APPENDIX B

STORMWATER MANAGEMENT SYSTEM MAINTENANCE

PHASE I

CULVERT CLEANING

SPECIFICATIONS

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GENERAL REQUIREMENTS

Section 101. – TERMS, FORMAT, AND DEFINITIONS

101.01 Meaning of Terms. These specifications are generally written in the imperative mood. In sentences using the imperative mood, the subject, *"the Contractor,"* is implied. Also implied in this language are *"shall," "shall be,"* or similar words and phrases. In material specifications, the subject may also be the supplier, fabricator, or manufacturer supplying material, products, or equipment for use on the project.

Wherever *"directed," "required," "prescribed,"* or other similar words are used, the *"direction," "requirement,"* or *"order"* of the Contracting Officer is intended. Similarly, wherever *"approved," "acceptable," "suitable," "satisfactory,"* or similar words are used, the words mean *"approved by," "acceptable to,"* or *"satisfactory to"* the Contracting Officer.

The word *"will"* generally pertains to decisions or actions of the Contracting Officer.

101.02 Specifications Format. These specifications are divided into 10 Divisions.

Division 100 consists of general contract requirements for which no direct payment is made. The requirements contained in Division 100 are applicable to all contracts.

Division 150 consists of project contract requirements that are applicable to all contracts. Work under Division 150 is paid for directly or indirectly according to Subsection 109.05 and the Section ordering the work. When there is no pay item in the bid schedule, no direct payment is made.

Divisions 200 through 600 consist of construction contract requirements for specific items of work. Work under these Divisions is paid for directly or indirectly according to Subsection 109.05 and the Section ordering the work. When there is no pay item in the bid schedule, no direct payment is made.

Division 700 contains the material requirements for Divisions 150 through 600. No direct payment is made in Division 700. Payment for material is included as part of the work required in Divisions 150 through 600.

The first three digits of the pay item number in the Bid Schedule identify the Section under which the work is performed.

101.03 Abbreviations. Whenever these abbreviations are used in the specifications, they represent the following:

(a) Acronyms.

AA — Aluminum Association

AAN — American Association of Nurserymen

AAR — Association of American Railroads

AASHTO — American Association of State Highway and Transportation Officials

ACI — American Concrete Institute

ACPA — American Concrete Pavement Association

ADA — Americans with Disabilities Act

AGC — Associated General Contractors of America

AI — Asphalt Institute

AIA — American Institute of Architects

AISC — American Institute of Steel Construction

AISI — American Iron and Steel Institute

AITC — American Institute of Timber Construction

ANSI — American National Standards Institute

APWA — American Public Works Association

ARA — American Railway Association

AREA — American Railway Engineering Association

ARTBA — American Road and Transportation Builders Association

ASCE — American Society of Civil Engineers

ASCII — American Standard Code for Information Interchange

ASLA — American Society of Landscape Architects

ASTM — American Society for Testing and Materials

ATSSA — American Traffic Safety Services Association

AWPA — American Wood Preservers Association

AWS — American Welding Society

AWWA — American Water Works Association

CFR — Code of Federal Regulations

CO — Contracting Officer and all representatives

CRSI — Concrete Reinforcing Steel Institute

FAR — Federal Acquisition Regulations (48 CFR Chapter 1)

FHWA — Federal Highway Administration

FICA — Federal Insurance Contributions Act

FLH — Federal Lands Highways

FSS — Federal Specifications and Standards

FTMS — Federal Test Method Standard

FUTA — Federal Unemployment Tax Act

GSA — General Services Administration

IEEE — Institute of Electrical and Electronic Engineers

ISO — International Organization for Standardization

ISSA — International Slurry Surfacing Association

ITE — Institute of Transportation Engineers

MIL — Military Specifications

MPI — Master Painters Institute

MUTCD — Manual on Uniform Traffic Control Devices (for Streets and Highways)

NCHRP — National Cooperative Highway Research Program

NEMA — National Electrical Manufacturer's Association

NFPA — National Forest Products Association

NIST — National Institute of Standards and Technology

OSHA — Occupational Safety and Health Administration

PCA — Portland Cement Association

PCI — Prestressed Concrete Institute

PVC — Polyvinyl Chloride

PTI — Post-Tensioning Institute

SAE — Society of Automotive Engineers

SF — Standard Form

SI — International System of Units

SSPC — Steel Structures Painting Council

TAR — Transportation Acquisition Regulations (48 CFR Chapter 12)

UL — Underwriter's Laboratory

U.S. — United States of America

USC — United States Code

USGS — United States Geological Survey

USPS — United States Postal Service

(b) SI symbols.

A	—	ampere	electric current
cd	—	candela	luminous intensity
ºC	—	degree Celsius	temperature
d	—	day	time
g	—	gram	mass
h	—	hour	time
H	—	Henry	inductance
ha	—	hectare	area
Hz	—	hertz (s^{-1})	frequency
J	—	joule (N•m)	energy
K	—	kelvin	temperature
L	—	liter	volume
lx	—	lux	illuminance
m	—	meter	length
m^2	—	square meter	area
m^3	—	cubic meter	volume
min	—	minute	time
N	—	newton (kg•m/s^2)	force
Pa	—	pascal (N/m^2)	pressure
s	—	second	time
t	—	metric ton	mass
V	—	volt (W/A)	electric potential
W	—	watt (J/s)	power
Ω	—	ohm V/A	electric resistance
º	—	degree	plane angle
'	—	minute	plane angle
"	—	second	plane angle

(c) SI prefix symbols.

E	—	exa	10^{18}
P	—	peta	10^{15}
T	—	tera	10^{12}
G	—	giga	10^{9}
M	—	mega	10^{6}
k	—	kilo	10^{3}
c	—	centi	10^{-2}
m	—	milli	10^{-3}
µ	—	micro	10^{-6}
n	—	nano	10^{-9}
p	—	pico	10^{-12}
f	—	femto	10^{-15}
a	—	atto	10^{-18}

(d) Slope notation (vertical : horizontal). For slopes flatter than 1V:1H, express the slope as the ratio of one unit vertical to a number of units horizontal. For slopes steeper than 1V:1H, express the slope as the ratio of a number of units vertical to one unit horizontal.

101.04 Definitions. The following definitions apply to this contract:

Award — The written acceptance of a bid by the CO.

Backfill — Material used to replace or the act of replacing material removed during construction. Material placed or the act of placing material adjacent to structures.

Base — The layer or layers of material placed on a subbase or subgrade to support a surface course.

Bid — A written offer by a bidder to perform work at a quoted price.

Bidder — Any individual or legal entity submitting a bid.

Bid Guarantee — A form of security assuring that the bidder will not withdraw a bid within the period specified for acceptance and will execute a written contract and furnish required bonds.

Bid Schedule — The prepared schedule included with the bid forms, containing the estimated quantities of pay items for which unit bid prices are invited.

Bridge — A structure more than 20 feet long, including supports, spanning and providing passage over a depression, waterway, railroad, highway, or other obstruction.

Clear Zone — The portion of the roadside, including the shoulder, available for the safe use by an errant vehicle in which the driver may regain control of the vehicle. Recommended distances for the clear zone are in the AASHTO Roadside Design Guide.

Commercial Certification — See Subsection 106.03.

Construction Limits — The limits on each side of the project that establish the area disturbed by construction operations and beyond which no disturbance is permitted. Typically the construction limits are the same as the clearing limits, except when additional clearing is required.

Contract — The written agreement between the Government and the Contractor setting forth the obligations of the parties for the performance of and payment for the prescribed work.

Contracting Officer (CO) — An official of the Government with the authority to enter into, administer, and terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the CO acting within the limits of their authority as delegated by the CO.

Contract Modification — Any written change in the terms of the contract. Contract modifications are of the following forms:

(a) Administrative change. A unilateral contract change, in writing, that does not affect the substantive rights of the parties (e.g., a change in the paying office or the appropriation data).

(b) Change order. A written order, signed by the CO, directing the Contractor to make a change that FAR Clause 52.243-4 Changes authorizes the CO to order without the Contractor's consent.

(c) Supplemental agreement. A contract modification that is accomplished by the mutual action of the parties.

Contractor — The individual or legal entity contracting with the Government for performance of prescribed work.

Contract Time — The specified time allowed for completion of all contract work.

Crashworthy — A highway feature is crashworthy if it was successfully crash tested under the NCHRP Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features* or earlier comparable criteria or if it was accepted through analysis by FHWA, based on similarity to other crashworthy features. A list of crashworthy highway features is available on the FHWA Safety website.

Cross-Section — A vertical section of the ground or structure at right angles to the centerline or baseline of the roadway or other work.

Culvert — Any structure, not classified as a bridge, that provides an opening under the roadway.

Day — Each and every day shown on the calendar, beginning and ending at midnight.

Density — Mass per unit volume of material. Specific gravity multiplied by the unit mass of water.

Detour — A temporary rerouting of public traffic onto alternate existing roadways in order to avoid the work or part of the work.

Diversion — A temporary rerouting of public traffic onto a temporary alignment within the project limits in order to bypass the work or a portion of the work.

Drawings — Design sheets or fabrication, erection, or construction details submitted to the Government by the Contractor according to FAR Clause 52.236-21 Specifications and Drawings for Construction. Also refers to submissions and submittals.

Government — The Government of the United States of America.

Highway, Street, or Road — A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

Layer — See "lift."

Lift — Defined as follows:

(a) When placing and compacting soils and aggregates, a lift is any single, continuous layer of material that receives the same compactive effort throughout during a single work operation.

(b) When installing culvert pipe less than or equal to 48 inches in diameter, the backfill material placed on both sides of the pipe is considered to be contained in the same lift when the material is placed to the same elevation on both sides of the culvert, the compactive effort applied to one side of the culvert is the same as that applied to the other, and the compactive effort is applied to both sides of the pipe in a continuous operation.

Material — Any substances specified or necessary to satisfactorily complete the contract work.

Maximum Particle Size — The smallest sieve opening through which all particles in the material will pass.

Measurement — The process of identifying the dimensions, quantity, or capacity of an item. See Section 109 for measurement methods, terms, and definitions.

Notice to Proceed — Written notice to the Contractor to begin the contract work.

Pavement Structure — The combination of subbase, base, paving geotextiles, and surface courses placed on a subgrade to support and distribute the traffic load to the roadbed.

Pay Item — A specific item of work for which a unit and price is provided in the contract.

Payment Bond — The security executed by the Contractor and surety or sureties and furnished to the Government to ensure payments as required by law to all persons supplying labor or material according to the contract.

Performance Bond — The security executed by the Contractor and surety or sureties furnished to the Government to guarantee completion of the contract work.

Plans — The contract plans furnished by the Government showing the location, type, dimensions, and details of the work.

Production Certification — See Subsection 106.03.

Professional Engineer — Engineers who hold valid State licenses permitting them to offer engineering services directly to the public, who are experienced in the work for which they are responsible, who take legal responsibility for their engineering designs, and who are bound by a code of ethics to protect the public health.

Profile Grade — The trace of a vertical plane intersecting a particular surface of the proposed road construction located as shown on the plans, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of the trace according to the context.

Project — The specific section of the highway or other property on which construction is to be performed under the contract.

Right-of-Way — Real property necessary for the project, including roadway, buffer areas, access, and drainage areas.

Roadbed — The graded portion of a highway prepared as a foundation for the pavement structure and shoulders.

Roadside — All area within the right-of-way excluding the traveled way and shoulders.

Roadway — In general, the portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways. In construction specifications, the portion of a highway within the construction limits.

Roadway Prism — The volume defined by the area between the original terrain cross-section and the final design cross-section multiplied by the horizontal distance along the centerline of the roadway.

Roller Pass — One trip of a roller in one direction over any one spot.

Shoulder — The portion of the roadway contiguous to the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of the pavement structure.

Sieve — See AASHTO M 92.

Solicitation — The complete assembly of documents (whether attached or incorporated by reference) furnished to prospective bidders.

Special Contract Requirements — Additions and revisions to the standard specifications applicable to an individual project.

Specifications — The written requirements for performing work.

Standard Forms — Numbered forms issued by the General Services Administration for use as contract documents.

Standard Plans — Detailed plans approved for repetitive use and included as part of the plans.

Standard Specifications — The Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects approved for general application and repetitive use.

Station — (1) A measure of distance used for highways and railroads. A station is equal to 100 feet. (2) A precise location along a surveyline.

Structures — Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other constructed features that may be encountered in the work.

Subbase — The layer or layers of material placed on a subgrade to support a base.

Subcontract — The written agreement between the Contractor and an individual or legal entity prescribing the performance of a specific portion of the work.

Subcontractor — An individual or legal entity with which the Contractor sublets part of the work. This includes all subcontractors in any tier.

Subgrade — The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.

Substantial Completion — The point at which the project is complete such that it can be safely and effectively used by the public without further delays, disruption, or other impediments. For conventional bridge and highway work, the point at which all bridge deck, parapet, pavement structure, shoulder, drainage, sidewalk, permanent signing and markings, traffic barrier, safety appurtenance, utility, and lighting work is complete.

Substructure — All of the bridge below the bearings of simple and continuous spans, skewbacks of arches, and tops of footings of rigid frames including backwalls, wingwalls, and wing protection railings.

Suitable Material — Rock or earth material that will provide stable foundations, embankments, or roadbeds, and is reasonably free of organic matter, roots, muck, sod, or other detrimental material. Suitable material may require drying or adding water, root picking, and other methods of manipulation before use. Suitable material includes the classifications of materials for which the project was designed.

Superintendent — The Contractor's authorized representative in responsible charge of the work.

Superstructure — The entire bridge except the substructure.

Surety — An individual or corporation legally liable for the debt, default, or failure of a Contractor to satisfy a contract obligation.

Surface Course — The top layer or layers of a pavement structure designed to accommodate the traffic load and resist skidding, traffic abrasion, and weathering.

Target Value (TV) — A number established as a center for operating a given process. Once established, adjustments should be made in the process as necessary to maintain a central tendency about the target value. Test results obtained from a well-controlled process should cluster closely around the established target value and the mean of the test results should be equal to or nearly equal to the established target value.

Traveled Way — The portion of the roadway designated for the movement of vehicles, including curve widening, exclusive of shoulders.

Unsuitable Material — Material not capable of creating stable foundations, embankments, or roadbeds. Unsuitable material includes muck, sod, or soils with high organic contents.

Work — The furnishing of all labor, material, equipment, and other incidentals necessary to successfully complete the project according to the contract.

Section 102. — BID, AWARD, AND EXECUTION OF CONTRACT

102.01 Acquisition Regulations. Bid, award, and execution of the contract are governed by the FAR and TAR.

102.02 Preparation of Bids. Follow the requirements of FAR Clause 52.214-18 Preparation of Bids — Construction.

Execute and submit all required standard forms, bid schedules, and solicitation provisions contained in the solicitation as part of the bid.

Complete SF 1442, *Solicitation, Offer, and Award*, and sign as follows:

***(a)* Individuals.** Sign your individual signature. For individuals doing business as a firm, follow the individual signature with the individual's typed, stamped, or printed name and the words, *"an individual doing business as* _____*(name of firm)*_____*."*

(b) Partnerships. Submit a list of all partners having authority to bind the partnership. One of the listed partners must sign on behalf of the partnership.

(c) Corporations. Sign in the corporate name, followed by the word *"by"* and the signature and title of the person authorized to sign. Submit evidence from the corporation that the person signing has authority to bind the corporation.

(d) Joint ventures. Submit a copy of the Joint Venture agreement. Sign the SF 1442 according to the Joint Venture agreement.

(e) Limited liability company. Sign in the company name, followed by the word "by" and the signature of the person authorized to sign. Submit evidence that the individual executing the document has authority to bind the company.

(f) Agents. When an agent signs, other than as stated in (a) through (e) above, furnish satisfactory evidence that the agent has authority to bind the bidder.

Insert a unit bid price, in figures, for each pay item for which a quantity appears in the bid schedule. Multiply the unit bid price by the quantity for each pay item and show the amount bid. Should any mathematical check made by the Government show a mistake in the amount bid, the corrected unit price extension shall govern.

When the words *"lump sum"* appear as a unit bid price, insert an amount bid for each lump sum pay item.

When the words *"contingent sum"* or a fixed rate appears as a unit bid price, include the Government inserted amount bid for the item in the total bid amount.

Total all of the amounts bid for each pay item and show the total bid amount.

The quantities shown in the bid schedule are approximate, unless designated as a contract quantity, and are used for the comparison of bids. Payment will be made for the actual quantities of work performed and accepted or material furnished according to the contract. The scheduled quantities may be increased, decreased, or deleted. Bid schedule quantities are considered the original contract quantities.

102.03 Bid Guarantee. Follow the requirements of FAR Clause 52.228-1 Bid Guarantee.

(a) General. Submit a bid guarantee of 20 percent of the amount of the bid or $3 million, whichever is less. Submit the bid guarantee on SF 24, *Bid Bond*. If the bid guarantee is other than a corporate or individual surety, sign the SF 24 as the principal and make a statement on the form pledging the security. Make checks or money orders payable to the agency issuing the solicitation.

(b) Power of attorney. A corporate surety shall submit a current power of attorney for the signing agent or attorney-in-fact with each SF 24.

(c) Evidence of guarantee assistance. A surety that has a guarantee of assistance from the Small Business Administration shall submit a copy of its *"Surety Bond Guarantee Agreement"* with each SF 24. In addition, submit a power of attorney for the surety representative identified in the agreement.

102.04 Individual Surety. Follow the requirements of FAR Clause 52.228-11 Pledges of Assets.

Complete and date the SF 28, *Affidavit of Individual Surety*, after the solicitation date. The individual surety shall personally sign the SF 28. Execution by power of attorney is not acceptable. Bidders cannot serve as their own surety. Assets named shall be committed to the project with a bank designated to serve as trustee.

After reviewing the SF 28, the surety may be requested to provide further documentation with respect to any of its assets, debts, or encumbrances. The information may be required to be furnished under oath. Failure of the surety to respond with the requested documentation within 7 days of receipt of the request is cause for rejection of the surety.

Any material misstatement by the surety, overstatement of assets (either as to ownership or value) or understatement of liabilities is cause for rejection of the surety. Substitution of individual sureties to support a bid bond after the bid opening will not be permitted.

102.05 Public Opening of Bids. Bids will be publicly opened at the time specified in the SF 1442. Their contents will be made public information. The Government reserves the right to reject bids as set forth in the FAR, Part 14.

102.06 Performance and Payment Bonds. Follow the requirements of FAR Clause 52.228-15 Performance and Payment Bonds – Construction. Furnish a performance bond and a payment bond each in the penal amount of 100 percent of the original contract price.

Use SF 25, *Performance Bond*, and SF 25A, *Payment Bond*, for submitting the bonds.

The requirements contained in Subsections 102.03 and 102.04 relating to power of attorney, evidence of guarantee assistance, and individual sureties also apply to performance and payment bonds.

Section 103. — SCOPE OF WORK

103.01 Intent of Contract. The intent of the contract is to provide for the construction and completion of the work described. The precise details of performing the work are not stipulated except as considered essential for the successful completion of the work. Furnish all labor, material, equipment, tools, transportation, and supplies necessary to complete the work according to the contract.

103.02 Disputes. Follow the requirements of FAR Clause 52.233-1 Disputes.

When requesting a CO's decision on an interpretation of contract terms for the recovery of increased costs, quantify the amount and, if required by FAR Clause 52.233-1, certify the amount. Include an explanation of the interpretation of contract terms, the contract clause under which the claim is made, all supporting documentation, and adequate cost data to support the amount claimed.

103.03 Value Engineering. Follow the requirements of FAR Clause 52.248-3 Value Engineering — Construction.

Before undertaking significant expenditures, provide the CO with a written description of the value engineering change proposal (VECP) concept. Within 14 days, the CO will inform the Contractor as to whether the concept appears to be viable or if the concept is unacceptable. If the CO indicates that the concept appears to be viable, prepare and submit the formal VECP proposal.

103.04 Contractor Records. Upon request, provide records related to the contract to the Government for up to 3 years after final payment and for longer periods as provided by law.

Include a provision in all subcontracts at all tiers giving the Government the same rights as provided above with respect to the subcontractor's records.

103.05 Partnering. To facilitate this contract, the Government offers to participate in a formal partnership with the Contractor. This partnership draws on the strengths of each organization to identify and achieve reciprocal goals. Partnering strives to resolve problems in a timely, professional, and non-adversarial manner. If problems result in disputes, partnering encourages, but does not require, alternative dispute resolution instead of the formal claim process. The objective is effective and efficient contract performance to achieve a quality project within budget and on schedule.

Acceptance of this partnering offer by the Contractor is optional, and the partnership is bilateral.

If the partnering offer is accepted, mutually agree with the Government on the level of organizational involvement and the need for a professional to facilitate the partnering process. Engage the facilitator and other resources for key Contractor and Government representatives to attend a partnership development and team-building workshop usually between the time of award and the notice to proceed. Hold additional progress meetings upon mutual agreement.

The direct cost of partnering facilities, professional facilitation, copying fees, and other miscellaneous costs directly related to partnering meetings will be shared by the Contractor and Government. Secure and pay for facilities, professional fees, and miscellaneous requirements. Provide invoices to the Government. The Government will reimburse the Contractor for 50 percent of the agreed costs incurred for the partnering process. The Government's share will not exceed $5,000.

Each party is responsible for making and paying for its own travel, lodging, and meal arrangements. The time allowed for completion of the project is not affected by partnering.

