS.

Set all posts vertically and embed them to the depth SHOWN ON THE DRAWINGS. Place concrete for embedment against undisturbed earth within an excavation sized to achieve the embedment dimensions. Compact the backfill in 6 inch layers to finished grade.

Furnish and install all signs and/or reflective warning markers accessory to the road closure device, as SHOWN ON THE DRAWINGS.

Measurement

640.04 Method. Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment

640.05 Basis. The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
640(01) Furnish and install road closure device, type _____, size _____	Each
640(02) Install road closure device, type _____, size _____	Each
640(03) Furnish and install road closure barrier, type _____, size _____	Each
640(04) Install road closure barrier, type _____, size _____	Each