Section 104. — CONTROL OF WORK

104.01 Authority of the Contracting Officer (CO). The CO may delegate authority to representatives to decide on acceptability of work, progress of work, suspension of work, interpretation of the contract, and acceptable fulfillment of the contract. The term *"CO"* includes all authorized representatives of the CO, including inspectors, acting within the limits of their authority as delegated by the CO.

104.02 Authority of Inspectors. Inspectors are authorized to inspect all work including the preparation, fabrication, or manufacture of material for the project. The inspector is not authorized to alter or waive contract requirements, issue instruction contrary to the contract, act as foreman for the Contractor, or direct the Contractor's operations. The inspector has authority to identify non-conforming work until the issue can be referred to and decided by the CO. The inspector may take necessary action to prevent imminent and substantial risk of death or injury including stopping work.

104.03 Specifications and Drawings. Follow the requirements of FAR Clause 52.236-21 Specifications and Drawings for Construction.

(a) General. Prepare drawings as necessary to construct the work. Drawings include, but are not limited to, layouts that show the relative position (vertical and horizontal as appropriate) of work to be performed, fabrication details for manufactured items and assemblies, installation and erection procedures, details of post-tensioning and other systems, detailed trench and excavation procedures that conform to OSHA requirements, traffic control implementation drawings, and methods for performing work near existing structures or other areas to be protected. Show all the drawing dimensions in United States customary units.

Limit drawings to a maximum size of 24 by 36 inches. Include on each drawing and calculation sheet, the project number, name, and other identification as shown in the contract.

Furnish 5 sets of drawings and supporting calculations for acceptance before performing work covered by the drawings. If drawings are returned for revision, correct and resubmit for acceptance. Allow 40 days per submission for railroad structures and 30 days per submission for all other structures. The review time as specified is applied separately to each drawing submitted. The CO may request additional specific drawings for unique situations in order to clarify layout, construction details, or methodology. If drawings must be resubmitted, the time for acceptance starts over. Obtain written approval before changing or deviating from the accepted drawings.

(b) Specific requirements for concrete and miscellaneous structures.

(1) Furnish drawings for the following:

(a) Site-specific layouts for all wall types and gabion installations;

(b) Gabion and revet mattress details and installation procedures;

(c) Forms and falsework for reinforced concrete box culverts less than or equal to 6 feet in height;

(d) Fabrication drawings for bridge railings and parapets;

(e) Fabrication drawings for prestressed members;

(f) Fabrication and installation drawings for expansion joint assemblies;

(g) Fabrication drawings for bearing assemblies;

(h) Construction joint location and concrete deck placement sequences not shown on the plans;

(i) Erection diagrams for Soil-Corrugated Metal Structure interaction systems (multi-plate structures);

(j) Structural steel fabrication drawings;

(k) Utility hangar details; and

(l) Fabrication and installation drawings for precast items.

(2) Furnish drawings that bear the seal and signature of a professional engineer proficient in the pertinent design field for the following:

(a) Erection plans*;*

(b) Reinforced soil slopes details;

(c) MSE wall and crib wall details*;*

(d) Details and installation procedures for proprietary wall systems;

(e) Temporary bridge structures for public use;

(f) All bridge forms except for railings, parapets, and components less than 6 feet in height;

(g) Shoring systems and cofferdams greater than 6 feet in height;

(h) All shoring systems that support traffic loadings;

(i) Forms and falsework for all structures greater than 6 feet in height;

(j) Post-tensioning systems;

(k) Ground anchors, soil nail, and rock bolt assembly details, layout, and installation and testing procedures;

(l) Tie back wall details; and

(m) Alternate retaining wall details.

(3) Furnish drawings that bear the seal and signature of a professional engineer who is proficient in forms and falsework design and licensed in the state where the project will be constructed for the following:

(a) Falsework for any structure with a span exceeding 16 feet;

(b) Falsework for any structure with a height exceeding 14 feet; and

(c) Falsework for structures where traffic, other than workers involved in constructing the structure, will travel under the structure.

104.04 Coordination of Contract Documents. The FAR, TAR, special contract requirements, plans, and standard specifications are contract documents. A requirement in one document is binding as though occurring in all the contract documents. The contract documents are intended to be complementary and to describe and provide for a complete contract. In case of discrepancy, calculated and shown dimensions govern over scaled dimensions. The contract documents govern in the following order:

(a) Federal Acquisition Regulations;

(b) Transportation Acquisition Regulations;

(c) Special contract requirements;

(d) Plans; and

(e) Standard specifications.

104.05 Load Restrictions. Follow the requirements of FAR Clause 52.236-10 Operations and Storage Areas, paragraph (c).

Comply with all legal load restrictions when hauling material and equipment on public roads to and from the project. A special permit does not relieve the Contractor of liability for damage resulting from the moving of material or equipment.

Unless otherwise permitted, do not operate equipment or vehicles that exceed the legal load limits over new or existing structures, or pavements within the project except those pavements intended to be removed.

Section 105. — CONTROL OF MATERIAL

105.01 Source of Supply and Quality Requirements. Follow the requirements of FAR Clause 52.236-5 Material and Workmanship.

Select sources and provide acceptable material. Notify the CO of all proposed sources before delivery to the project to expedite material inspection and testing. Do not incorporate material requiring submittal into the work until approved.

Material may be approved at the source of supply before delivery to the project. Approval does not constitute acceptance. If an approved source does not continue to supply acceptable material during the life of the project, further use of that source may be denied.

105.02 Material Sources.

(a) Government-provided sources. The Government will acquire the permits and rights to remove material from provided sources identified in the contract and to use such property for a plant site and stockpiles. Test reports and available historical performance data verifying the presence of acceptable material are available upon request.

Do not perform work within a Government-provided source until a plan of operation for the development of the source is accepted. Perform all work necessary to produce acceptable material including site development, preparation, erosion control, and restoration.

The quality of material in provided sources is acceptable in general, but may contain layers or pockets of unacceptable material. It is not feasible to ascertain from samples the quality of material for an entire deposit, and variations may be expected. Determine the quantity and type of equipment and work necessary to select and produce acceptable material.

Strip and stockpile the overburden. After operations are complete, move all waste back into the source. Neatly trim and flatten the side slopes to the extent practicable. Spread the stockpiled overburden uniformly over the sides and bottom of the mined area. Shape the mined area to blend into the surrounding natural terrain.

(b) Contractor-located sources. The Contractor is responsible for located sources, including established commercial sources. Use sources that fulfill the contract quantity and quality requirements. Determine the quantity and types of equipment and work necessary to select and produce acceptable material. Secure all permits and clearances for use of the source and provide copies of the documents.

Provide laboratory test reports and available historical performance data indicating that acceptable material is available from the source. Do not use material from a source that is unacceptable to the Government. Dispose of unacceptable material and locate another source at no cost to the Government.

105.03 Material Source Management. Notify the CO 14 days before starting pit operations. Develop and operate within a material source according to the accepted plan of operation or written agreement for developing the source.

Before developing a material source, measure the sediment content of bodies of water adjacent to the work area that will receive drainage from the work area. Control all erosion so the sediment levels in the bodies of water within the drainage area of the work area do not increase. Control erosion so that sediment does not leave the work area.

105.04 Storing and Handling Material. Store and handle material to preserve its quality and fitness for the work. Stored material approved before storage may again be inspected before use in the work. Locate stored material to facilitate prompt inspection.

Use only approved portions of the right-of-way for storing material and placing plants and equipment. Provide all additional space needed. Do not use private property for storage without written permission of the owner or lessee. Furnish copies of all agreements. Restore all Government-provided storage sites to their original condition.

The Contractor is responsible for the security of all stored material.

105.05 Use of Material Found in the Work. Material, such as stone, gravel, or sand, found in the excavation may be used for another pay item when acceptable. When there is an applicable excavation item in the bid schedule, such material will be paid both as excavation and as the other pay item for which it is used. Replace material so used and needed for embankment or backfill with acceptable material at no cost to the Government. Excavate or remove material only from within the grading limits, as indicated by the slope and grade lines.

The right to use and process material found in the work does not include the use and processing of material for nongovernment contract work except for the disposal of waste material. If the Contractor produces or processes material from Government lands in excess of the quantities required for the contract, the Government may:

(a) Take possession of the excess material and direct its use, paying the Contractor only for the cost of production, or

(b) Require removal of the material and restoration of the land to a satisfactory condition at no cost to the Government.

Section 106. — ACCEPTANCE OF WORK

106.01 Conformity with Contract Requirements. Follow the requirements of FAR Clause 52.246-12 Inspection of Construction.

References to standard test methods of AASHTO, ASTM, GSA, and other recognized standard authorities refer to the methods in effect on the date of solicitation for bids.

Perform work according to the contract requirements. Perform all work to the lines, grades, cross-sections, dimensions, and processes or material requirements shown on the plans or specified in the contract.

Incorporate manufactured materials into the work according to the manufacturer's recommendations or to these specifications, whichever is stricter.

Plan dimensions and contract specification values are the values to be strived for and complied with as the design values from which any deviations are allowed. Perform work and provide material that is uniform in character and reasonably close to the prescribed value or within the specified tolerance range. The purpose of a tolerance range is to accommodate occasional minor variations from the median zone that are unavoidable for practical reasons.

The Government may inspect, sample, or test all work at any time before final acceptance of the project. When the Government tests work, copies of test reports are furnished to the Contractor upon request. Government tests may or may not be performed at the work site. If Contractor testing and inspection is verified by the Government, the Contractor's results may be used by the Government to evaluate work for acceptance. Do not rely on the availability of Government test results for process control.

Acceptable work conforming to the contract will be paid for at the contract unit bid price. Four methods of determining conformity and accepting work are described in Subsections **106.02** to 106.05 inclusive. The primary method of acceptance is specified in each Section of work. However, work may be rejected at any time it is found by any of the methods not to comply with the contract.

Remove and replace work that does not conform to the contract, or to prevailing industry standards where no specific contract requirements are noted, at no cost to the Government.

As an alternative to removal and replacement, the Contractor may submit a written request to:

(a) Have the work accepted at a reduced price; or

(b) Be given permission to perform corrective measures to bring the work into conformity.

The request must contain supporting rationale and documentation. Include references or data justifying the proposal based on an evaluation of test results, effect on service life, value of material or work, quality, aesthetics, and other tangible engineering basis. The CO will determine disposition of the nonconforming work.

When standard manufactured items are specified (such as fence, wire, plates, rolled shapes, pipe conduits, etc., that are identified by gauge, unit mass, section dimensions, etc.), the identification will be considered to be nominal masses or dimensions. Unless specific contract tolerances are noted, established manufacturing tolerances will be accepted.

106.02 Visual Inspection. Acceptance is based on visual inspection of the work for compliance with the contract and prevailing industry standards.

106.03 Certification. For material manufactured off-site, use a manufacturer with an ISO 9000 certification or an effective testing and inspection system. Require the manufacturer to clearly mark the material or packaging with a unique product identification or specification standard to which it is produced.

Other than references in or to the FAR or Federal Law, when these Standard Specifications reference certifications; certificates; or certified documents, equipment, or individuals, these references are not certifications under Section 4301 of Public Law 104-106, National Defense Authorization Act for Fiscal Year 1996. These references refer to documentation of non-regulatory, peripheral contract requirements that are required to be validated by an individual or organization having unique knowledge or qualifications to perform such validation.

Material accepted by certification may be sampled and tested at any time. If found not in conformance with the contract, the material will be rejected whether in place or not.

One of the following certifications may be required:

(a) Production certification. Material requiring a production certification is identified in the Acceptance Subsection of each Section. Require the manufacturer to furnish a production certification for each shipment of material. Include the following with each production certification:

(1) Date and place of manufacture;

(2) Lot number or other means of cross-referencing to the manufacturer's inspection and testing system; and

(3) Substantiating evidence that the material conforms to the contract quality requirements as required by FAR 46.105(a)(4), including all of the following:

(a) Test results on material from the same lot and documentation of the inspection and testing system;

(b) A statement from the manufacturer that the material complies with all contract requirements; and

(c) Manufacturer's signature or other means of demonstrating accountability for the certification.

(b) Commercial certification. When a certification is required, but not a production certification, furnish one commercial certification for all similar material from the same manufacturer.

A commercial certification is a manufacturer's or Contractor's representation that the material complies with all contract requirements. The representation may be labels, catalog data, stamped specification standards, or supplier's certifications indicating the material is produced to a commercial standard or specification.

106.04 Measured or Tested Conformance. Provide all necessary production and processing of the work and control performance of the work so that all of the work complies with the contract requirements.

Results from inspection or testing shall have values within the specified tolerances or specification limits. When no tolerance values are identified in the contract, the work will be accepted based on customary manufacturing and construction tolerances.

106.05 Statistical Evaluation of Work and Determination of Pay Factor (Value of Work). Statistical evaluation of work is a method of analyzing inspection or test results to determine conformity with the contract requirements. The work will be accepted as follows:

(a) General. For work evaluated based on statistical evaluation, both the Government and Contractor assume some risk.

The Government's risk is the probability that work of a rejectable quality level is accepted. The Contractor's risk is either the probability that work produced at an acceptable quality level (AQL) is rejected (α) or the probability that the work produced at the AQL is accepted at less than the contract price (α_{100}).

Acceptable quality level is the lowest percentage of work within the specification limits that is considered acceptable for payment at contract price. There are 2 categories. Category I is based on an AQL of 95 percent. Category II is based on an AQL of 90 percent. In both cases, the Contractor's risk (α_{100}) is 5 percent and the risk of rejection (α) is significantly lower.

As an incentive to produce uniform quality work and to offset the Contractor's risk, a final payment greater than the contract price may be obtained under certain conditions.

The quality characteristics to be evaluated, lot size, sampling frequency, sampling location, test methods, specification limits, and category are as follows:

(1) Quality characteristics. The quality characteristics to be evaluated are listed in the Acceptance Subsection of each Section.

(2) Lot size. A lot is a discrete quantity of work to which the statistical evaluation procedure is applied. A lot normally represents the total quantity of work produced. More than one lot may occur if changes in the target values, material sources, or job-mix formula are requested in writing and approved.

(3) Sampling frequency. The frequency of sampling is listed in the Acceptance Subsection of each Section. The frequency rate shown normally results in a minimum of 5 samples. The minimum number required to perform a statistical evaluation is 3. The maximum obtainable pay factor with 3, 4, or 5 samples is 1.01. A minimum of 8 samples are required to obtain a 1.05 pay factor.

If the sampling frequencies and quantity of work would otherwise result in fewer than 8 samples, a written request is required to increase the sampling frequency to provide for a minimum of 8 samples. Provide the request to increase the sampling frequency at least 48 hours before beginning production. An increase in the sampling frequency may result in a reduced pay factor.

(4) Sampling location. The point of sampling is listed in the Acceptance Subsection of each Section. The exact location of sampling will be specified by the CO based on random numbers.

(5) Test methods. The test methods used to test the sample are listed in the Acceptance Subsection of each Section.

(6) Specification limits. The specification limits for the quality characteristics are listed in the contract provisions for the work in question.

(7) Category. The category for the quality characteristics to be analyzed is listed in the acceptance subsection of each Section.

(b) Acceptance. The work in the lot will be paid for at a final pay factor when all inspections or test results are completed and evaluated.

Before determining the final pay factor, the work may be incorporated into the project provided the current pay factor does not fall below 0.90. If a lot is concluded with fewer than 3 samples, the material will be evaluated under Subsection 106.04.

If the current pay factor of a lot falls below 0.90, terminate production. Production may resume after the Contractor takes effective and acceptable actions to improve the quality of the production.

A lot containing an unsatisfactory percentage of nonspecification material (less than 1.00 pay factor) is accepted provided the lowest single pay factor has not fallen into the reject portion of Table 106-2.

A lot containing an unsatisfactory percentage of nonspecification material with the lowest single pay factor falling into the reject portion of Table 106-2 is rejected. Remove all rejected material from the work.

When approved, it is permissible to voluntarily remove nonspecification material and replace it with new material to avoid or minimize a pay factor of less than 1.00. New material will be sampled, tested, and evaluated according to this Subsection.

Any quantity of material may be rejected based on visual inspection or test results. Do not incorporate rejected material in the work. The results of tests run on rejected material will be excluded from the lot.

(c) Statistical evaluation. The Variability-Unknown/Standard Deviation Method will be used to determine the estimated percentage of the lot that is within specification limits.

The number of significant figures used in the calculations will be according to AASHTO R 11, absolute method.

The estimated percentage of work that is within the specification limits for each quality characteristic will be determined as follows:

(1) Calculate the arithmetic mean $(\bar{x})$ of the test values: $\bar{x} = \frac{\sum x}{n}$

where: $\sum$ = summation of

x = individual test value

n = total number of test values

(2) Calculate the standard deviation (s):

$$s = \sqrt{\frac{n\sum(x^2) - (\sum x)^2}{n(n-1)}}$$

where: $\sum(x^2)$ = summation of the squares of individual test values

$(\sum x)^2$ = summation of the individual test values squared

(3) Calculate the upper quality index (Q_U): $Q_U = \dfrac{USL - \overline{X}}{s}$

where: *USL* = upper specification limit

Note: The *USL* is equal to the contract specification limit or the target value plus the allowable deviation.

(4) Calculate the lower quality index (Q_L): $Q_L = \dfrac{\overline{X} - LSL}{s}$

where: *LSL* = lower specification limit

Note: The *LSL* is equal to the contract specification limit or the target value minus the allowable deviation.

(5) From Table 106-1, determine P_U (the estimated percentage of work within the *USL*). P_U corresponds to a given Q_U. If a *USL* is not specified, P_U is 100.

(6) From Table 106-1, determine P_L (the estimated percentage of work within the lot within the *LSL*). P_L corresponds to a given Q_L. If an *LSL* is not specified, P_L is 100.

(7) Calculate the total estimated percentage of work within the *USL* and *LSL*:

$$P_U + P_L - 100$$

(8) Repeat steps 1 through 7 for each quality characteristic listed for statistical evaluation.

(d) Pay factor determination (value of the work). The pay factor for a lot will be determined as follows:

(1) From Table 106-2, determine the pay factor for each quality characteristic using the total number of test values and the total estimated percentage within the specification limits from step (c)(7).

(2) When all quality characteristics for a lot are Category I, the lot pay factor is based on the lowest single pay factor for any Category I quality characteristic. The maximum obtainable pay factor is 1.05 (with a minimum of 8 test values).

(3) When quality characteristics for a lot are both Category I and II, the lot pay factor is based on the following:

(a) When all Category II quality characteristics are 1.00, the lot payment is based on the lowest single pay factor for all category I characteristics. The maximum obtainable pay factor is 1.05 (with a minimum of 8 test values).

Table 106-1
Estimated Percent of Work Within Specification Limits

Estimated Percent within Specification Limits (P_U or P_L)	Upper Quality Index Q_U or Lower Quality Index Q_L								
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10 to n=11	n=12 to n=14
100	1.16	1.49	1.72	1.88	1.99	2.07	2.13	2.20	2.28
99	-	1.46	1.64	1.75	1.82	1.88	1.91	1.96	2.01
98	-	1.43	1.58	1.66	1.72	1.75	1.78	1.81	1.84
97	1.15	1.40	1.52	1.59	1.63	1.66	1.68	1.71	1.73
96	-	1.37	1.47	1.52	1.56	1.58	1.60	1.62	1.64
95	1.14	1.34	1.42	1.47	1.49	1.51	1.52	1.54	1.55
94	-	1.31	1.38	1.41	1.43	1.45	1.46	1.47	1.48
93	1.13	1.28	1.33	1.36	1.38	1.39	1.40	1.41	1.41
92	1.12	1.25	1.29	1.31	1.33	1.33	1.34	1.35	1.35
91	1.11	1.22	1.25	1.27	1.28	1.28	1.29	1.29	1.30
90	1.10	1.19	1.21	1.23	1.23	1.24	1.24	1.24	1.25
89	1.09	1.16	1.18	1.18	1.19	1.19	1.19	1.19	1.20
88	1.07	1.13	1.14	1.14	1.15	1.15	1.15	1.15	1.15
87	1.06	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.11
86	1.04	1.07	1.07	1.07	1.07	1.06	1.06	1.06	1.06
85	1.03	1.04	1.03	1.03	1.03	1.03	1.02	1.02	1.02
84	1.01	1.01	1.00	0.99	0.99	0.99	0.99	0.98	0.98
83	0.99	0.98	0.97	0.96	0.95	0.95	0.95	0.95	0.94
82	0.97	0.95	0.93	0.92	0.92	0.92	0.91	0.91	0.91
81	0.95	0.92	0.90	0.89	0.88	0.88	0.88	0.87	0.87
80	0.93	0.89	0.87	0.86	0.85	0.85	0.84	0.84	0.84
79	0.91	0.86	0.84	0.82	0.82	0.81	0.81	0.81	0.80
78	0.88	0.83	0.81	0.79	0.79	0.78	0.78	0.77	0.77
77	0.86	0.80	0.77	0.76	0.75	0.75	0.74	0.74	0.74
76	0.83	0.77	0.74	0.73	0.72	0.72	0.71	0.71	0.70
75	0.81	0.74	0.71	0.70	0.69	0.69	0.68	0.68	0.67
74	0.78	0.71	0.68	0.67	0.67	0.65	0.65	0.65	0.64
73	0.75	0.68	0.65	0.64	0.63	0.62	0.62	0.62	0.61
72	0.73	0.65	0.62	0.61	0.60	0.59	0.59	0.59	0.58
71	0.70	0.62	0.59	0.58	0.57	0.57	0.56	0.56	0.55
70	0.67	0.59	0.56	0.55	0.54	0.54	0.53	0.53	0.52
69	0.64	0.56	0.53	0.52	0.51	0.51	0.50	0.50	0.50
68	0.61	0.53	0.50	0.49	0.48	0.48	0.48	0.47	0.47
67	0.58	0.50	0.47	0.46	0.45	0.45	0.45	0.44	0.44
66	0.55	0.47	0.45	0.43	0.43	0.42	0.42	0.42	0.41
65	0.51	0.44	0.42	0.40	0.40	0.39	0.39	0.39	0.38
64	0.48	0.41	0.39	0.38	0.37	0.37	0.36	0.36	0.36
63	0.45	0.38	0.36	0.35	0.34	0.34	0.34	0.33	0.33
62	0.41	0.35	0.33	0.32	0.32	0.31	0.31	0.31	0.30
61	0.38	0.30	0.30	0.30	0.29	0.28	0.28	0.28	0.28
60	0.34	0.28	0.28	0.25	0.25	0.25	0.25	0.25	0.25
59	0.31	0.27	0.25	0.23	0.23	0.23	0.23	0.23	0.23
58	0.30	0.25	0.23	0.20	0.20	0.20	0.20	0.20	0.20
57	0.25	0.20	0.18	0.18	0.18	0.18	0.18	0.18	0.18
56	0.20	0.18	0.16	0.15	0.15	0.15	0.15	0.15	0.15
55	0.18	0.15	0.13	0.13	0.13	0.13	0.13	0.13	0.13
54	0.15	0.13	0.10	0.10	0.10	0.10	0.10	0.10	0.10
53	0.10	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: If the value of Q_U or Q_L does not correspond to a value in the table, use the next lower Q value.
If Q_U or Q_L are negative values, P_U or P_L is equal to 100 minus the table value for P_U or P_L.

(continued)

Table 106-1 (continued)
Estimated Percent of Work Within Specification Limits

Estimated Percent within Specification Limits (P_U or P_L)	Upper Quality Index Q_U or Lower Quality Index Q_L					
	n=15 to n=17	n=18 to n=22	n=23 to n=29	n=30 to n=42	n=43 to n=66	n=67 to ∞
100	2.34	2.39	2.44	2.48	2.51	2.56
99	2.04	2.07	2.09	2.12	2.14	2.16
98	1.87	1.89	1.91	1.93	1.94	1.95
97	1.75	1.76	1.78	1.79	1.80	1.81
96	1.65	1.66	1.67	1.68	1.69	1.70
95	1.56	1.57	1.58	1.59	1.59	1.60
94	1.49	1.50	1.50	1.51	1.51	1.52
93	1.42	1.43	1.43	1.44	1.44	1.44
92	1.36	1.36	1.37	1.37	1.37	1.38
91	1.30	1.30	1.31	1.31	1.31	1.31
90	1.25	1.25	1.25	1.25	1.26	1.26
89	1.20	1.20	1.20	1.20	1.20	1.20
88	1.15	1.15	1.15	1.15	1.15	1.15
87	1.11	1.11	1.11	1.11	1.11	1.11
86	1.06	1.06	1.06	1.06	1.06	1.06
85	1.02	1.02	1.02	1.02	1.02	1.02
84	0.98	0.98	0.98	0.98	0.98	0.98
83	0.94	0.94	0.94	0.94	0.94	0.94
82	0.91	0.90	0.90	0.90	0.90	0.90
81	0.87	0.87	0.87	0.87	0.87	0.87
80	0.83	0.83	0.83	0.83	0.83	0.83
79	0.80	0.80	0.80	0.80	0.80	0.79
78	0.77	0.76	0.76	0.76	0.76	0.76
77	0.73	0.73	0.73	0.73	0.73	0.73
76	0.70	0.70	0.70	0.70	0.70	0.70
75	0.67	0.67	0.67	0.67	0.67	0.66
74	0.64	0.64	0.64	0.64	0.64	0.63
73	0.61	0.61	0.61	0.61	0.61	0.60
72	0.58	0.58	0.58	0.58	0.58	0.57
71	0.55	0.55	0.55	0.55	0.55	0.54
70	0.52	0.52	0.52	0.52	0.52	0.52
69	0.49	0.49	0.49	0.49	0.49	0.49
68	0.47	0.46	0.46	0.46	0.46	0.46
67	0.44	0.44	0.43	0.43	0.43	0.43
66	0.41	0.41	0.41	0.41	0.41	0.40
65	0.38	0.38	0.38	0.38	0.38	0.38
64	0.36	0.35	0.35	0.35	0.35	0.35
63	0.33	0.33	0.33	0.33	0.33	0.32
62	0.30	0.30	0.30	0.30	0.30	0.30
61	0.28	0.28	0.28	0.28	0.28	0.28
60	0.25	0.25	0.25	0.25	0.25	0.25
59	0.23	0.23	0.23	0.23	0.23	0.23
58	0.20	0.20	0.20	0.20	0.20	0.20
57	0.18	0.18	0.18	0.18	0.18	0.18
56	0.15	0.15	0.15	0.15	0.15	0.15
55	0.13	0.13	0.13	0.13	0.13	0.13
54	0.10	0.10	0.10	0.10	0.10	0.10
53	0.08	0.08	0.08	0.08	0.08	0.08
52	0.05	0.05	0.05	0.05	0.05	0.05
51	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00

Note: If the value of Q_U or Q_L does not correspond to a value in the table, use the next lower Q value. If Q_U or Q_L are negative values, P_U or P_L is equal to 100 minus the table value for P_U or P_L.

Table 106-2 Pay Factors

PAY FACTOR		Minimum Required Percent of Work Within Specification Limits for a Given Pay Factor ($P_U + P_L$) – 100													
Category		n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10 to n=11	n=12 to n=14	n=15 to n=17	n=18 to n=22	n=23 to n=29	n=30 to n=42	n=43 to n=66	n=67 to ∞
I	II															
1.05							100	100	100	100	100	100	100	100	100	100
1.04						100	99	97	95	96	96	96	97	97	97	97
1.03					100	98	96	84	92	93	93	94	95	95	96	96
1.02					99	97	94	91	89	90	91	92	93	93	94	94
1.01		100	100	100	98	95	92	89	87	88	89	90	91	92	92	93
1.00		69	75	78	80	82	83	84	85	86	87	88	89	90	91	92
0.99		66	72	76	78	80	81	82	83	84	85	86	87	89	90	91
0.98		64	70	74	76	78	79	80	81	82	84	85	86	87	88	90
0.97		63	68	72	74	76	77	78	79	81	82	83	84	86	87	88
0.96		61	67	70	72	74	75	76	78	79	81	82	83	84	86	87
0.95	1.00	59	65	68	71	72	74	75	76	78	79	80	82	83	84	86
0.94	0.99	58	63	67	69	71	72	73	75	76	78	79	80	82	83	85
0.93	0.98	57	62	65	67	69	71	72	73	75	76	78	79	80	82	84
0.92	0.97	55	60	63	66	68	69	70	72	73	75	76	78	79	81	82
0.91	0.96	54	59	62	64	66	68	69	70	72	74	75	76	78	79	81
0.90	0.95	53	57	61	63	65	66	67	69	71	72	74	75	77	78	80
0.89	0.94	51	56	59	62	63	65	66	68	69	71	72	74	75	77	79
0.88	0.93	50	55	58	60	62	64	65	66	68	70	71	73	74	76	78
0.87	0.92	49	53	57	59	61	62	63	65	67	68	70	71	73	75	77
0.86	0.91	48	52	55	58	59	61	62	64	66	67	69	70	72	74	76

Note: If the value of ($P_U + P_L$) – 100 does not correspond to a ($P_U + P_L$) – 100 value in this table, use the next smaller ($P_U + P_L$) – 100 value.

(continued)

Table 106-2 Pay Factors (continued)

PAY FACTOR		Minimum Required Percent of Work Within Specification Limits for a Given Pay Factor ($P_U + P_L$) - 100														
Category		n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10 to n=11	n=12 to n=14	n=15 to n=17	n=18 to n=22	n=23 to n=29	n=30 to n=42	n=43 to n=66	n=67 to ∞
I	II															
0.85	0.90	46	51	54	56	58	60	61	62	64	66	67	69	71	72	75
0.84	0.89	45	49	53	55	57	58	60	61	63	65	66	68	70	71	73
0.83	0.88	44	48	51	54	56	57	58	60	62	64	65	67	69	70	72
0.82	0.87	43	47	50	53	54	56	57	59	61	62	64	66	67	69	71
0.81	0.86	41	46	49	51	53	55	56	58	59	61	63	64	66	68	70
0.80	0.85	40	44	48	50	52	54	55	56	58	60	62	63	65	67	69
0.79	0.84	39	43	46	49	51	52	54	55	57	59	61	62	64	66	68
0.78	0.83	38	42	45	48	50	51	52	54	56	58	59	61	63	65	67
0.77	0.82	36	41	44	46	48	50	51	53	55	57	58	60	62	64	66
0.76	0.81	35	39	43	45	47	49	50	52	54	56	57	59	61	63	65
0.75	0.80	33	38	42	44	46	48	49	51	53	54	56	58	60	62	64
REJECT	0.79	32	37	40	43	45	47	48	49	52	53	55	57	59	60	63
	0.78	30	36	39	42	44	45	47	48	50	52	54	56	57	59	62
	0.77	28	34	38	41	43	44	46	47	49	51	53	55	56	58	61
	0.76	27	33	37	39	42	43	45	46	48	50	52	53	55	57	60
	0.75	35	32	36	38	40	42	43	45	47	49	51	52	54	56	59
Values Less Than Those Shown Above																

Note: If the value of ($P_U + P_L$) – 100 does not correspond to a ($P_U + P_L$) – 100 value in this table, use the next smaller ($P_U + P_L$) – 100 value.

(b) When any Category II quality characteristic is less than 1.00, the lot payment is based on the lowest single pay factor for any Category I or II quality characteristic.

(4) When all quality characteristics for a lot are Category II, the lot pay factor is based on the lowest single pay factor for any Category II quality characteristic. The maximum obtainable pay factor is 1.00.

(5) Adjusted payment for material in a lot will be made at a price determined by multiplying the contract unit bid price by the lot pay factor as determined above, or as described in the Payment Subsection of the Section ordering the work.

106.06 Inspection at the Plant. Work may be inspected at the point of production or fabrication. Manufacturing plants may be inspected for compliance with specified manufacturing methods. Material samples may be obtained for laboratory testing for compliance with quality requirements. Allow full entry at all times to the parts of the plant producing the work.

106.07 Partial and Final Acceptance. Maintain the work during construction and until the project is accepted. Damage caused by the Contractor prior to final acceptance of the entire project will be repaired at the Contractor's expense. See FAR Clause 52.236-11 Use and Possession Prior to Completion.

(a) Partial acceptance. When a separate portion of the project is completed, a final inspection of that portion may be requested. If the portion is complete and in compliance with the contract, it may be accepted. If accepted, the CO will relieve the Contractor of further responsibility for maintenance of the completed portion. Partial acceptance does not void or alter any of the terms of the contract.

When public traffic is accommodated through construction and begins using sections of roadway as they are completed, continue maintenance of such sections until final acceptance.

(b) Final acceptance. When notified that the entire project is complete, an inspection will be scheduled. If all work is determined to be complete, the inspection will constitute the final inspection and the Contractor will be notified in writing of final acceptance as of the date of the final inspection. Final acceptance relieves the Contractor of further responsibility for the maintenance of the project.

If the inspection discloses any unsatisfactory work, the CO will provide to the Contractor a list of the work that is incomplete or requires correction. Immediately complete or correct the work. Furnish notification when the work has been completed as provided above.

Section 107. — LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

107.01 Laws to be Observed. Follow the requirements of FAR Clause 52.236-7 Permits and Responsibilities.

Comply with all applicable laws, ordinances, safety codes, regulations, orders, and decrees. Protect and indemnify the Government and its representatives against any claim or liability arising from or based on the alleged violation of the same.

Comply with all permits and agreements obtained by the Government for performing the work that is included in the contract. Obtain all additional permits or agreements and modifications to Government-obtained permits or agreements that are required by the Contractor's methods of operation. Furnish copies of all permits and agreements.

107.02 Protection and Restoration of Property and Landscape. Follow the requirements of FAR Clause 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements.

Preserve public and private property, and protect monuments established for the purpose of perpetuating horizontal, vertical, cadastral, or boundary control. When necessary to destroy a monument, reestablish the monument according to applicable state statute or by the direction of the agency or individual who established the monument.

Do not disturb the area beyond the construction limits. Replace trees, shrubs, or vegetated areas damaged by construction operations as directed and at no cost to the Government. Remove any damaged limbs of existing trees by an approved arborist.

Do not excavate, remove, damage, alter, or deface any archeological or paleontological remains or specimens. Control the actions of employees and subcontractors on the project to ensure that protected sites are not disturbed or damaged. Should any of these items be encountered, suspend operations at the discovery site, notify the CO, and continue operations in other areas. The CO will inform the Contractor when operations may resume at the discovery site.

When utilities are to be relocated or adjusted, the Government will notify all utility owners affected by the relocations or adjustments. The relocations or adjustments will be performed by others or will be included in the contract work.

Before beginning work in an area, the Contractor shall have all utility owners locate their utilities. Protect utilities from construction operations. Cooperate with utility owners to expedite the relocation or adjustment of their utilities to minimize interruption of service and duplication of work.

If utility services are interrupted as a result of damage by the construction, immediately notify the utility owner, the CO, and other proper authorities. Cooperate with them until service is restored. Do not work around fire hydrants until provisions for continued service are made and approved by the local fire authority.

If utility adjustment work, not included in the contract, is required, compensation for the work will be provided under applicable clauses of the contract. Satisfactorily repair damage due to the fault or negligence of the Contractor at no cost to the Government.

Repair of damage to underground utilities that were not shown on the plans or identified before construction, and not caused by the fault or negligence of the Contractor, will be paid for by the Government.

107.03 Bulletin Board. Furnish a weatherproof bulletin board of suitable size and construction for continuous display of posters and other information required by the contract. Erect and maintain the bulletin board at a conspicuously accessible location on the project and remove and dispose of it after project final acceptance.

Display each of the following documents on the bulletin board:

(a) "Equal Opportunity" poster, according to FAR Clause 52.222-26 Equal Opportunity;

(b) "Notice" that the project is subject to Title 18, U.S. Criminal Code, Section 1020, FHWA Form 1022;

(c) "Notice to Employees" poster, WH-1321, regarding proper pay;

(d) "Right to Safe and Healthful Workplace" poster, according to Title 29, Code of Federal Regulations, Part 1903;

(e) "General Wage Decision" contained in the contract; and

(f) Company equal employment opportunity policy.

107.04 Railroad Protection.

NOT USED

107.05 Responsibility for Damage Claims. Indemnify and hold harmless the Government, its employees, and its consultants from suits; actions; or claims brought for injuries or damage received or sustained by any person, persons, or property resulting from the construction operations or arising out of the negligent performance of the contract.

Procure and maintain until final acceptance of the contract, liability insurance of the types and limits specified below. Obtain insurance from companies authorized to do business in the appropriate state. The insurance shall cover all operations under the contract whether performed by the Contractor or by subcontractors.

Before work begins, furnish *"certificates of insurance"* certifying that the policies will not be changed or canceled until 30 days written notice has been given to the Government. Insurance coverage in the minimum amounts set forth below shall not relieve the Contractor of liability in excess of the coverage.

Carry insurance meeting the following minimums:

(a) Worker's compensation insurance. Minimum required by law.

(b) Comprehensive or commercial general liability insurance.

(1) Personal injury and property damage coverage;

(2) Contractual liability coverage;

(3) Completed operations liability coverage;

(4) $1,000,000 combined single limit for each occurrence; and

(5) $2,000,000 general aggregate limit.

(c) Automobile liability insurance. $1,000,000 combined single limit for each occurrence.

107.06 Contractor's Responsibility for Work. Assume responsibility for all work until final acceptance except as provided in Subsection 106.07. This includes periods of suspended work. Protect the work against injury, loss, or damage from all causes whether arising from the execution or nonexecution of the work.

Maintain public traffic according to Section 156. Rebuild, repair, restore, and make good all losses, injuries, or damages to any portion of the work. This includes losses, injuries, or damages caused by vandalism, theft, accommodation of public traffic, and weather that occurs during the contract.

The Government will only be responsible for losses, injuries, and damages to work put in place that was caused by declared enemies and terrorists of the Government and cataclysmic natural phenomenon such as tornadoes, earthquakes, major floods, and other officially declared natural disasters. The Government will only be responsible for costs attributable to repairing or replacing damaged work. The Government will not be responsible for delay costs, impact costs, or extended overhead costs.

107.07 Furnishing Right-of-Way. The Government will obtain all right-of-way.

107.08 Sanitation, Health, and Safety. Follow the requirements of FAR Clause 52.236-13 Accident Prevention.

Observe rules and regulations of Federal, State, and local health officials. Do not permit any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous.

Admit any OSHA inspector or other legally responsible official involved in safety and health administration to the project work site upon presentation of proper credentials.

Report accidents on forms furnished by the Government or, with prior approval, on forms used to report accidents to other agencies or insurance carriers. Maintain a *"Log of Work Related Injuries and Illnesses,"* OSHA Form 300, and make it available for inspection.

Install a reverse signal alarm audible above the surrounding noise level on all motorized vehicles having an obstructed view and on all earth-moving and compaction equipment.

107.09 Legal Relationship of the Parties. In the performance of the contract, the Contractor is an independent contractor and neither the Contractor nor anyone used or employed by the Contractor shall be an agent, employee, servant, or representative of the Government. The Contractor's independent contractor status does not limit the Government's general rights under the contract.

107.10 Environmental Protection. Do not operate mechanized equipment or discharge or otherwise place any material within the wetted perimeter of any waters of the U.S. within the scope of the Clean Water Act (33 USC § 1251 et seq.). This includes wetlands unless authorized by a permit issued by the U.S. Army Corps of Engineers according to 33 USC § 1344, and, if required, by any State agency having jurisdiction over the discharge of material into the waters of the U.S. In the event of an unauthorized discharge:

(a) Immediately prevent further contamination;

(b) Immediately notify appropriate authorities; and

(c) Mitigate damages as required.

Comply with the terms and conditions of any permits that are issued for the performance of work within the wetted perimeter of the waters of the U.S.

Separate work areas, including material sources, by the use of a dike or other suitable barrier that prevents sediment, petroleum products, chemicals, or other liquid or solid material from entering the waters of the U.S. Use care in constructing and removing the barriers to avoid any discharge of material into, or the siltation of, the water. Remove and properly dispose of the sediment or other material collected by the barrier.

Repair leaks on equipment immediately. Do not use equipment that is leaking. Keep a supply of acceptable absorbent materials at the job site in the event of spills. Acceptable absorbent materials are those that are manufactured specifically for the containment and clean up of hazardous materials.

107.11 Protection of Forests, Parks, and Public Lands. Comply with all regulations of the State fire marshal, conservation commission, Forest Service, National Park Service, Bureau of Land Management, Fish & Wildlife Service, Bureau of Indian Affairs, or other authority having jurisdiction governing the protection of land including or adjacent to the project.

Section 108. — PROSECUTION AND PROGRESS

108.01 Commencement, Prosecution, and Completion of Work. Follow the requirements of FAR Clause 52.211-10 Commencement, Prosecution, and Completion of Work.

A preconstruction conference will be held after the contract is awarded and before beginning work. Seven days before the preconstruction conference, furnish three copies of the preliminary construction schedule according to Section 155.

108.02 Subcontracting. Follow the requirements of FAR Clauses 52.219-14 Limitations on Subcontracting, 52.222-11 – Subcontracts (Labor Standards), and 52.236-1 Performance of Work by the Contractor.

Subcontracting does not relieve the Contractor of liability and responsibility under the contract and does not create any contractual relation between subcontractors and the Government. The Contractor is liable and responsible for any action or lack of action of subcontractors.

Within 14 days of subcontract award, submit an SF 1413 with Part I completed. Complete other forms that may be provided by the Government to clearly show the work subcontracted and the total dollar amount of the subcontract. For subcontracts involving on-site labor, require the subcontractor to complete Part II of the SF 1413 and complete other forms that may be provided by the Government. Submit a separate statement documenting the cumulative amount of all on-site subcontracts to date as a percentage of the original contract amount. Furnish this information on all subcontracts at lower tiers.

In FAR Clauses 52.219-8 Utilization of Small Business Concerns and 52.232-27 Prompt Payment for Construction Contracts, the subcontracts include both on-site and off-site work and supply contracts. In FAR Clause 52.219-14 Limitations on Subcontracting or in FAR Clause 52.236-1 Performance of Work by the Contractor, the percentage of work performed on-site by the Contractor will be computed as 100 percent less the combined initial dollar amount of all subcontracts involving on-site labor as a percent of the original dollar amount of the contract.

108.03 Determination and Extension of Contract Time. Follow the requirements of FAR Clause 52.211-10 Commencement, Prosecution, and Completion of Work.

Only delays or modifications that affect critical activities or cause noncritical activities to become critical will be considered for time extensions.

When Critical Path Method schedules are used, no time extension will be made for delays or modifications that use available float time as shown in the current construction schedule required by Section 155.

Time will not be extended for a claim that states insufficient time was provided in the contract.

When requesting a time extension, follow the applicable contract clauses. Make the request in writing and include the following:

(a) Contract clause(s) under which the request is being made.

(b) Detailed narrative description of the reasons for the requested contract time adjustment including the following:

(1) Cause of the impact affecting time;

(2) Start date of the impact;

(3) Duration of the impact;

(4) Activities affected; and

(5) Methods to be employed to mitigate the impact.

(c) Suggested new completion date or number of days supported by current and revised construction schedules according to Section 155.

108.04 Failure to Complete Work on Time. Follow the requirements of FAR Clause 52.211-12 Liquidated Damages — Construction.

Liquidated damages in the amount specified in Table 108-1 will be assessed for each day beyond the time allowed to complete the contract until substantial completion of the work.

If a winter shutdown occurs during this period, liquidated damages in an amount equal to 10 percent of the amount specified in Table 108-1 will be assessed for each day until work resumes at which time full liquidated damages will be assessed.

Liquidated damages in an amount equal to 20 percent of the amount specified in Table 108-1 will be assessed for each day beyond the time allowed to complete the contract beginning with the day after substantial completion and ending with the date of final completion and acceptance.

Liquidated damages will not be assessed for the following:

(a) The day of the final inspection;

(b) Days required to perform work added to the contract after substantial completion including items identified during the final inspection that were not required before that time; or

(c) Delays by the Government after all work is complete and before a formal acceptance is executed.

(d) Periods of time when all work is complete but acceptance is delayed pending the plant establishment period or similar warranty period.

Table 108-1
Charge for Liquidated Damages for Each Day
Work Is Not Substantially Completed

Original Contract Price		Daily Charge
From More Than —	To and Including —	
$ 0	$ 1,000,000	$ 500
1,000,000	2,000,000	1,100
2,000,000	5,000,000	2,200
5,000,000	10,000,000	2,700
10,000,000	and more	3,300

108.05 Stop Order. The CO may order the performance of the work to be stopped, either in whole or in part, for such periods deemed necessary due to the following:

(a) Weather or soil conditions considered unsuitable for prosecution of the work; or

(b) Failure of the Contractor to:

(1) Correct conditions unsafe for the workers or the general public;

(2) Carry out written orders given by the CO; or

(3) Perform any provision of the contract.

No adjustment in contract time or amount will be made for stop orders issued under (a) or (b) above except an adjustment in contract time, as provided by FAR Clause 52.249-10 Default (Fixed-Price Construction), may be made when the Contractor is able to demonstrate that the weather was unusually severe based on the most recent 10 years of historical data.

Section 109. — MEASUREMENT AND PAYMENT

109.01 Measurement of Work. Take and record measurements and perform calculations to determine pay quantities for invoicing for work performed. Take or convert all measurements of work according to United States customary measure.

Unless otherwise specified, measure when the work is in place, complete, and accepted. Measure the actual work performed, except do not measure work outside the design limits or other adjusted or specified limits (staked limits). Measure structures to the lines shown on the plans or to approved lines adjusted to fit field conditions.

Take measurements as described in Subsection 109.02 unless otherwise modified by the Measurement Subsection of the Section controlling the work being performed.

Remeasure quantities if it has been determined that any portion of the work is acceptable but has not been completed to the lines, grades, and dimensions shown on the plans or established by the CO.

Submit measurement notes to the CO within 24 hours of completing the work. For on-going work, submit measurement notes weekly. When work is not complete, identify the measurement as being an interim measurement. Submit the final measurement when the installation is completed. Measurement notes form the basis of the Government's receiving report (see Subsection 109.08(d)). For lump sum items, submit documentation to support invoiced progress payment on a monthly basis.

Use an acceptable format for measurement records. As a minimum, include the following information in all records of measurement:

(a) Project name and number;

(b) Contract item number;

(c) Date the work was performed;

(d) Location of the work;

(e) Measured quantity;

(f) Calculations made to arrive at the quantity;

(g) Supporting sketch and details as needed to clearly define the work performed and the quantity measured;

(h) Names of persons measuring the work;

(i) Identification as to whether the measurement is interim or final; and

(j) Signed certification statement by the persons taking the measurements, performing the calculations, and submitting them for payment that the measurement and calculations are correct to the best of their knowledge and that the quantity being measured is subject to direct payment for the identified item under the contract.

109.02 Measurement Terms and Definitions. Unless otherwise specified, the following terms are defined as follows:

(a) Acre. 43,560 square feet. Make longitudinal and transverse measurements for area computations horizontally unless specified on the ground surface. Do not make deductions from the area computation for individual fixtures having an area of 500 square feet or less.

(b) Contract quantity. The quantity to be paid is the quantity shown in the bid schedule. The contract quantity will be adjusted for authorized changes that affect the quantity or for errors made in computing this quantity. If there is evidence that a quantity specified as a contract quantity is incorrect, submit calculations, drawings, or other evidence indicating why the quantity is in error and request, in writing, that the quantity be adjusted.

(b) Cubic yard.

(1) Cubic yard in place. Measure solid volumes by a method approved by the CO or by the average end area method as follows:

(a) Take cross-sections of the original ground and use with design or staked templates or take other comparable measurements to determine the end areas. Do not measure work outside of the established lines or slopes.

(b) If any portion of the work is acceptable but is not completed to the established lines and slopes, retake cross-sections or comparable measurements of that portion of the work. Deduct any quantity outside the designated or staked limits. Use these measurements to calculate new end areas.

(c) Compute the quantity using the average end areas multiplied by the horizontal distance along a centerline or reference line between the end areas. Deduct any quantity outside the designed or staked limits.

(2) Cubic yard in the hauling vehicle. Measure the cubic yard volume in the hauling vehicle using three-dimensional measurements at the point of delivery. Use vehicles bearing a legible identification mark with the body shaped so the actual contents may be readily and accurately determined. Before use, mutually agree in writing on the volume of material to be hauled by each vehicle. Vehicles carrying less than the agreed volume may be rejected or accepted at the reduced volume.

Level selected loads. If leveling reveals the vehicle was hauling less than the approved volume, reduce the quantity of all material received since the last leveled load by the same ratio as the current leveled load volume is to the agreed volume. Payment will not be made for material in excess of the agreed volume.

Material measured in the hauling vehicle may be weighed and converted to cubic yards for payment purposes if the conversion factors are mutually agreed to in writing.

(3) Cubic yard in the structure. Measure according to the lines of the structure as shown on the plans except as altered by the CO to fit field conditions. Make no deduction for the volume occupied by reinforcing steel, anchors, weep holes, piling, or pipes less than 8 inches in diameter.

(4) Cubic yard by metering. Use an approved metering system.

(d) Each. One entire unit. The quantity is the actual number of units completed and accepted.

(e) Gallon. The quantity may be measured by any of the following methods:

(1) Measured volume container.

(2) Metered volume. Use an approved metering system.

(3) Commercially-packaged volumes.

When asphalt material is measured by the gallon, measure the volume at 60 ºF or correct the volume to 60 ºF using recognized standard correction factors.

(f) Hour. Measure the actual number of hours ordered by the CO and performed by the Contractor.

(g) Linear foot. As applicable, measure the work along its length from end-to-end; parallel to the base or foundation; along the top; along the front face; or along the invert. Do not measure overlaps.

(h) Lump sum. Do not measure directly. The bid amount is complete payment for all work described in the contract and necessary to complete the work for that item. The quantity is designated as *"All."* Estimated quantities of lump sum work shown in the contract are approximate.

(i) M-gallon. 1,000 gallons. Measure according to (e) above.

(j) Mile. 5,280 linear feet. Measure horizontally along the centerline of each roadway, approach road, or ramp.

(k) Pound. Measure according to Subsection 109.03. If sacked or packaged material is furnished, the net weight as packed by the manufacturer may be used.

(l) Square foot. Measure on a plane parallel to the surface being measured.

(m) Square yard. 9 square feet. Longitudinal and transverse measurements for area computations will be made horizontally. No deductions from the area computation will be made for individual fixtures having area of 9 square feet or less.

(n) Station. 100 linear feet. Measure horizontally along centerline or reference line of each roadway, approach road, or ramp.

(o) Ton. 2,000 pounds avoirdupois. Measure according to Subsection 109.03.

No adjustment in a contract unit price will be made for variations in quantity due to differences in the specific gravity or moisture content.

Use net-certified scale masses, or masses based on certified volumes in the case of rail shipments as a basis of measurement subject to correction when asphalt material is lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt material is shipped by truck or transport, net-certified masses, subject to correction for loss or foaming, may be used for computing quantities.

When emulsified asphalt is converted from volume to mass, use a factor of 240 gallons per ton regardless of temperature.

When asphalt binder for asphalt concrete pavement is stored in tanks devoted exclusively to the project, base quantities on invoices. When asphalt binder for asphalt concrete pavement is not stored in tanks devoted exclusively to the project, or when the validity of the quantity requested for payment is in question, base quantities on the asphalt content determined by testing.

109.03 Weighing Procedures and Devices.

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109.04 Receiving Procedures. When the method of measurement requires weighing or volume measurement in the hauling vehicle, furnish a person to direct the spreading and distribution of material and to record the location and placement of the material on the project. During the placement, maintain a record of each delivery and document it in an acceptable manner. Include the following information as applicable:

(a) Project identification;

(b) Contract pay item number and description;

(c) Location where placed;

(d) Date;

(e) Load number;

(f) Truck identification;

(g) Time of arrival;

(h) Mass or volume; and

(i) Spread person's signature.

Use an approved format for the delivery record(s). Furnish the original record(s) and a written certification of the delivery of the material at the end of each shift.

109.05 Scope of Payment. Payment for all contract work is provided, either directly or indirectly, under the pay items shown in the bid schedule.

(a) Direct payment. Payment is provided directly under a pay item shown in the bid schedule when one of the following applies:

(1) The work is measured in the Measurement Subsection of the Section ordering the work, and the bid schedule contains a pay item for the work from the Section ordering the work.

(2) The Measurement Subsection, of the Section ordering the work, references another Section for measuring the work and the bid schedule contains a pay item for the work from the referenced Section.

(b) Indirect payment. Work for which direct payment is not provided is a subsidiary obligation of the Contractor. Payment for such work is indirectly included under other pay items shown in the bid schedule. This includes instances when the Section ordering the work references another Section for performing the work and the work is not referenced in the Measurement Subsection of the Section ordering the work.

Compensation provided by the pay items included in the contract bid schedule is full payment for performing all contract work in a complete and acceptable manner. All risk, loss, damage, or expense arising out of the nature or prosecution of the work is included in the compensation provided by the contract pay items.

Work measured and paid for under one pay item will not be paid for under any other pay item.

The quantities shown in the bid schedule are approximate unless designated as a contract quantity. Limit pay quantities to the quantities staked, ordered, or otherwise authorized before performing the work. Payment will be made for the actual quantities of work performed and accepted or material furnished according to the contract. No payment will be made for work performed in excess of that staked, ordered, or otherwise authorized.

109.06 Pricing of Adjustments. Determine all costs according to the contract cost principles and procedures of FAR Part 31. Follow the requirements of all FAR clauses providing for an equitable price adjustment.

If agreement on price cannot be reached, the CO may determine the price unilaterally.

If the work will delay contract completion, request a time extension according to Subsection 108.03.

(a) Proposal.

(1) General. Submit a written proposal for each line item of the work or a lump sum for the total work. Identify the major elements of the work, the quantity of the element, and its contribution to the proposed price. Provide further breakdowns if requested by the CO.

When price is based on actual costs (e.g., cost-plus-fixed-fee), profit is based on the estimated cost of the work and may not exceed the statutory limit of 10 percent of the total cost. Due to the limited risk in this type of pricing arrangement, a lower profit percentage may be indicated.

(2) Data. Submit information as requested by the CO to the extent necessary to permit the CO to determine the reasonableness of the proposed price.

(3) Cost or pricing data. When the contract modification exceeds the amount indicated in FAR Clause 52.214-27 Price Reduction for Defective Cost or Pricing Data - Modifications - Sealed Bidding, or FAR Clause 52.215-11 Price Reduction for Defective Cost or Pricing Data - Modifications, submit cost or pricing data.

Provide cost or pricing data, broken down by individual work item, for the Contractor and each major subcontractor. Include the information required by (b)(1) and (b)(2) below. When cost or pricing data is submitted before all or most of the work is performed, submit material and subcontractor quotes, anticipated labor and equipment usage, and anticipated production rates. Provide data for all proposed increases or decreases to the contract price.

Submit with the cost or pricing data a written proposal for pricing the work according to (1) above. See Table 15-2 following FAR Subpart 15.4 for guidance.

Upon completion of negotiations, certify the cost or pricing data as being accurate, complete, and current as of the date the agreement was reached.

(b) Postwork pricing. When negotiating the price of additional or changed work after all or most of the work has been performed, furnish the following:

(1) Direct costs.

(a) Material. Furnish invoices showing the cost of material delivered to the work.

(b) Labor. Show basic hourly wage rates, fringe benefits, applicable payroll costs (i.e., FICA, FUTA, worker's compensation, insurance, and tax levies), paid subsistence, and travel costs for each labor classification and foreman employed in the adjusted work.

(c) Equipment. Provide a complete descriptive listing of equipment including make, model, and year of manufacture. Support rented or leased equipment costs with invoices. Determine allowable ownership and operating costs for Contractor- and subcontractor-owned equipment as follows:

(1) Use actual equipment cost data when such data can be acceptably determined from the Contractor's or subcontractor's ownership and operating cost records.

(2) When actual costs cannot be determined, use the rates shown in *Construction Equipment Ownership and Operating Expense Schedules (CEOOES)* published by the U.S. Army Corps of Engineers for the area where costs are incurred. This document is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402-9325. Adjust the rates for used equipment and for other variable parameters used in the schedules.

(3) Compute proposed standby costs from acceptable ownership records or when actual costs cannot be determined, according to *CEOOES*. Do not exceed 8 hours in any 24-hour period or 40 hours in any calendar week. Do not include standby for periods when the equipment would have otherwise been in an idle status or for equipment that was not in operational condition.

(d) Other direct costs. Furnish documentation or invoices to support any other direct costs incurred that are not included above (e.g., bonds, mobilization, demobilization, permits, royalties, etc).

(e) Production rates. Provide actual hours of performance, on a daily basis, for each labor classification and for each piece of equipment.

(f) Subcontract costs. Provide supporting data as required above.

(2) Overhead. Identify overhead rate(s) and provide supporting data, which justifies the rate(s). List the types of costs, which are included in overhead. Identify the cost pool(s) to which overhead is applied. Apply the overhead to the appropriate pool.

Limit Contractor overhead applied to subcontractor payments to 5 percent of such payments unless a higher percentage is justified.

(3) Profit. Except when precluded by the FAR, include a reasonable profit reflecting the efficiency and economy of the Contractor and subcontractors in performing the work, the contract risk type, the work difficulty, and management effectiveness and diversity.

For work priced after all or most of the work is performed, profit is limited by statute to 10 percent of the total cost. Due to the limited risk in post-work pricing, a lower profit percentage may be indicated.

109.07 Eliminated Work. Follow the requirements of FAR Clause 52.243-4 Changes.

Work may be eliminated from the contract without invalidating the contract. The Contractor is entitled to compensation for all direct costs incurred before the date of elimination of work plus profit and overhead on the direct incurred costs. Anticipated profit and overhead expense on the eliminated work will not be compensated.

109.08 Progress Payments. Follow the requirements of FAR Clauses 52.232-5 Payments under Fixed-Price Construction Contracts and 52.232-27 — Prompt Payment for Construction Contracts.

(a) General. Only invoice payments will be made under this contract. Invoice payments include progress payments made monthly as work is accomplished and the final payment made upon final acceptance. Only one progress payment will be made each month. No progress payment will be made in a month in which the work accomplished results in a net payment of less than $1,000. Full or partial progress

payment will be withheld until a construction schedule or schedule update is submitted to, and accepted by, the CO.

(b) Closing date and invoice submittal date. The closing date for progress payments will be designated by the CO. Include work performed after the closing date in the following month's invoice. Submit invoices to the designated billing office.

(c) Invoice requirements. Submit the invoice to the Government's designated billing office. Include the following items in the invoice:

(1) The information required in FAR Clause 52.232-27(a)(2)(i) through (a)(2)(xi).

(2) A tabulation of total quantities and unit prices of work accomplished or completed on each pay item as of the monthly closing date. Do not include any quantities unless field note documentation for those quantities was submitted by the closing date. Do not include quantities of work involving material for which test reports required under Sections 153 or 154 or certifications required by Subsection 106.03 are, or will be, past due as of the closing date.

(3) The certification required by FAR Clause 52.232-5(c) and, if applicable, the notice required by FAR Clause 52.232-5(d). Provide an original signature on the certification. Facsimiles are not acceptable.

(4) If applicable, a copy of the notices that are required by FAR Clause 52.232-27(e)(5) and (g).

(5) The amount included for work performed by each subcontractor under the contract.

(6) The total amount of each subcontract under the contract.

(7) The amounts previously paid to each subcontractor under the contract.

(8) Adjustments to the proposed total payment that relate to the quantity and quality of individual items of work. Adjustments for the following may be made by the Government after validation of the invoice:

(a) Retent resulting from a failure to maintain acceptable progress;

(b) Retent resulting from violations of the labor provisions;

(c) Retent pending completion of incomplete work, other *"no pay"* work, and verification of final quantities;

(d) Obligations to the Government such as excess testing cost or the cost of corrective work pursuant to FAR Clause 52.246-12(g); or

(e) Liquidated damages for failure to complete work on time.

(d) Government's receiving report. The Government's receiving report will be developed using the measurement notes received by the CO and determined acceptable. Within 7 days after the closing date, the CO will be available by appointment at the Government's designated billing office to advise the Contractor of quantities and unit prices appearing on the Government's receiving report.

(e) Processing progress payment requests. No payment will be made for work unless field note documentation for the work was provided by the closing date.

(1) Proper invoices. If the invoice meets the requirements of Subsection 109.08(c), and the quantities and unit prices shown on the Contractor's invoice agree with the corresponding quantities and unit prices shown on the Government's receiving report, the invoice will be paid.

(2) Defective invoices. If the invoice does not meet the requirements of Subsection 109.08(c), or if any of the quantities or unit prices shown on the Contractor's invoice exceed the corresponding quantities and unit prices shown on the Government's receiving report, the invoice is defective, and the Contractor will be notified according to FAR Clause 52.232-27(a)(2). Defective invoices will be returned to the Contractor within 7 days after receipt by the Government's designated billing office. Correct and resubmit returned invoices. If the defects are minor, the Contractor may elect, in writing, to accept the quantities and unit prices shown on the Government's receiving report for payment.

(f) Partial payments. Progress payments may include partial payment for material to be incorporated in the work, provided the material meets the requirements of the contract and is delivered on, or in the vicinity of, the project site or stored in acceptable storage places.

Partial payment for material does not constitute acceptance of such material for use in completing items of work. Partial payments will not be made for living or perishable material until incorporated into the project.

Partial payments for material will not exceed the lesser of:

(1) 80 percent of the contract bid price for the item; or

(2) 100 percent of amount supported by copies of invoices submitted.

The quantity paid will not exceed the corresponding quantity estimated in the contract.

109.09 Final Payment. Follow the requirements of FAR Clause 52.232-5 Payment under Fixed-Price Construction Contracts and FAR Clause 52.232-27 Prompt Payment for Construction.

Upon final acceptance and verification of final pay records, the Government will send, by certified mail, a final voucher (SF 1034) and a release of claims document. Execute both the voucher and the release of claims, and return the documents to the Government for payment. The date of approval by the Government of the final voucher for payment constitutes the date of final settlement of the contract.

If unresolved claims exist or claims are proposed, reserve the right to the claims by listing a description of each claim and the amount being claimed on the release of claims document.

Failure to execute and return the voucher and release of claims document within 90 days after receipt shall constitute and be deemed execution of the documents and the release of all claims against the Government arising by virtue of the contract. In this event, the day after 90 days from receipt constitutes the date of final settlement of the contract.

DIVISION 150

PROJECT REQUIREMENTS

Section 151. — MOBILIZATION

Description

151.01 This work consists of moving personnel, equipment, material, and incidentals to the project and performing all work necessary before beginning work at the project site. Mobilization includes the obtaining of permits, insurance, and bonds.

Measurement

151.02 Measure mobilization according to Subsection 109.02.

Payment

151.03 The accepted quantity, measured as provided in Subsection 109.02, will be paid at the contract price per unit of measurement for the Section 151 pay item shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for mobilization lump sum will be paid as follows:

(a) Bond premiums will be reimbursed according to FAR Clause 52.232-5 Payments Under Fixed-Price Construction Contracts, after receipt of the evidence of payment.

(b) When 5 percent of the original contract amount is earned from other bid items, 50 percent of the mobilization item, or 5 percent of the original contract amount, whichever is less, will be paid.

(c) When 10 percent of the original contract amount is earned from other bid items, 100 percent of the mobilization item, or 10 percent of the original contract amount, whichever is less, will be paid.

(d) Any portion of the mobilization item in excess of 10 percent of the original contract amount will be paid after final acceptance.

Section 152. — CONSTRUCTION SURVEY AND STAKING

Description

152.01 This work consists of furnishing qualified personnel and necessary equipment and material to survey, stake, calculate, and record data for the control of work. See FAR Clause 52.236-17 Layout of Work.

Personnel, equipment, and material shall conform to the following:

(a) Personnel. Furnish technically qualified survey crews experienced in highway construction survey and staking. Provide personnel capable of performing in a timely and accurate manner. An acceptable crew supervisor shall be on the project whenever surveying/staking is in progress.

(b) Equipment. Furnish survey instruments and supporting equipment capable of achieving the specified tolerances.

(c) Material. Furnish acceptable tools, supplies, and stakes of the type and quality normally used in highway survey work and suitable for the intended use. Furnish stakes and hubs of sufficient length to provide a solid set in the ground with sufficient surface area above ground for necessary legible markings.

Construction Requirements

152.02 General. Include staking activities in the construction schedule submitted according to Section 155. Include the dates and sequence of each staking activity. The Government will set initial reference lines, will set horizontal and vertical control points, and will furnish the data for use in establishing control for completion of each element of the work. Data relating to horizontal and vertical alignment, theoretical slope stake catch points, and other design data will be furnished.

Before beginning construction, notify the CO of any missing initial reference lines, control points, or stakes. The Government will reestablish initial reference lines, control points, and stakes missing before the beginning of construction.

Perform additional calculations for convenient use of Government-furnished data. Provide immediate notification of apparent errors in the initial staking or in the furnished data.

Preserve all initial reference and control points. After beginning construction, replace all destroyed or disturbed initial reference or control points necessary to the work.

Before surveying or staking, discuss and coordinate the following with the CO:

(a) Surveying and staking methods;

(b) Stake marking;

(c) Grade control for courses of material;

(d) Referencing;

(e) Structure control; and

(f) Any other procedures and controls necessary for the work.

Survey and establish controls within the tolerances shown in Table 152-1.

Prepare field notes in an approved format. Furnish all survey notes at least weekly. All field notes and supporting documentation become the property of the Government upon completion of the work.

Start work only after staking for the affected work is accepted.

The construction survey and staking work may be spot-checked for accuracy, and unacceptable portions of work may be rejected. Resurvey rejected work, and correct work that is not within the tolerances specified in Table 152-1. Acceptance of the construction staking does not relieve the Contractor of responsibility for correcting errors discovered during the work and for bearing all additional costs associated with the error.

Remove and dispose of all flagging, lath, stakes, and other staking material after the project is complete.

152.03 Survey and Staking Requirements. Perform all survey, staking, recording of data, and calculations as necessary to construct the project from the initial layout to final completion. Reset stakes as many times as necessary to construct the work.

(a) Control points. Relocate initial horizontal and vertical control points in conflict with construction to areas that will not be disturbed by construction operations. Furnish the coordinates and elevations for the relocated points before the initial points are disturbed.

(b) Roadway cross-sections. Take roadway cross-sections normal to centerline. When the centerline curve radius is less than or equal to 500 feet, take cross-sections at a maximum centerline spacing of 25 feet. When the centerline curve radius is greater than 500 feet, take cross-sections at a maximum centerline spacing of 50 feet. Take additional cross-sections at significant breaks in topography and at changes in the typical section. Along each cross-section, measure and record points at breaks in topography, but no further apart than 20 feet. Measure and record points to at least the anticipated slope stake and reference locations. Reduce all cross-section distances to horizontal distances from centerline.

(c) Slope stakes and references. Set slope stakes and references on both sides of centerline at the cross-section locations. Establish slope stakes in the field as the actual point of intersection of the design roadway slope with the natural ground line. Set slope stake references outside the clearing limits. Include all reference point and slope stake information on the reference stakes. When initial references are provided, slope stakes may be set from these points with verification of the slope stake location with field measurements. Recatch slope stakes on any section that does not match the staking report within the tolerances established in Table 152-1. Take roadway cross-section data between centerline and the new slope stake location. Set additional references even when initial references are provided.

(d) Clearing and grubbing limits. Set clearing and grubbing limits on both sides of centerline at roadway cross-section locations.

(e) Centerline reestablishment. Reestablish centerline from instrument control points. The maximum spacing between centerline points is 25 feet when the centerline curve radius is less than or equal to 500 feet. When the centerline curve radius is greater than 500 feet, the maximum distance between centerline points is 50 feet.

(f) Grade finishing stakes. Set grade finishing stakes, for grade elevations and horizontal alignment, on centerline and on each shoulder at roadway cross-section locations. Set stakes at the top of subgrade and the top of each aggregate course.

Where turnouts are constructed, set stakes on centerline, on each normal shoulder, and on the shoulder of the turnout. In parking areas, set hubs at the center and along the edges of the parking area. Set stakes in all ditches to be paved.

The maximum longitudinal spacing between stakes is 25 feet when the centerline curve radius is less than or equal to 500 feet. When the centerline curve radius is greater than 500 feet, the maximum longitudinal spacing between stakes is 50 feet. The maximum transverse spacing between stakes is 20 feet. Use brushes or guard stakes at each stake.

(g) Culverts. Stake culverts to fit field conditions. The location of culverts may differ from the plans. Perform the following:

(1) Survey and record the ground profile along the culvert centerline.

(2) Determine the slope catch points at the inlet and outlet.

(3) Set reference points and record information necessary to determine culvert length and end treatments.

(4) Plot-to-scale the profile along the culvert centerline. Show the natural ground, the flow line, the roadway section, and the culvert including end treatments and other appurtenances. Show elevations, grade, culvert length, and degree of elbow.

(5) Submit the plotted field-design cross-section for approval of final culvert length and alignment.

(6) When the field design has been approved, set drainage structure survey stakes, reference stakes, and stake inlet and outlet ditches to make the structure functional.

(7) Stake or grade ditches to make the culvert functional.

(h) Bridges. Set adequate horizontal and vertical control and reference points for all bridge substructure and superstructure components. Establish and reference the bridge chord or the bridge tangent. Also establish and reference the centerline of each pier, bent, and abutment.

(i) Retaining walls. Survey and record profile measurements along the face of the proposed wall and 5 feet in front of the wall face. Every 25 feet along the length of the wall and at all major breaks in terrain take cross-sections within the limits designated by the CO. For each cross-section, measure and record points every 25 feet and at all major breaks in terrain. Set adequate references and horizontal and vertical control points.

(j) Borrow and waste sites. Perform the work essential for initial layout and measurement of the borrow or waste site. Establish a referenced baseline, site limits, and clearing limits. Survey and record initial and final cross-sections.

(k) Permanent monuments and markers. Perform all survey and staking necessary to establish permanent monuments and markers. Set permanent monuments according to Section 621.

(l) Miscellaneous survey and staking. Perform all surveying, staking, and recording of data essential for establishing the layout and control of the following, as applicable:

(1) Approach roads and trails;

(2) Curb and gutter;

(3) Guardrail;

(4) Parking areas;

(5) Paved waterways;

(6) Special ditches;

(7) Turf establishment;

(8) Utilities;

(9) Signs, delineators, and object markers; and

(10) Pavement markings.

Table 152-1
Construction Survey and Staking Tolerances[1]

Staking Phase	Horizontal	Vertical
Existing Government network control points	±0.06 feet	±0.035 feet $\times\sqrt{M}$ [2]
Local supplemental control points set from existing Government network points	±0.03 feet	±0.01 feet $\times\sqrt{N}$ [3]
Centerline points [4] — (PC), (PT), (POT), and (POC) including references	±0.03 feet	±0.03 feet
Other centerline points	±0.16 feet	±0.16 feet
Cross-section points and slope stakes [5]	±0.16 feet	±0.16 feet
Slope stake references [5]	±0.16 feet	±0.16 feet
Culverts, ditches, and minor drainage structures	±0.16 feet	±0.06 feet
Retaining walls and curb and gutter	±0.06 feet	±0.03 feet
Bridge substructures	±0.03 feet [6]	±0.03 feet
Bridge superstructures	±0.03 feet [6]	±0.03 feet
Clearing and grubbing limits	±2.00 feet	—
Roadway subgrade finish stakes [7]	±0.16 feet	±0.03 feet
Roadway finish grade stakes [7]	±0.16 feet	±0.03 feet

(1) At 95% confidence level. Tolerances are relative to existing Government network control points.
(2) M is the distance in miles.
(3) N is the number of instrument setups.
(4) Centerline points: PC - point of curve, PT - point of tangent, POT - point on tangent, POC - point on curve.
(5) Take the cross-sections normal to the centerline ±1 degree.
(6) Bridge control is established as a local network and the tolerances are relative to that network.
(7) Includes paved ditches.

152.04 Acceptance. Construction survey and staking will be evaluated under Subsections 106.02 and 106.04.

Measurement

152.05 Measure the Section 152 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure grade finishing stakes one time for the subgrade and one time for each aggregate course.

Do not measure resetting stakes.

For miscellaneous survey and staking paid by the hour, the minimum survey crew size is 2 persons. Do not measure time spent in making preparations, traveling to and from the project site, performing calculations, plotting cross-sections and other data, processing computer data, and other efforts necessary to successfully accomplish construction survey and staking.

Payment

152.06 The accepted quantities, as provided above, will be paid at the contract price per unit of measurement for the Section 152 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment for lump sum items will be prorated based on the total work completed.

Section 153. — CONTRACTOR QUALITY CONTROL

Description

153.01 This work consists of obtaining samples for Contractor quality control testing, performing tests for Contractor quality control, providing inspection, and exercising management control to ensure that work conforms to the contract requirements. See FAR Clause 52.246-12 Inspection of Construction.

Construction Requirements

153.02 Contractor Quality Control Plan. Before the start of the work, submit a written quality control plan for acceptance. With prior approval, submission of a quality control plan for items of work not immediately scheduled to begin may be deferred.

Submit the following with the quality control plan:

(a) Process control testing. List the material to be tested by pay item, tests to be conducted, the location of sampling, and the frequency of testing.

(b) Inspection/control procedures. Address each of the following subjects in each phase of construction:

(1) Preparatory phase.

(a) Review all contract requirements.

(b) Ensure compliance of component material to the contract requirements.

(c) Coordinate all submittals including certifications.

(d) Ensure capability of equipment and personnel to comply with the contract requirements.

(e) Ensure preliminary testing is accomplished.

(f) Coordinate surveying and staking of the work.

(2) Start-up phase.

(a) Review the contract requirements with personnel performing the work.

(b) Inspect start-up of work.

(c) Establish standards of workmanship.

(d) Provide training as necessary.

(e) Establish detailed testing schedule based on the production schedule.

(3) Production phase.

(a) Conduct intermittent or continuous inspection during construction to identify and correct deficiencies.

(b) Inspect completed work before requesting Government inspection acceptance.

(c) Provide feedback and system changes to prevent repeated deficiencies.

(c) Description of records. List the records to be maintained.

(d) Personnel qualifications.

(1) Document the name, authority, relevant experience, and qualifications of person with overall responsibility for the inspection system.

(2) Document the names, authority, and relevant experience of all personnel directly responsible for inspection and testing.

(e) Subcontractors. Include the work of all subcontractors. If a subcontractor is to perform work under this Section, detail how that subcontractor will interface with the Contractor's and other subcontractor's organizations.

Modifications or additions may be required to any part of the plan that is not adequately covered. Acceptance of the quality control plan will be based on the inclusion of the required information. Acceptance does not imply any warranty by the Government that the plan will result in consistent contract compliance. It remains the responsibility of the Contractor to demonstrate such compliance.

Do not begin the work until the quality control plan covering that work is accepted.

Supplement the plan as work progresses and whenever quality control or quality control personnel changes are made.

153.03 Testing. Perform testing according to the accepted quality control plan. Keep laboratory facilities clean and maintain all equipment in proper working condition. Allow unrestricted access for inspection and review of the facility.

153.04 Records. Maintain complete testing and inspection records by pay item number and make them accessible to the CO.

For each day of work, prepare an *"Inspector's Daily Record of Construction Operations"* (Form FHWA 1413) or an approved alternate form. Detail inspection results including deficiencies observed and corrective actions taken. Include the following certification signed by the person with overall responsibility for the inspection system:

"It is hereby certified that the information contained in this record is accurate and that all work documented herein complies with the requirements of the contract. Any exceptions to this certification are documented as a part of this record."

Submit the record and certification within one working day of the work being performed. If the record is incomplete, in error, or otherwise misleading, a copy of the record will be returned with corrections noted. When chronic errors or omissions occur, correct the procedures by which the records are produced.

Maintain linear control charts that identify the project number, pay item number, test number, each test parameter, the upper and lower specification limit applicable to each test parameter, and the test results. Use the control charts as part of the quality control system to document the variability of the process, to identify production and equipment problems, and to identify potential pay factor adjustments.

Post control charts in an accessible location and keep them up-to-date. Cease production and make corrections to the process when problems are evident.

153.05 Acceptance. The Contractor's quality control system will be evaluated under Subsection 106.02 based on the demonstrated ability of the quality control system to result in work meeting the contract requirements.

If the Government's testing and inspection indicate that the Contractor's quality control system is ineffective, make immediate improvements to the system to correct these inadequacies. Furnish notification in writing of improvements and modifications to the system.

Measurement and Payment

153.06 Do not measure Contractor quality control for payment.

Section 154. — CONTRACTOR SAMPLING AND TESTING

Description

154.01 This work consists of obtaining samples for testing. When there is a contract pay item for Contractor testing included in the bid schedule, it also consists of testing and reporting required test results. It does not include Contractor quality control testing required under Section 153. However, include the work required under this Section in the Section 153 quality control plan.

Construction Requirements

154.02 Sampling. Sample material to be tested according to the Sampling and Testing Requirements tables included at the end of each section. The sampling schedules and times will be provided by the CO using a random number system. In addition, sample any material that appears defective or inconsistent with similar material being produced unless such material is voluntarily removed and replaced or corrected.

Sample and split samples according to AASHTO or other acceptable procedures. Allow the CO the opportunity to witness all sampling. Immediately perform splits when required. Deliver the Government's portion of the sample or split sample in an acceptable container suitable for shipment. Label all samples with the following information:

(a) Project number;

(b) Source of material;

(c) Pay item number;

(d) Sample number;

(e) Date sampled;

(f) Time sampled;

(g) Location sample taken;

(h) Name of person sampling;

(i) Name of person witnessing sampling; and

(j) Type of test required on sample.

154.03 Testing. When there is a contract pay item for Contractor testing included in the bid schedule, perform all tests required by the Sampling and Testing Requirements tables at the end of each section. Allow the CO the opportunity to witness all testing. Testing of trial samples may be required to demonstrate testing competence.

154.04 Records. Report test results on forms containing all sample information required by Subsection 154.02. Label clearly all interim measurements used to determine the results. Attach work sheets used to determine test values to the test result forms when submitted. When tests are on material being incorporated in the work, report test results within 24 hours except as specified in the Sampling and Testing Requirements tables. Payment for work may be delayed or the work suspended until test results are provided.

154.05 Acceptance. Contractor sampling and testing will be evaluated under Subsections 106.02 and 106.04 based on Government verification testing.

Measurement

154.06 Measure the Section 154 items listed in the bid schedule according to Subsection 109.02.

Payment

154.07 The accepted quantities will be paid at the contract price per unit of measurement for the Section 154 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for Contractor testing will be paid as follows:

(a) 25 percent of the item amount, not to exceed 0.5 percent of the original contract amount, will be paid after all the testing facilities are in place, qualified sampling and testing personnel are identified, and the work being tested has started.

(b) Payment for the remaining portion of the item amount will be prorated based on the total work completed.

Payment for all or part of this item may be retained if Government verification testing invalidates the Contractor testing.

Section 155. — SCHEDULES FOR CONSTRUCTION CONTRACTS

Description

155.01 This work consists of scheduling and monitoring all construction activities. See FAR Clause 52.236-15 Schedules for Construction Contracts.

Construction Requirements

155.02 General. Submit 3 copies of a preliminary construction schedule at least 7 days before the preconstruction conference.

A preliminary construction schedule is a written narrative with a detailed breakdown of all contract activities for the first 45 days after the notice to proceed is issued. Within 7 days after the preconstruction conference, the preliminary construction schedule will be accepted or rejected. If rejected, submit a revised schedule within 3 days. Do not begin work, except mobilization, traffic control, and Section 637 work, without an accepted preliminary construction schedule.

Use either the Bar Chart Method (BCM) or the Critical Path Method (CPM) described below to develop the construction schedule for the total contract work. Preface each construction schedule as follows:

(a) Project name;

(b) Contract number;

(c) Contractor;

(d) Original contract time allowed or completion date;

(e) Type of construction schedule (initial or update);

(f) Effective date of the schedule;

(g) Percent work complete; and

(h) Percent time used.

Submit 3 copies of the construction schedule within 30 days after the notice to proceed is issued. Allow 14 days for acceptance or rejection of the construction schedule or a revised schedule. If rejected, submit a revised schedule within 7 days. No progress payment will be made for any work until a construction schedule is submitted to the CO and accepted by the CO.

Do not show conflicts with any scheduled activities, limits on operations, order of work requirements, interim or final completion dates, or other contract restrictions.

Show completion of the work within the contract time.

155.03 Bar Chart Method (BCM). The BCM construction schedule consists of a progress bar chart and a written narrative.

(a) Progress bar chart. The following applies to the initial submission and all updates:

(1) Use a time scale to graphically show the percentage of work scheduled for completion during the contract time.

(2) Define and relate activities to the contract pay items.

(3) Show all activities in the order the work is to be performed including submittals, submittal reviews, fabrication, and delivery.

(4) Show all critical (major) activities that are controlling factors in the completion of the work.

(5) Show the time needed to perform each activity and its relationship in time to other activities.

(6) Show the total expected time to complete all work.

(7) Provide enough space for each activity to permit 2 additional plots parallel to the original time span plot. Use one space for revision of the planned time span, and one for showing actual time span achieved.

(b) Written narrative. Furnish a written narrative of the activities displayed in the progress bar chart.

155.04 Critical Path Method (CPM). The CPM construction schedule consists of a diagram, a tabulated schedule, and a written narrative.

(a) Diagram. Use the *"activity-on-arrow"* format for the arrow diagrams or the *"activity-on-node"* format for precedence diagrams. The following applies to the initial submission and all updates:

(1) Use a time scale to graphically show the percent of work scheduled for completion by any given date during the contract time.

(2) Define and relate activities to the contract pay items.

(3) Show the sequence and interdependence of all activities including submittals, submittal reviews, fabrication, and deliveries.

(4) Show all activity nodes, activity descriptions, and durations.

(5) Show all network dummies (for arrow diagrams only).

(6) Identify the critical path.

(b) Tabulated schedule. The following requirements apply to the tabulated schedule:

(1) For arrow diagrams, show activity beginning and ending node numbers. For precedence diagrams, list activities and show lead or lag times.

(2) Show activity durations.

(3) Show activity descriptions.

(4) Show early start and finish dates.

(5) Show late start and finish dates.

(6) Show status (critical or not).

(7) Show total float.

(c) Written narrative. Furnish a written narrative of the activities displayed in the schedule diagram.

155.05 Written Narrative. The following applies to the written narrative:

(a) Estimate starting and completion dates of each activity.

(b) Describe work to be done within each activity including the type and quantity of equipment, labor, and material to be used.

(c) Describe the location on the project where each activity occurs.

(d) Describe planned production rates by pay item quantities (e.g., cubic yards of excavation per day/week).

(e) Describe work days per week, holidays, number of shifts per day, and number of hours per shift.

(f) Estimate any periods during which an activity is idle or partially idle. Show the beginning and end dates for reduced production or idle time.

(g) Describe expected and critical delivery dates for equipment or material that can affect timely completion of the project.

(h) Describe critical completion dates for maintaining the construction schedule.

(i) Identify the vendor, supplier, or subcontractor to perform the activity. State all assumptions made in the scheduling of the subcontractor's or supplier's work.

155.06 Schedule Updates. Review the construction schedule to verify finish dates of completed activities, remaining duration of uncompleted activities, any proposed logic, and time estimate revisions. Keep the CO informed of the current construction schedule and all logic changes.

Submit 3 copies of an updated construction schedule for acceptance at least every 8 weeks or when:

(a) A delay occurs in the completion of a critical (major) activity;

(b) A delay occurs which causes a change in the critical path for CPM schedules or a change in a critical activity for BCM schedules;

(c) The actual prosecution of the work is different from that represented on the current construction schedule;

(d) There is an addition, deletion, or revision of activities caused by a contract modification; or

(e) There is a change in the schedule logic.

Allow 7 days after receipt for acceptance of the updated construction schedule or a return for revisions.

No progress payment will be made for any work until an updated construction schedule has been submitted to, and accepted by, the CO.

155.07 Acceptance. Construction schedules will be evaluated under Subsection 106.02.

Measurement

155.08 Measure the Section 155 items listed in the bid schedule according to Subsection 109.02.

Payment

155.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 155 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for construction schedule will be paid as follows:

(a) 25 percent of the item amount, not to exceed one percent of the original contract amount, will be paid after the construction schedule is accepted.

(b) Payment of the remaining portion of the lump sum will be prorated based on the total work completed.

Section 156. — PUBLIC TRAFFIC

Description

156.01 This work consists of controlling and protecting public traffic adjacent to and within the project. See FAR Clause 52.236-13 Accident Prevention.

Material

156.02 Conform to the following Section:

Temporary traffic control	635

Construction Requirements

156.03 Accommodating Traffic During Work. Accommodate traffic according to the contract traffic control plan, MUTCD, Section 635, and this Section. The Contractor may submit an alternate traffic control proposal. Submit alternate traffic control proposals according to Subsection 104.03 for acceptance at least 30 days before intended use.

Perform work in a manner that ensures the safety and convenience of the public and protects the residents and property adjacent to the project. Accommodate public traffic on roads adjacent to and within the project until the project is accepted according to Subsection 106.07(b).

156.04 Maintaining Roadways During Work. Perform roadway maintenance as follows:

(a) Construct and remove diversion roads and bridges as required by the traffic control plan.

(b) Maintain intersections with trails, roads, streets, businesses, parking lots, residences, garages, farms, and other features.

(c) Snow removal to facilitate the work is the Contractor's responsibility. Snow removal to provide public access is the responsibility of the maintaining agency and will be performed at the maintaining agency's discretion. Allow the maintaining agency access to perform snow removal.

(d) Maintain a dust-free traveled way such that visibility and air quality are not affected and a hazardous condition is not created.

(e) Remove accumulations of soil and other material from traveled way.

(f) Maintain the roadway, detours, and diversions in a safe and acceptable condition. If corrective action is requested and the corrective action is not taken immediately, the condition may be corrected and the cost of the corrective action deducted from monies due the Contractor.

156.05 Maintaining Roadways During Non-Work Periods. Maintain roadways and traffic control for public traffic during all periods when work is not in progress. Snow removal to provide public access is the responsibility of the maintaining agency.

156.06 Limitations on Construction Operations. When the roadway is open to public traffic, restrict operations as follows:

(a) Operate equipment in the direction of traffic, where practical.

(b) For shoulder drop-offs in excess of 2 inches, provide *"Low Shoulder"* warning signs. For shoulder drop-offs in excess of 4 inches, provide a 1V:3H fillet with *"Low Shoulder"* warning signs. Complete the construction of shoulders adjacent to traffic lanes to the same elevation within 14 days.

(c) Provide minimum lane widths of 10 feet. Use barricades, drums, or other acceptable devices to delineate traffic lanes through areas where the edge of pavement or intended path has been obliterated by construction operations.

(d) Locate staging areas at least 30 feet from the traveled way or behind acceptable traffic barriers. Obtain approval of the location and access to staging areas. Store unused traffic control devices at staging areas.

(e) Park equipment at least 30 feet from the traveled way or behind acceptable traffic barriers.

(f) Provide parking areas for employees' personal vehicles in approved areas.

(g) Provide two-way radio communications between flaggers and also between flaggers and pilot cars unless flaggers are able to see each other and communicate. Citizen band radios are not acceptable. Make radio equipment available to the CO as necessary.

(h) Where switching traffic to a completed lane, provide adequate personnel and equipment to set or relocate traffic control devices.

(i) Limit construction-caused delays to public traffic to a maximum of 30 minutes per passage through the project.

(j) Maintain existing guardrails, barriers, and bridge railings until removal is necessary for construction. Use a temporary barrier or appropriate channelizing devices while the guardrails and bridge rails are absent. Install permanent barriers, guardrails, and bridge rails as soon as possible to minimize risk to the public.

156.07 Nighttime Operations. Perform construction operations during the hours of daylight (½ hour after sunrise to ½ hour before sunset).

Where night operations are permitted, submit a night lighting system for approval. Include the light types, locations, and the manner in which the lights will be moved. Submit the proposed system at least 14 days before use. Use an independent source other than vehicle headlights. Do not use incandescent lights. Furnish and install the approved system to illuminate the entire work area. Position the lights so they do not shine directly at motorists traveling from any direction. If the operation is moving, move the lighting with the operation. Provide lighting at each flagger location. Equip all vehicles with an exterior flashing yellow dome light.

156.08 Traffic and Safety Supervisor. Provide a traffic and safety supervisor who is certified by a State highway agency or other acceptable certification program. Do not designate the superintendent as the traffic safety supervisor. Furnish the traffic safety supervisor's name, address, and 24-hour telephone number(s) at the preconstruction conference. At all times during the contract, including periods of suspensions and work stoppages, perform all of the following:

(a) Implement the traffic control plans.

(b) Coordinate traffic control operations, including those of subcontractors and suppliers.

(c) Ensure the condition, position, and applicability of traffic control devices in use.

(d) Immediately correct traffic control deficiencies.

(e) Coordinate traffic control maintenance operations with the CO.

(f) Ensure unused traffic control devices are properly handled and stored.

(g) Conduct weekly traffic safety meetings for construction workers, and invite the CO to these weekly meetings.

(h) Furnish a weekly certification that inspections and reviews were conducted and that the traffic control devices meet contract requirements. Include the number and types of devices in use. Report with the weekly certification, all changes or corrective actions taken to ensure the safe passage of public traffic through the project.

156.09 Acceptance. Public traffic work will be evaluated under Subsection 106.02.

Traffic control devices and services will be evaluated under Section 635.

Measurement and Payment

156.10 See Subsection 109.05.

Measure traffic control under Section 635.

Measure dust abatement under Section 158 or 306.

Measure diversion construction, required by the contract, under the applicable Sections.

Section 157. — SOIL EROSION CONTROL

Description

157.01 This work consists of furnishing, constructing, and maintaining permanent and temporary erosion and sediment control measures.

Material

157.02 Conform to the following Subsections:

Backfill material	704.03
Erosion control bales, wattles, logs, and rolls	713.13
Erosion control culvert pipe	713.15
Fertilizer	713.03
Geotextile	714.01
Mulch	713.05
Plastic lining	725.19
Riprap	251.02
Sandbags	713.14
Seed	713.04
Silt fence	713.16
Water	725.01

Construction Requirements

157.03 General. Provide permanent and temporary erosion control measures to minimize erosion and sedimentation during and after construction according to the contract erosion control plan, contract permits, Section 107, and this Section. Contract permits amend the requirements of this Section. Do not modify the type, size, or location of any control or practice without approval.

The contract erosion control plan reflects special concerns and measures to protect resources. An alternate erosion control proposal, with all necessary permits, may be submitted for acceptance according to Subsection 104.03. Submit alternate erosion control proposals at least 30 days before their intended use.

When erosion control measures are not functioning as intended, immediately take corrective action.

157.04 Controls and Limitations on Work. Before grubbing and grading, construct all erosion controls around the perimeter of the project including filter barriers, diversion, and settling structures.

Limit the combined grubbing and grading operations area to 350,000 square feet of exposed soil at one time.

Construct erosion control and sediment control measures as follows:

(a) Construct temporary erosion controls in incremental stages as construction proceeds.

(b) Construct temporary slope drains, diversion channels, and earth berms to protect disturbed areas and slopes.

(c) Unless a specific seeding season is identified in the contract, apply permanent turf establishment to the finished slopes and ditches within 14 days according to Sections 624 and 625.

(d) Apply temporary turf establishment, mulch, or other approved measures on disturbed areas within 14 days after the last disturbance except where:

(1) The area will be disturbed within 21 days after last disturbance.

(2) When initial stabilization is precluded by snow cover or by seasonal arid conditions in arid or semi-arid areas (average annual rainfall of 20 inches or less).

(e) Construct outlet protection as soon as culverts or other structures are complete.

(f) Construct permanent erosion controls including waterway linings and slope treatments as soon as practical or upon completion of the roadbed.

(g) Construct and maintain erosion controls on and around soil stockpiles to prevent soil loss.

(h) Following each day's grading operations, shape earthwork to minimize and control erosion from storm runoff.

157.05 Filter Barriers. Construct silt fence, bales, wattles, logs, rolls, and brush barriers for filtering sediment from runoff and reducing the velocity of sheet flow. Conserve brush from clearing operations to construct brush barriers.

157.06 Sediment Retention Structures. Construct sediment retention structures of the following types:

(a) Temporary sediment traps. Construct temporary sediment traps to detain runoff from disturbed areas and settle out sediment. Provide outlet protection.

(b) Sediment basins. Construct sediment basins to store runoff and settle out sediment for large drainage areas. Excavate and construct sediment basins according to Section 204. Construct riser pipes according to Section 602. Provide outlet protection.

157.07 Outlet Protection. Construct riprap aprons or basins to reduce water velocity and prevent scour at the outlet of permanent and temporary erosion control measures. Construct riprap according to Section 251.

157.08 Water Crossings. Construct temporary culvert pipe at temporary crossings where construction vehicles cross a live waterway.

157.09 Diversions. Construct temporary channels, temporary culverts, earth berms, or sandbags to divert water around disturbed areas and slopes. Use temporary channels, temporary culverts, pumps, sandbags, or other methods to divert the flow of live streams for permanent culvert installations and other work. Stabilize channels according to Subsection 157.10. Provide outlet protection.

157.10 Waterway and Slope Protection and Stabilization. Use plastic lining, riprap, check dams, erosion control blankets and mats, and temporary slope drains as follows:

(a) Plastic lining. Use plastic lining to protect underlying soil from erosion. Place the plastic lining loosely on a smooth soil surface free of projections or depressions that may cause the liner to puncture or tear. Lap transverse joints a minimum of 36 inches in the direction of flow. Do not use longitudinal joints. Anchor the lining in place using riprap.

(b) Riprap. Construct riprap for channel lining according to Section 251.

(c) Check dams. Construct riprap, sandbags, or earth berms for temporary dams to reduce the velocity of runoff in ditches and swales.

(d) Rolled erosion control products. Use rolled erosion control products to stabilize waterways and slopes before or after temporary or permanent seeding. Install according to Section 629.

(e) Temporary slope drains. Use drainpipe, riprap, or plastic lined waterway for temporary slope drains to channel runoff down slopes. Channel water into the slope drain with an earth berm constructed at the top of a cut or fill. Anchor slope drains to the slope. Provide outlet protection.

157.11 Temporary Turf Establishment. Apply seed, fertilizer, and mulch for soil erosion protection at the rates shown in Table 157-1. Protect and care for seeded areas, including watering, until permanent turf establishment is in place.

Table 157-1
Application Rates for Temporary Turf Establishment

Material	Application Rate pounds/acre
Seed	35
Fertilizer	335
Mulch	1350

157.12 Inspection and Reporting. Inspect all erosion control facilities at least every 7 days, within 24 hours after more than 3/8 inch of rain in a 24-hour period, and as required by the contract permits.

Within 24 hours, furnish inspection reports to the CO which include all of the following:

(a) Summary of the inspection;

(b) Names of personnel making the inspection;

(c) Date and time of inspection;

(d) Observations made; and

(e) Corrective action necessary, action taken, and date and time of action.

157.13 Maintenance and Cleanup. Maintain temporary erosion control measures in working condition until the project is complete or the measures are no longer needed. Clean erosion control measures when half full of sediment. Use the sediment in the work, if acceptable, or dispose of it according to Subsection 204.14.

Replace erosion control measures that cannot be maintained and those that are damaged by construction operations.

Remove and dispose of temporary erosion control measures when the vegetation is satisfactorily established and drainage ditches and channels are lined and stabilized. Remove and dispose of erosion control measures according to Subsection 203.05.

Restore the ground to its natural or intended condition and provide permanent erosion control measures.

157.14 Acceptance. Material for soil erosion control measures will be evaluated under Subsections 106.02 and 106.03.

Construction, maintenance, and removal of soil erosion control measures will be evaluated under Subsections 106.02 and 106.04.

Geotextile will be evaluated under Section 207.

Measurement

157.15 Measure the Section 157 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Do not measure replacement items.

Measure temporary turf establishment by the acre on the ground surface. When measurement is by the pound, weigh the seed in pounds.

Measure excavation for diversion channels and sediment basins under Section 204.

Measure riprap under Section 251.

Measure permanent paved waterways under Section 608.

Measure permanent slope paving under Section 616.

Measure topsoil under Section 624.

Measure permanent turf establishment under Section 625.

Measure rolled erosion control products under Section 629.

Payment

157.16 The accepted quantities will be paid at the contract price per unit of measurement for the Section 157 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for erosion control measures will be made as follows:

(a) 50 percent of the unit bid price will be paid upon installation.

(b) An additional 25 percent of the unit bid price will be paid following completion of 50 percent of the contract amount.

(c) Payment of the remaining portion of the unit bid price will be paid when the temporary erosion control measures are removed from the project.

Section 158. — WATERING FOR DUST CONTROL

Description

158.01 This work consists of furnishing and applying water for the control of dust caused by the work and public travel.

Material

158.02 Conform to the following Subsection:

Water	725.01

Construction Requirements

158.03 General. Provide an adequate water supply and apply water needed at all hours (including nights, weekends, and periods of nonwork) as necessary to control dust. Uniformly apply water using pressure-type distributors, pipelines equipped with spray systems, or hoses with nozzles.

(a) Project dust control for public benefit. Control dust within the construction limits at all hours when the project is open to public traffic. When the project is not open to public traffic, control dust in areas of the project which neighbor inhabited residences or places of business. Control dust on approved, active detours established for the project. Apply water at the locations, rates, and frequencies ordered by the CO.

(b) Other dust control. Control dust on active haul roads, in pits and staging areas, and on the project during all periods not covered in (a) above.

158.04 Acceptance. Furnishing and placing water will be evaluated under Subsection 106.02.

Measurement

158.05 Measure the Section 158 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure water for dust control by the cubic yard in the hauling vehicle or by metering.

Do not measure water for dust control applied according to Subsection 158.03(b).

Payment

158.06 The accepted quantities will be paid at the contract price per unit of measurement for the Section 158 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

DIVISION 200

EARTHWORK

Section 201. — CLEARING AND GRUBBING

Description

201.01 This work consists of clearing and grubbing within the clearing limits designated on the plans.

Material

201.02 Conform to the following Subsections:

Backfill material	704.03
Tree wound dressing	713.08(g)

Construction Requirements

201.03 General. Construct erosion control measures according to Section 157. Perform work within designated limits. Do not damage vegetation designated to remain. If vegetation designated to remain is damaged or destroyed, repair or replace the vegetation in an acceptable manner. Where possible, preserve all vegetation adjacent to bodies of water. Treat cuts or scarred surfaces of trees and shrubs with tree wound dressing.

201.04 Clearing. Within the clearing limits, clear trees, brush, downed timber, and other vegetation as follows:

(a) Cut all trees so they fall within the clearing limits.

(b) In areas of cut slope rounding, cut stumps flush with or below the final groundline.

(c) In areas outside the excavation, embankment, and slope rounding limits, cut stumps to within 6 inches of the ground.

(d) Trim tree branches that extend over the road surface and shoulders to attain a clear height of 20 feet. If required, remove other branches to present a balanced appearance. Trim according to accepted tree surgery practices. Treat wounds with tree wound dressing.

201.05 Grubbing. Grub deep enough to remove stumps, roots, buried logs, moss, turf, or other vegetative debris as follows:

(a) Grub all areas to be excavated except for cut slope rounding areas.

(b) Grub all embankment areas. Undisturbed stumps may be left in place if they protrude less than 6 inches above the original ground and will be covered with more than 4 feet of embankment.

(c) Grub pits, channel changes, and ditches only to the depth necessary for the excavation.

(d) Backfill stump holes and other grubbing holes with backfill material to the level of the surrounding ground according to Subsection 209.10. Compact backfill according to Subsection 209.11.

201.06 Disposal. Merchantable timber is the Contractor's property. Dispose of clearing and grubbing debris according to Subsection 203.05.

201.07 Acceptance. Clearing and grubbing will be evaluated under Subsection 106.02.

Material for tree wound dressing will be evaluated under Subsection 106.03.

Backfilling and compacting of stumps and grubbing holes will be evaluated under Section 209.

Measurement

201.08 Measure the Section 201 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Do not make deductions from the area computation unless excluded areas are identified in the contract.

Do not measure clearing and grubbing of borrow or material sources.

Payment

201.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 201 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 202. — ADDITIONAL CLEARING AND GRUBBING

Description

202.01 This work consists of clearing and grubbing outside the clearing limits specified in Section 201. It includes scalloping clearing lines, clearing vistas, thinning vegetation, special clearing and grubbing, and the removal of individual trees and stumps.

202.02 Definitions.

(a) Selective clearing. Clearing where some trees and vegetation is designated to remain.

(b) Selective clearing and grubbing. Clearing and grubbing where some trees and vegetation is designated to remain.

(c) Special clearing and grubbing. Clearing and grubbing where all trees and vegetation are removed.

(d) Removal of individual trees or stumps. Removing individual trees or stumps outside the clearing limits designated in Section 201 or outside areas designated in (a) through (c) above.

Construction Requirements

202.03 General. Clear and grub according to Section 201 except as modified herein. Do not push, pull, or fall trees into trees designated to remain. Remove designated debris by methods that prevent damage to vegetation not designated to be removed. Dispose of clearing and grubbing debris according to Subsection 203.05.

202.04 Selective Clearing. Clear and dispose of all trees, snags, brush, downed timber, and other vegetation designated to be removed.

202.05 Selective Clearing and Grubbing. Clear, grub, and dispose of all trees, snags, brush, downed timber, stumps, roots, buried logs, moss, turf, grass, and other vegetation designated to be removed.

202.06 Special Clearing and Grubbing. Clear, grub, and dispose of all trees, snags, brush, downed timber, stumps, roots, buried logs, moss, turf, grass, and other vegetation.

202.07 Removal of Individual Trees or Stumps. Remove and dispose of all designated trees or stumps.

202.08 Acceptance. Additional clearing and grubbing work will be evaluated under Subsection 106.02 and Section 201.

Measurement

202.09 Measure the Section 202 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure removal of individual trees based on the average diameter at the cutoff. Do not measure trees less than 6 inches in diameter at the cutoff.

Payment

202.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 202 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 203. — REMOVAL OF STRUCTURES AND OBSTRUCTIONS

Description

203.01 This work consists of salvaging, removing, and disposing of buildings, fences, structures, pavements, culverts, utilities, curbs, sidewalks, and other obstructions.

Material

203.02 Conform to the following Section and Subsection:

Backfill material	704.03
Concrete	601

Construction Requirements

203.03 Salvaging Material. Salvage, with reasonable care, all material designated to be salvaged. Salvage in readily transportable sections or pieces. Replace or repair all members, pins, nuts, plates, and related hardware damaged, lost, or destroyed during the salvage operation. Wire all loose parts to adjacent members or pack them in sturdy boxes with the contents clearly marked.

Match mark members of salvaged structures. Furnish one set of drawings identifying the members and their respective match marks.

Stockpile salvaged material at a designated area on the project.

203.04 Removing Material. Saw cut sidewalks, curbs, pavements, and structures when partial removal is required.

Construct structurally adequate debris shields to contain debris within the construction limits. Do not permit debris to enter waterways, travel lanes open to public traffic, or areas designated not to be disturbed.

Raze and remove all buildings, foundations, pavements, sidewalks, curbs, fences, structures, and other obstructions interfering with the work and not designated to remain.

Where part of an existing culvert is removed, remove the entire culvert upstream from the removal. The remaining downstream culvert may be left in place if no portion of the culvert is within 4 feet of the subgrade, embankment slope, or new culvert or structure; and the culvert ends are sealed with concrete.

Remove structures and obstructions in the roadbed to 3 feet below subgrade elevation. Remove structures and obstructions outside the roadbed to 2 feet below finished ground or to the natural stream bottom.

Abandon existing manholes, inlets, catch basins, and spring boxes according to Subsection 604.07.

Except in excavation areas, backfill and compact cavities left by structure removal with backfill material to the level of the finished ground. Backfill excavated areas according to Subsection 209.10. Compact backfill according to Subsection 209.11.

203.05 Disposing of Material. Dispose of debris and unsuitable and excess material as follows:

(a) Remove from project. Recycle or dispose of material legally off the project. Furnish a statement documenting the nature and quantity of material processed or sold for recycling. Otherwise, furnish a signed copy of the disposal agreement before disposal begins.

(b) Burn. Obtain necessary burning permits. Furnish a copy of the burning permits before burning begins.

Burn using high intensity burning processes that produce few emissions. Examples include incinerators, high stacking, or pit and ditch burning with forced air supplements. Provide a competent watchperson during the burning operations.

When burning is complete, extinguish the fire so no smoldering debris remains. Dispose of unburned material according to (a) above.

(c) Bury. Bury debris in trenches or pits in approved areas within the right-of-way. Do not bury debris inside the roadway prism limits, beneath drainage ditches, or in any areas subject to free-flowing water.

Place debris in alternating layers of 4 feet of debris covered with 2 feet of earth material. Distribute stumps, logs, and other large pieces to form a dense mass and minimize air voids. Cover the top layer of buried debris with at least 1 foot of compacted earth. Grade and shape the area. Seed and mulch disposal areas on Government property according to Section 625.

(d) Hazardous material. Furnish a copy of all disposal permits. Dispose of material according to Federal, State, and local regulations.

203.06 Acceptance. Removal of structures and obstructions will be evaluated under Subsection 106.02.

Backfilling and compacting cavities left by structures will be evaluated under Section 209.

Concrete will be evaluated under Section 601.

Measurement

203.07 Measure the Section 203 items listed in the bid schedule according to Subsection 109.02.

Payment

203.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 203 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 204. — EXCAVATION AND EMBANKMENT

Description

204.01 This work consists of excavating material and constructing embankments. This includes furnishing, hauling, stockpiling, placing, disposing, sloping, shaping, compacting, and finishing earthen and rocky material.

204.02 Definitions.

(a) Excavation. Excavation consists of the following:

(1) Roadway excavation. All material excavated from within the right-of-way or easement areas, except subexcavation covered in (2) below and structure excavation covered in Sections 208 and 209. Roadway excavation includes all material encountered regardless of its nature or characteristics.

(2) Subexcavation. Material excavated from below subgrade elevation in cut sections or from below the original groundline in embankment sections. Subexcavation does not include the work required by Subsections 204.05, 204.06(b), and 204.06(c).

(3) Borrow excavation. Material used for embankment construction that is obtained from outside the roadway prism. Borrow excavation includes unclassified borrow, select borrow, and select topping.

(b) Embankment construction. Embankment construction consists of placing and compacting roadway or borrow excavation. This work includes:

(1) Preparing foundation for embankment;

(2) Constructing roadway embankments;

(3) Benching for side-hill embankments;

(4) Constructing dikes, ramps, mounds, and berms; and

(5) Backfilling subexcavated areas, holes, pits, and other depressions.

(c) Conserved topsoil. Excavated material conserved from the roadway excavation and embankment foundation areas that is suitable for growth of grass, cover crops, or native vegetation.

(d) Waste. Excess and unsuitable roadway excavation and subexcavation that cannot be used.

Material

204.03 Conform to the following Subsections:

Backfill material	704.03
Select borrow	704.07
Select topping	704.08
Topping	704.05
Unclassified borrow	704.06
Water	725.01

Construction Requirements

204.04 Preparation for Roadway Excavation and Embankment Construction. Clear the area of vegetation and obstructions according to Sections 201 and 203.

204.05 Conserved Topsoil. Conserve topsoil from roadway excavation and embankment foundation areas. Stockpile conserved topsoil in low windrows immediately beyond the rounding limits of cut and embankment slopes or in other approved locations. Separate topsoil from other excavated material.

Place conserved topsoil on completed slopes according to Section 624.

204.06 Roadway Excavation. Excavate as follows:

(a) General. Do not disturb material and vegetation outside the construction limits.

Incorporate only suitable material into embankments. Replace any shortage of suitable material caused by premature disposal of roadway excavation. Dispose of unsuitable or excess excavation material according to Subsection 204.14.

At the end of each day's operations, shape to drain and compact the work area to a uniform cross-section. Eliminate all ruts and low spots that could hold water.

(b) Rock cuts. Blast rock according to Section 205. Excavate rock cuts to 6 inches below subgrade within the roadbed limits. Backfill to subgrade with topping or with other suitable material. Compact the material according to Subsection 204.11.

(c) Earth cuts. Scarify earth cuts to 6 inches below subgrade within the roadbed limits. Compact the scarified material according to Subsection 204.11.

204.07 Subexcavation. Excavate material to the limits designated by the CO. Take cross-sections according to Section 152. Prevent unsuitable material from becoming mixed with the backfill. Dispose of unsuitable material according to Subsection 204.14. Backfill the subexcavation with topping, or other suitable material. Compact the material according to Subsection 204.11.

204.08 Borrow Excavation. Use all suitable roadway excavation in embankment construction. Do not use borrow excavation when it results in excess roadway excavation. Deduct excess borrow excavation from the appropriate borrow excavation quantity.

Obtain borrow source acceptance according to Subsection 105.02. Develop and restore borrow sources according to Subsection 105.03. Do not excavate beyond the established limits. When applicable, shape the borrow source to permit accurate measurements when excavation is complete.

204.09 Preparing Foundation for Embankment Construction. Prepare foundation for embankment construction as follows:

(a) Embankment less than 4 feet high over natural ground. Remove topsoil and break up the ground surface to a minimum depth of 6 inches by plowing or scarifying. Compact the ground surface according to Subsection 204.11.

(b) Embankments over an existing asphalt, concrete, or gravel road surface. Scarify gravel roads to a minimum depth of 6 inches. Scarify or pulverize asphalt and concrete roads to 6 inches below the pavement. Reduce all particles to a maximum size of 6 inches and produce a uniform material. Compact the surface according to Subsection 204.11.

(c) Embankment across ground not capable of supporting equipment. Dump successive loads of embankment material in a uniformly distributed layer to construct the lower portion of the embankment. Limit the layer thickness to the minimum depth necessary to support the equipment.

(d) Embankment on an existing slope steeper than 1V:3H. Cut horizontal benches in the existing slope to a sufficient width to accommodate placement and compaction operations and equipment. Bench the slope as the embankment is placed and compacted in layers. Begin each bench at the intersection of the original ground and the vertical cut of the previous bench.

204.10 Embankment Construction. Incorporate only suitable roadway excavation material into the embankment. When the supply of suitable roadway excavation is exhausted, furnish unclassified borrow to complete the embankment. Construct embankments as follows:

(a) General. At the end of each day's operations, shape to drain and compact the embankment surface to a uniform cross-section. Eliminate all ruts and low spots that could hold water.

During all stages of construction, route and distribute hauling and leveling equipment over the width and length of each layer of material.

Compact embankment side slopes with a tamping foot roller, by walking with a dozer, or by over-building the fill and then removing excess material to the final slope line. For slopes 1V:1¾H or steeper, compact the slopes as embankment construction progresses.

Where placing embankment on one side of abutments, wing walls, piers, or culvert headwalls, compact the material using methods that prevent excessive pressure against the structure.

Where placing embankment material on both sides of a concrete wall or box structure, conduct operations so compacted embankment material is at the same elevation on both sides of the structure.

Where structural pilings are placed in embankment locations, limit the maximum particle size to 4 inches.

(b) Embankment within the roadway prism. Place embankment material in horizontal layers not exceeding 12 inches in compacted thickness. Incorporate oversize boulders or rock fragments into the 12-inch layers by reducing them in size or placing them individually as required by (c) below. Compact each layer according to Subsection 204.11 before placing the next layer.

Material composed predominately of boulders or rock fragments too large for 12-inch layers may be placed in layers up to 24 inches thick. Incorporate oversize boulders or rock fragments into the 24-inch layer by reducing them in size or placing them individually according to (c) below. Place sufficient earth and smaller rocks to fill the voids. Compact each layer according to Subsection 204.11 before placing the next layer.

(c) Individual rock fragments and boulders. Place individual rock fragments and boulders greater than 24 inches in diameter as follows:

(1) Reduce rock to less than 48 inches in the largest dimension.

(2) Distribute rock within the embankment to prevent nesting.

(3) Place layers of embankment material around each rock to a depth not greater than that permitted by (b) above. Fill all the voids between rocks.

(4) Compact each layer according to Subsection 204.11 before placing the next layer.

(d) Embankment outside of roadway prism. Where placing embankment outside the staked roadway prism, place material in horizontal layers not exceeding 24 inches in compacted thickness. Compact each layer according to Subsection 204.11.

204.11 Compaction. For the purpose of compaction, use AASHTO T 27 to determine the amount of material retained on a No. 4 sieve. Compact as follows:

(a) More than 80 percent retained on a No. 4 sieve. Adjust the moisture content to a level suitable for compaction. Fill the interstices around rock with earth or other fine material as practical. Use compression-type rollers at speeds less than 6 feet per second and vibratory rollers at speeds less than 3 feet per second. Compact each layer of material full width with one of the following and until there is no visible evidence of further consolidation.

(1) Four roller passes of a vibratory roller having a minimum dynamic force of 40,000 pounds impact per vibration and a minimum frequency of 1000 vibrations per minute.

(2) Eight roller passes of a 20-ton compression-type roller.

(3) Eight roller passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1000 vibrations per minute.

Increase the compactive effort for layers deeper than 12 inches as follows:

- For each additional 6 inches or fraction thereof, increase the number of roller passes in (1) above by four passes.
- For each additional 6 inches or fraction thereof, increase the number of roller passes in (2) and (3) above, by eight passes.

(b) 50 to 80 percent retained on a No. 4 sieve. Use AASHTO T 99 to determine the optimum moisture content of the portion of the material passing a No. 4 sieve. Multiply this number by the percentage of material passing a No. 4 sieve, and add 2 percent to determine the optimum moisture content of the material. Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content.

Use compression-type rollers at speeds less than 6 feet per second and vibratory rollers at speeds less than 3 feet per second. Compact each layer of material full width according to (a) above.

(c) Less than 50 percent retained on a No. 4 sieve. Classify the material according to AASHTO M 145. For material classified A-1 or A-2-4, determine the maximum density according to AASHTO T 180, method D. For other material classifications, determine the optimum moisture content and maximum density according to AASHTO T 99, method C.

Adjust the moisture content of material classified A-1 through A-5 to a moisture content suitable for compaction. Adjust the moisture content of material classified A-6 and A-7 to within 2 percent of the optimum moisture content.

Use compression-type or vibratory rollers. Compact each layer of material full width to at least 95 percent of the maximum density. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures. When required, use AASHTO T 224 to correct for coarse particles.

204.12 Ditches. Slope, grade, and shape ditches. Remove all projecting roots, stumps, rock, or similar matter. Maintain all ditches in an open condition and free from leaves, sticks, and other debris.

Form furrow ditches by plowing or using other acceptable methods to produce a continuous furrow. Place all excavated material on the downhill side so the bottom of the ditch is approximately 18 inches below the crest of the loose material. Clean the ditch using a hand shovel, ditcher, or other suitable method. Shape to provide drainage without overflow.

204.13 Sloping, Shaping, and Finishing. Complete slopes, ditches, culverts, riprap, and other underground minor structures before placing aggregate courses. Slope, shape, and finish as follows:

(a) Sloping. Leave all earth slopes with uniform roughened surfaces, except as described in (b) below, with no noticeable break as viewed from the road. Except in solid rock, round tops and bottoms of all slopes including the slopes of drainage ditches. Round material overlaying solid rock to the extent practical. Scale all rock slopes.

If a slide or slipout occurs on a cut or embankment slope, remove or replace the material, and repair or restore all damage to the work. Bench or key the slope to stabilize the slide. Reshape the cut or embankment slope to an acceptable condition.

(b) Stepped slopes. Where required by the contract, construct steps on slopes of 1⅓V:1H to 1V:2H. Construct the steps approximately 18 inches high. Blend the steps into natural ground at the end of the cut. If the slope contains nonrippable rock outcrops, blend steps into the rock. Remove loose material found in transitional area. Except for removing large rocks that may fall, scaling stepped slopes is not required.

(c) Shaping. Shape the subgrade to a smooth surface and to the cross-section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts and at intersections of cuts and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.

(d) Finishing. Remove all material larger than 6 inches from the top 6 inches of the roadbed. Remove unsuitable material from the roadbed, and replace it with suitable material. Finish roadbeds that are compacted according to Subsection 204.11(b) and (c) to within ±0.05 feet of the staked line and grade. Finish roadbeds that are compacted according to Subsection 204.11(a) to within ±0.10 feet of the staked line

and grade. Finish ditch cross-sections to within ±0.10 feet of the staked line and grade. Maintain proper ditch drainage.

204.14 Disposal of Unsuitable or Excess Material. Dispose of unsuitable or excess material legally off the project.

When there is a pay item for waste, shape and compact the waste material in its final location. Do not mix clearing or other material not subject to payment with the waste material.

204.15 Acceptance. See Table 204-1 for sampling and testing requirements.

Material for embankment and conserved topsoil will be evaluated under Subsections 106.02 and 106.04.

Excavation and embankment construction will be evaluated under Subsections 106.02 and 106.04.

Clearing and removal of obstructions will be evaluated under Sections 201 and 203.

Placing of conserved topsoil will be evaluated under Section 624.

Measurement

204.16 Measure the Section 204 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

(a) Roadway excavation. Measure roadway excavation in its original position as follows:

(1) Include the following volumes in roadway excavation:

(a) Roadway prism excavation;

(b) Rock material excavated and removed from below subgrade in cut sections;

(c) Unsuitable material below subgrade and unsuitable material beneath embankment areas when a pay item for subexcavation is not shown in the bid schedule;

(d) Ditches, except furrow ditches measured under a separate bid item;

(e) Conserved topsoil;

(f) Borrow material used in the work when a pay item for borrow is not shown in the bid schedule;

(g) Loose scattered rocks removed and placed as required within the roadway;

(h) Conserved material taken from stockpiles and used in Section 204 work except topsoil measured under Section 624; and

(i) Slide and slipout material not attributable to the Contractor's method of operation.

(2) Do not include the following in roadway excavation:

(a) Overburden and other spoil material from borrow sources;

(b) Overbreakage from the backslope in rock excavation;

(c) Water or other liquid material;

(d) Material used for purposes other than required;

(e) Roadbed material scarified in place and not removed;

(f) Material excavated when stepping cut slopes;

(g) Material excavated when rounding cut slopes;

(h) Preparing foundations for embankment construction;

(i) Material excavated when benching for embankments;

(j) Slide or slipout material attributable to the Contractor's method of operation;

(k) Conserved material taken from stockpiles constructed at the option of the Contractor; and

(l) Material excavated outside the established slope limits.

(3) When both roadway excavation and embankment construction pay items are shown in the bid schedule, measure roadway excavation only for the following:

(a) Unsuitable material below subgrade in cuts and unsuitable material beneath embankment areas when a pay item for subexcavation is not shown in the bid schedule;

(b) Slide and slipout material not attributable to the Contractor’s method of operations; and

(c) Drainage ditches, channel changes, and diversion ditches.

(b) Unclassified borrow, select borrow, and select topping. When measuring by the cubic yard measure in its original position. If borrow excavation is measured by the cubic yard in place, take initial cross-sections of the ground surface after stripping overburden. Upon completion of excavation and after the borrow source waste material is returned to the source, retake cross-sections before replacing the overburden.

Do not measure borrow excavation used in place of excess roadway excavation.

(c) Embankment construction. Measure embankment construction in its final position. Do not make deductions from the embankment construction quantity for the volume of minor structures.

(1) Include the following volumes in embankment construction:

(a) Roadway embankments;

(b) Material used to backfill subexcavated areas, holes, pits, and other depressions;

(c) Material used to restore obliterated roadbeds to original contours; and

(d) Material used for dikes, ramps, mounds, and berms.

(2) Do not include the following in embankment construction:

(a) Preparing foundations for embankment construction;

(b) Adjustments for subsidence or settlement of the embankment or of the foundation on which the embankment is placed; and

(c) Material used to round fill slopes.

(d) **Rounding cut slopes**. Measure rounding cut slopes horizontally along the centerline of the roadway.

(e) **Waste.** Measure waste by the cubic yard in its final position. Take initial cross-sections of the ground surface after stripping over burden. Upon completion of the waste placement, retake cross-sections before replacing overburden.

(f) **Slope scaling.** Measure slope scaling by the cubic yard in the hauling vehicle.

Payment

204.17 The accepted quantities will be paid at the contract price per unit of measurement for the Section 204 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 204-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Topping (704.05)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type	Processed material before incorporating in work	Yes, when requested	Before using in work
		Moisture-density	—	AASHTO T 180, method D(1) or T 99, method C(1)	1 per soil type but not less than 1 per 13,000 yd^3	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 6000 yd^2 but not less than 1 per layer	In-place	—	—
Select topping (704.08)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type but not less than 1 for each day of production	Processed material before incorporating in work	Yes, when requested	Before using in work
		Gradation	—	AASHTO T 27 & T 11	"	"	"	"
		Liquid limit	—	AASHTO T 89	"	"	"	"
		Moisture-density	—	AASHTO T 180, method D(1) or T 99, method C(1)	1 per soil type but not less than 1 per 13,000 yd^3	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 6000 yd^2 but not less than 1 per layer	In-place	"	Before placing next layer

(1) Minimum of 5 points per proctor

Table 204-1 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Unclassified borrow (704.06)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type	Processed material before incorporating in work	Yes, when requested	Before using in work
		Moisture-density	—	AASHTO T 180, method D(1) or T 99, method C(1)	1 per soil type but not less than 1 per 13,000 yd^3	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 3500 yd^2 but not less than 1 per layer	In-place	—	Before placing next layer
Select borrow (704.07)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type but not less than 1 for each day of production	Processed material before incorporating in work	Yes, when requested	24 hours
		Gradation	—	AASHTO T 27 & T 11	"	"	"	"
		Liquid limit	—	AASHTO T 89	"	"	"	"
		Moisture-density	—	AASHTO T 180, method D(1) or T 99, method C(1)	1 per soil type but not less than 1 per 13,000 yd^3	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 3500 yd^2 but not less than 1 per layer	In-place	"	Before placing next layer

(1) Minimum of 5 points per proctor.

Table 204-1 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Earth embankment (204.11)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type	Source of Material	Yes, when requested	Before using in work
		Moisture-density	—	AASHTO T 180, method D(1) or T 99, method C(1)	1 per soil type but not less than 1 per 13,000 yd^3	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 3500 yd^2 but not less than 1 per layer	In-place	—	Before placing next layer
Top of subgrade (204.11)	Measured and tested for conformance (106.04)	Compaction	—	AASHTO T 310 or other approved procedures	1 per 2500 yd^2	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Section 205. — ROCK BLASTING

NOT USED

Section 206. — Reserved

Section 207. — EARTHWORK GEOTEXTILES

Description

207.01 This work consists of furnishing and placing a geotextile as a permeable separator, stabilizer, or permanent erosion control measure.

Geotextile types are designated as shown in Subsection 714.01.

Material

207.02 Conform to the following Subsection:

Geotextile	714.01

Construction Requirements

207.03 General. Where placing a geotextile on native ground, cut the trees and shrubs flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all sharp objects and large rocks. Fill depressions or holes with suitable material to provide a firm foundation.

Replace or repair all geotextile that is torn, punctured, or muddy. Remove the damaged area and place a patch of the same type of geotextile overlapping 3 feet beyond the damaged area.

207.04 Separation and Stabilization Applications. Where placing a geotextile on a subgrade, prepare the subgrade according to Subsections 204.13(c) and (d).

Place the geotextile smooth and free of tension, stress, or wrinkles. Fold or cut the geotextile to conform to curves. Overlap in the direction of construction. Overlap the geotextile a minimum of 2 feet at the ends and sides of adjoining sheets, or sew the geotextile joints according to the manufacturer's recommendations. Do not place longitudinal overlaps below anticipated wheel loads. Hold the geotextile in place with pins, staples, or piles of cover material.

End dump the cover material onto the geotextile from the edge of the geo-textile or from previously placed cover material. Do not operate equipment directly on the geotextile. Spread the end-dumped pile of cover material maintaining a minimum lift thickness of 12 inches. Compact the cover material with rubber-tired or nonvibratory smooth drum rollers. Avoid sudden stops, starts, or turns of the construction equipment. Fill all ruts from construction equipment with additional cover material. Do not regrade ruts with placement equipment.

Place subsequent lifts of cover material in the same manner. Vibratory compactors may be used for compacting subsequent lifts. If foundation failures occur, repair the damaged areas and revert to the use of nonvibratory compaction equipment.

207.05 Permanent Erosion Control Applications. Place and anchor the geotextile on an approved smooth-graded surface. For slope or wave protection, place the long dimension of the geotextile down the slope. For stream bank protection, place the long dimension of the geotextile parallel to the centerline of the channel.

Overlap the geotextile a minimum of 12 inches at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer's recommendations. Overlap the uphill or upstream sheet over the downhill or downstream sheet. Offset end joints of adjacent sheets a minimum of 5 feet. Pins may be used to hold the geotextile sheets in place. Space pins along the overlaps at approximately 3-foot centers.

Place aggregate, slope protection, or riprap on the geotextile starting at the toe of the slope and proceed upward. Place riprap onto the geotextile from a height of less than 12 inches. Place slope protection rock or aggregate backfill onto the geotextile from a height less than 3 feet. In underwater applications, place the geotextile and cover material in the same day.

207.06 Acceptance. Material for earthwork geotextile will be evaluated under Subsections 106.02, 106.03, and 714.01.

Earthwork geotextile installation will be evaluated under Subsections 106.02 and 106.04.

Measurement

207.07 Measure the Section 207 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Payment

207.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 207 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 208. — STRUCTURE EXCAVATION AND BACKFILL FOR SELECTED MAJOR STRUCTURES

NOT USED

Section 209. — STRUCTURE EXCAVATION AND BACKFILL

Description

209.01 This work consists of excavating material for the construction of all structures except those specifically designated under Section 208. The work includes preserving channels, shoring and bracing, sealing foundations, dewatering, excavating, preparing foundations, bedding, and backfilling.

Material

209.02 Conform to the following Sections and Subsections:

Backfill material	704.03
Bedding material	704.02
Concrete	601
Foundation fill	704.01
Lean concrete backfill	614
Seal concrete	552
Unclassified borrow	704.06

Construction Requirements

209.03 Preparation for Structure Excavation. Clear the area of vegetation and obstructions according to Sections 201 and 203.

209.04 General. Excavate trenches or foundation pits according to Subsection 208.04. Excavate to foundation grade without unduly disturbing the trench or foundation surface. Foundation grade is the elevation at the bottom of any bedding for installing the structure. Compact the foundation.

209.05 Channel Preservation. Preserve channels according to Subsection 208.05 except excavate inside separations such as dikes or sandbags.

209.06 Foundation Seal. Where necessary for a foundation seal, construct a foundation seal according to Subsection 208.07.

209.07 Dewatering. Where necessary to dewater, dewater according to Subsection 208.08.

209.08 Foundation Preparation. Excavate any unsuitable material present at foundation grade, and replace it with foundation fill. Place and compact the foundation fill material according to Subsection 208.09(d).

Where a footing is required to be keyed into undisturbed material, prepare foundation and construct footing according to Subsection 208.09(c).

209.09 Bedding. Place bedding as follows:

(a) For box culverts and structures other than pipe culverts. Construct bedding when required by the contract. Place and shape bedding material in compacted layers not exceeding 6 inches in depth. Compact each layer according to Subsection 209.11.

(b) For pipe culverts. Level the foundation. Place un-compacted bedding material over the foundation in a layer of uniform thickness. For pipe with diameters of 12 to 54 inches, the bedding thickness is 4 inches. For pipe diameters larger than 54 inches, the bedding thickness is 6 inches. For belled joints, recess the bedding to receive the joints. Place the culvert on un-compacted bedding layer. Backfill according to Subsection 209.10(b).

209.10 Backfill. Backfill as follows:

(a) General. Place backfill in horizontal layers that, when compacted, do not exceed 6 inches in depth. Compact each layer according to Subsection 209.11.

Bring backfill up evenly on all sides of the structure, and extend each layer to the limits of the excavation or to natural ground.

Do not place backfill against concrete less than 7-days-old or until 80 percent of the design strength is achieved.

(b) Pipe culverts. Place and compact material in evenly balanced layers on each side of each pipe culvert. Backfill according to one of the following:

(1) Pipe culverts with compacted backfill. Place and compact backfill material to a height of 12 inches above the top of the pipe. Complete the backfilling of the trench with suitable roadway excavation or unclassified borrow.

Place the material in layers that, when compacted, do not exceed 6 inches in thickness. Compact each layer according to Subsection 209.11.

(2) Pipe culverts with lean concrete backfill. Place and stake pipe to prevent floating and movement. Backfill using lean concrete according to Section 614.

(c) Arch culverts with headwalls. Backfill according to one of the following:

(1) Before headwalls are in place. Place and compact the first backfill material midway between the ends of the arch. Place and compact backfill material in layers on both sides of the arch to form as narrow a ramp as possible. Build the ramp evenly on both sides until reaching the top of the arch. Place the remainder of the backfill material from the top of the ramp working both ways to the ends. Compact the backfill material evenly in layers on both sides of the arch.

(2) After headwalls are in place. Place and compact the first backfill material adjacent to one headwall. Place and compact backfill material evenly in layers on both sides of the arch adjacent to the headwall until reaching the top of the arch. Place remainder of the backfill material from the top of the arch working toward the other headwall. Compact the backfill material evenly in layers on both sides of the arch.

(d) Patching existing pavement areas. Construct the top 15 inches with 12 inches of crushed aggregate according to Section 301 and 3 inches of asphalt concrete according to Section 404 or 417.

209.11 Compacting. Determine optimum moisture content and maximum density according to AASHTO T 99, method C. Adjust the moisture content of the backfill material to a moisture content suitable for compaction.

Compact material placed in all layers to at least 95 percent of the maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures.

Do not apply density requirements as measured by AASHTO T 310 to material that is incapable of being tested or compacted to maximum values determined by AASHTO T 99. For these materials, fill the voids around the rock in each layer with earth or other fine material. Compact each layer, full width, until there is no visible evidence of further consolidation.

209.12 Acceptance. See Table 209-1 for sampling and testing requirements.

Material for backfill, bedding, and foundation fill will be evaluated under Subsections 106.02 and 106.04, except concrete for bedding or backfill will be evaluated according to Section 601.

Structural excavation and backfill work will be evaluated under Subsections 106.02 and 106.04.

Shoring, bracing, and cofferdams will be evaluated under Subsections 106.02 and 106.04.

Clearing and removal of obstructions will be evaluated under Sections 201 and 203.

Seal concrete will be evaluated under Section 552.

Measurement and Payment

209.13 See Subsection 109.05.

Do not measure structure excavation and backfill for payment.

Measure foundation fill under Section 208.

Measure seal concrete under Section 552.

Table 209-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Backfill material (704.03)	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per soil type	Source of material	Yes	Before using in work
		Moisture-density	—	AASHTO T 99, method C(1)	"	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer
Bedding material (704.02)	Measured and tested for conformance (106.04)	Moisture-density	—	AASHTO T 99, method C(1)	1 per soil type	Source of material	Yes	Before using in work
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Table 209-1 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Foundation fill (704.01)	Measured and tested for conformance (106.04)	Moisture-density	—	AASHTO T 99, method C(1)	1 per soil type	Source of material	Yes	Before using in work
		Compaction (204.11)	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer
Unclassified borrow (704.06)	Measured and tested for conformance (106.04)	Moisture-density	—	AASHTO T 99, method C(1)	1 per soil type	Source of material	Yes	Before using in work
		Classification	—	AASHTO M 145	“	“	“	“
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Section 210. — Reserved

Section 211. — ROADWAY OBLITERATION

NOT USED

Section 212. — LINEAR GRADING

NOT USED

Section 213. — SUBGRADE STABILIZATION

Description

213.01 This work consists of processing and incorporating lime, lime/fly ash, or hydraulic cement into the upper layer of a subgrade.

Material

213.02 Conform to the following Subsections:

Blotter	703.13
Chemical admixtures (retarder)	711.03
Emulsified asphalt	702.03
Fly ash	725.04
Hydraulic cement	701.01
Lime	725.03
Water	725.01

Construction Requirements

213.03 Proportioning. Submit a subgrade stabilization mix design 30 days before production. Provide minimum compressive strengths in Table 213-1.

Table 213-1
Subgrade Stabilization Strengths

Stabilization Mixture	Test Procedure	Minimum Compressive Strength
Lime/Soil	ASTM D 5102	100 pounds / square inch (1)
Lime/Fly ash/Soil	ASTM C 593	400 pounds / square inch (2)
Cement/Soil	ASTM D 1633	400 pounds / square inch (2)

(1) 28-day cure.

(2) 7-day cure followed by vacuum saturation.

Include the following with the mix design, as applicable:

(a) Source of each component material;

(b) Results of the applicable tests;

(c) 200-pound sample of the subgrade soil;

(d) 50-pound sample of the fly ash;

(e) 25-pound sample of the lime;

(f) 25-pound sample of the cement; and

(g) 5-pound sample of the retarder or other admixtures proposed.

Begin production only after the mix design is approved. Furnish a new mix design if there is a change in a material source.

213.04 General. Store chemical additives and admixtures in closed, weatherproof containers. Prepare the subgrade according to Section 303. Scarify and pulverize the subgrade to a depth of 6 inches. Size and shape the subgrade material to a windrow or blanket that is suitable for mixing. Determine the optimum moisture content and maximum density according to AASHTO T 99, method C.

213.05 Application. Apply additives when the subgrade material is at least 3 percent below optimum moisture content and at least 40 ºF. Do not apply when excessive additive is lost to washing or blowing or when the air temperature is expected to fall below 40 ºF within 48 hours.

Apply additives at the required rates by one of the following methods:

(a) Dry method. Uniformly apply the additives by an approved spreader. A motor grader is not an approved spreader. Apply water using approved methods to obtain the proper moisture content for mixing and compaction.

(b) Slurry method. Mix additives with water and apply as a thin water suspension or slurry using either trucks with approved distributors or rotary mixers. Equip the distributor truck or rotary mixer tank with an agitator to keep the additives suspended in water. Make successive passes over the material to obtain the moisture and additive content for mixing and compacting.

213.06 Mixing. Keep all traffic, except mixing equipment, off the spread material. Mix the material to obtain a homogeneous friable mixture.

(a) Lime and lime/fly ash mixtures. Add water and thoroughly mix to adjust the moisture content of the mixture to the optimum moisture content plus necessary hydration moisture. Hydration moisture is 1½ percent for each percent of additive in the mixture. Complete the mixing within 6 hours of additive application. Cure the mixture for 2 to 4 days by keeping it moist.

After curing, remix the mixture until 95 percent of all the mixture, except rock, passes a 1¾-inch sieve and at least 50 percent of the mixture passes a No. 4 sieve when tested according to AASHTO T 27, in a nondried condition. Retarders may be added.

(b) Cement mixtures. Add water and thoroughly mix to adjust the moisture content of the mixture to 2 percent above the optimum moisture content. Complete the mixing within 2 hours of cement application.

Adjust the moisture content of the mixture to within 2 percent of the optimum moisture content.

213.07 Compacting and Finishing. Immediately after mixing, spread and compact the mixture to at least 95 percent of the maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures. If the time between compacting adjacent partial widths exceeds 30 minutes, or when tying into the previous work, provide a construction joint according to Subsection 302.07. Finish the subgrade so it is smooth and suitable for placing a subsequent course.

213.08 Curing. Do not allow traffic on the stabilized subgrade. Keep the subgrade continuously moist until the next course is placed. Apply water under pressure through a spray bar equipped with nozzles, which produce a fine, uniform spray. Place the next course within 7 days after compacting and finishing the subgrade.

Placement of the next course may be deferred up to 21 days by sealing the surface with rapid setting emulsified asphalt. Keep the surface continuously moist for at least 7 days after compacting and finishing. After the 7 days, apply undiluted CRS-2 or RS-2 emulsified asphalt at a rate of ¼ gallon per square yard according to Section 409. Provide a continuous film over the surface. If the surface is opened to public traffic, furnish and apply blotter according to Section 411.

If the subgrade looses stability, density, or finish before placement of the next course, reprocess or recompact the subgrade as necessary to restore the strength of the damaged material to that specified in the mix design. Reapply the emulsified asphalt seal where the continuous film is damaged.

213.09 Acceptance. See Table 213-2 for sampling and testing requirements.

Material for blotter, chemical admixtures (retarder), fly ash, lime, hydraulic cement, and water will be evaluated under Subsections 106.02 and 106.03.

Emulsified asphalt will be evaluated under Subsections 106.03 and 702.09.

Subgrade stabilization work will be evaluated under Subsections 106.02 and 106.04.

Reconditioning of subgrade will be evaluated under Section 303.

Emulsified asphalt seal will be evaluated under Section 409.

Measurement

213.10 Measure the Section 213 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure the width horizontally to include the top of subgrade width and allowable curve widening. Measure length horizontally along the centerline of the roadway.

Measure emulsified asphalt under Section 409.

Measure blotter under Section 411.

Payment

213.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 213 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 213

Table 213-2
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Remix material	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 6000 yd^2	Processed material	Yes	Before using in work
		Moisture-density	—	AASHTO T 99, method C(1)	"	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 2500 yd^2, but not less than 1 per layer	In-place	—	Before placing next layer
		Strength	—	ASTM D 5102, C 593, & D 1633	1 per mix design	After proportioning	Yes	Before producing

(1) Minium of 5 points per proctor.

DIVISION 250
SLOPE REINFORCEMENT AND RETAINING WALLS

Section 251. — RIPRAP

Description

251.01 This work consists of furnishing and placing riprap for bank protection, slope protection, drainage structures, and erosion control.

Riprap classes are designated as shown in Table 705-1.

Material

251.02 Conform to the following Subsections:

Geotextile type IV	714.01
Cement grout	725.22(e)
Riprap rock	705.02

Construction Requirements

251.03 General. Perform the work under Section 209. Dress the slope to produce a smooth surface. If earthwork geotextile is required, place according to Section 207.

251.04 Placed Riprap. Placed riprap is rock placed on a prepared surface to form a well-graded mass.

Place riprap to its full thickness in one operation to avoid displacing the underlying material. Do not place riprap material by methods that cause segregation or damage to the prepared surface. Place or rearrange individual rocks by mechanical or hand methods to obtain a dense uniform blanket with a reasonably smooth surface.

251.05 Keyed Riprap. Keyed riprap is rock placed on a prepared surface and set into place by impact pressure.

Place rock for keyed riprap according to Subsection 251.04. Set the riprap into place by exerting impact pressure with a hydraulic-powered bucket or an approximate 5000-pound flat-faced mass. Repeated impacts should be made until the rock is firmly seated and forms a reasonably uniform surface without reducing the effective sizes of the rocks. Do not use impact pressure on riprap below the water surface.

251.06 Grouted Riprap. Grouted riprap is rock placed or keyed on a prepared surface with the voids filled with grout.

Place rock for grouted riprap according to Subsections 251.04 or 251.05. Thoroughly moisten the rocks and wash excess fines from the riprap or to the underside of the riprap. Place grout only when the air temperature is no less than 35 ºF within the near-surface voids of the riprap. Place the grout in a manner to prevent segregation. Begin placing grout at the lowest elevation of the riprap. Fill all voids without unseating the rocks. Do not exceed 5-foot thickness for each layer of grouted riprap. Allow 3 days curing time before adding the next layer of riprap and grout. Provide weep holes through the grouted riprap as required. Keep the grouted riprap moist for 3 days after the work is completed and protect it from freezing for a minimum of 7 days after grouting.

251.07 Acceptance. See Table 251-1 for sampling and testing requirements.

Rock for riprap will be evaluated under Subsection 106.02 and 106.03.

Rock placement for riprap will be evaluated under Subsections 106.02 and 106.04.

Structure excavation and backfill will be evaluated under Section 209.

Geotextile will be evaluated under Section 207.

Material for grout will be evaluated under Subsections 106.02 and 106.03. Grout will be evaluated under Subsections 106.02 and 106.04. Grout placement will be evaluated under Subsection 106.02.

Measurement

251.08 Measure the Section 251 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure riprap by the cubic yard in place.

Payment

251.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 251 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 251-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Riprap (705.02)	Measured and tested for conformance (106.04)	Apparent specific gravity & absorption	—	AASHTO T 85	1 per material type	Source of material	Yes	Before using in work
		Coarse durability index	—	AASHTO T 210	"	"	"	"
		Sodium sulfate soundness	—	AASHTO T 104	"	"	"	"
		LA abrasion	—	AASHTO T 96	"	"	"	"
Mortar	Measured and tested for conformance (106.04)	Making test specimens Compressive strength	—	AASHTO T 23 & T 22	1 per mix design	—	Yes, when requested	Before using in work

Section 252. — SPECIAL ROCK EMBANKMENT AND ROCK BUTTRESS

Description

252.01 Special rock embankment work consists of furnishing and placing hand-placed or mechanically-placed rock in fill sections. Rock buttress work consists of furnishing and placing hand-placed or mechanically-placed rock in cut sections.

Special rock embankments and rock buttresses are designated as hand-placed or mechanically-placed.

Material

252.02 Conform to the following Subsections:

Rock for buttresses	705.05
Rock for special rock embankment	705.04

Construction Requirements

252.03 Placing Rock. Perform the work under Section 204 or 209 as required.

Place the rock in a stable orientation with minimal voids. Offset the rock to produce a random pattern. Use spalls smaller than the minimum rock size to chock the larger rock solidly in position and to fill voids between the large rock.

Construct the exposed face of the rock mass reasonably uniform with no projections beyond the line of the slope that are more than 12 inches for mechanically-placed rock or 6 inches for hand-placed rock.

252.04 Acceptance. Rock for special rock embankment and rock buttress will be evaluated under Subsection 106.02.

Rock placement for special rock embankment and rock buttress will be evaluated under Subsections 106.02 and 106.04.

Structure excavation and backfill will be evaluated under Section 209.

Measurement

252.05 Measure the Section 252 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure special rock embankment and rock buttress by the cubic yard in place.

Payment

252.06 The accepted quantities will be paid at the contract price per unit of measurement for the Section 252 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 253. — GABIONS AND REVET MATTRESSES

Description

253.01 This work consists of constructing gabion structures and revet mattresses.

Material

253.02 Conform to the following Subsections:

Backfill material	704.03
Gabion and revet mattress material	720.02
Gabion and revet mattress rock	705.01
Geotextile type IV	714.01
Structural backfill	704.04

Construction Requirements

253.03 General. Survey according to Section 152 and verify the limits of the wall installation. Prepare and submit installation drawings according to Subsection 104.03. Perform the work under Section 209.

253.04 Basket Assembly. Do not damage wire coatings during basket assembly, structure erection, cell filling, or backfilling. Rotate the basket panels into position and join the vertical edges with fasteners according to Subsection 253.05. Temporary fasteners may be used for basket assembly if they are supplemented during structure erection with permanent fasteners according to Subsection 253.05.

Rotate the diaphragms into position and join the vertical edges according to Subsection 253.05.

253.05 Structure Erection. Place the empty gabion baskets on the foundation and interconnect the adjacent baskets along the top and vertical edges using permanent fasteners.

Where lacing wire is used, wrap the wire with alternating single and double loops every other mesh opening and not more than 6 inches apart. Where spiral binders are used, crimp the ends to secure the binders in place. Where alternate fasteners are used, space the fasteners in every mesh opening and not more than 6 inches apart.

In the same manner, interconnect each vertical layer of baskets to the underlying layer of baskets along the front, back, and sides. Stagger the vertical joints between baskets of adjacent rows and layers by at least one cell length.

253.06 Cell Filling. Remove all kinks and folds in the wire mesh, and properly align all the baskets. Place rock carefully in the basket cells to prevent bulging of the baskets and to minimize voids in the rock fill. Maintain the basket alignment.

Place internal connecting wires in each unrestrained exterior basket cell greater than 1 foot in height. This includes interior basket cells left temporarily unrestrained. Place internal connecting wires concurrently with rock placement.

Fill the cells in any row or layer so that no cell is filled more than 1 foot above an adjacent cell. Repeat this process until the basket is full and the lid bears on the final rock layer.

Secure the lid to the sides, ends, and diaphragms according to Subsection 253.05. Make all exposed basket surfaces smooth and neat with no sharp rock edges projecting through the wire mesh.

253.07 Backfilling. Place a geotextile over the back face of the gabion structure. Concurrently with the cell filling operation, backfill the area behind the gabion structure with structural backfill according to Subsection 209.10. Compact each layer according to Subsection 209.11 except use an acceptable lightweight mechanical or vibratory compactor within 3 feet of the gabion structure.

253.08 Revet Mattresses. Place a geotextile according to Section 207. Construct revet mattresses according to Subsections 253.04 through 253.06. Anchor the mattresses in place. Place geotextile against the vertical edges of the mattress and backfill against the geotextile using backfill material or other approved material. Overfill revet mattresses by 1 to 2 inches.

253.09 Acceptance. See Table 209-1 for sampling and testing requirements.

Material for gabion structures and revet mattresses will be evaluated under Subsections 106.02 and 106.03.

Construction of gabion structures and revet mattresses will be evaluated under Subsections 106.02 and 106.04.

Survey work will be evaluated under Section 152.

Geotextile will be evaluated under Subsection 207.

Structure excavation, structural backfill, and backfill material will be evaluated under Section 209.

Measurement

253.10 Measure the Section 253 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure gabions by the square yard of front wall face or by the cubic yard in the structures.

Measure foundation fill under Section 208.

Payment

253.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 253 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 254. — CRIB WALLS

Description

254.01 This work consists of constructing concrete, metal, or timber crib retaining walls.

Material

254.02 Conform to the following Section and Subsections:

Bed course	704.09
Concrete	601
Crib wall backfill	704.12
Hardware for timber structures	716.02
Metal bin type crib walls	720.03
Precast concrete units	725.11(c)
Reinforcing steel	709.01
Structural backfill	704.04
Treated structural timber and lumber	716.03

Construction Requirements

254.03 General. Survey according to Section 152 and verify the limits of the wall installation. Prepare and submit installation drawings according to Subsection 104.03. Perform the work under Section 209. When the wall is set on a rocky foundation, place 8 inches of bed course under the wall base elements.

254.04 Erection. Furnish all necessary bolts, nuts, and hardware for complete assembly of the units into a continuous wall of connected units. Erect the crib wall according to the fabricator's or manufacturer's instructions. On curves, obtain the proper curvature for the face by using shorter stringers in the front or rear panels. Construct the wall to within 1 inch in 10 feet from the lines and elevations shown on the plans.

(a) Concrete crib wall. Remove and replace all concrete members that are cracked or damaged.

(b) Metal crib wall. Torque bolts for metal crib walls to at least 25 foot-pounds.

(c) Timber crib wall. Construct timber cribs according to Section 557.

254.05 Backfilling. Backfill within the cribs with crib wall backfill according to Subsection 209.10. Backfill behind the cribs with structural backfill according to Subsection 209.10. Maintain an equal level of backfill within and behind the cribs during

the backfilling process. Compact each layer according to Subsection 209.11 except use an acceptable lightweight mechanical or vibratory compactor within 3 feet of the crib wall face.

254.06 Acceptance. Material for crib walls will be evaluated under Subsections 106.02 and 106.03. Furnish a production certification with each shipment for the following:

(a) Metal bin type crib walls;

(b) Precast concrete units;

(c) Reinforcement steel; and

(d) Treated structural timber and lumber.

Concrete, metal, or timber crib retaining wall construction will be evaluated under Subsections 106.02 and 106.04.

Survey work will be evaluated under Section 152.

Structure excavation, crib wall backfill, structural backfill, and bed course material will be evaluated under Section 209.

Concrete crib walls will be evaluated under Section 601.

Timber crib walls will be evaluated under Section 557.

Measurement

254.07 Measure the Section 254 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure crib walls by the square foot of front wall face.

Measure crib wall backfill by the cubic yard in place.

Measure foundation fill under Section 208.

Payment

254.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 254 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 255. — MECHANICALLY-STABLILIZED EARTH WALLS

Description

255.01 This work consists of constructing mechanically-stabilized earth walls.

Material

255.02 Conform to the following Section and Subsections:

Concrete leveling pad	601
Geotextile type IV	714.01
Mechanically-stabilized earth wall material	720.01
Select granular backfill	704.10
Structural backfill	704.04

Construction Requirements

255.03 General. Survey according to Section 152, and verify the limits of the wall installation. Prepare and submit installation drawings according to Subsection 104.03. Perform the work under Section 209. Grade the foundation for a width equal to the length of reinforcing elements plus 18 inches. Where the wall is set on a rocky foundation, place 6 inches of select granular backfill under the reinforcing mesh or strips.

For concrete-faced walls, provide a precast reinforced or a nonreinforced cast-in-place concrete leveling pad. Cure cast-in-place leveling pads a minimum of 12 hours before placing wall panels.

255.04 Wall Erection. Erect the wall according to the drawings and the manufacturer's recommendations. When requested, have an experienced field representative from the wall system manufacturer available during erection.

(a) Concrete-faced walls. Erect panels by means of lifting devices connected to the upper edge of the panel. Align precast facing panels within 3/4 inch vertically and horizontally when measured with a 10-foot straightedge.

Make the joint openings 3/4±1/4 inch wide. Install joint material according to the drawings. Cover all joints on the backside of the panels with a 12-inch wide strip of geotextile. Overlap geotextile splices a minimum of 4 inches.

Hold the panels in position with temporary wedges or bracing during backfilling operations. Erect the wall so the overall vertical tolerance (top to bottom) does not exceed 1/2 inch per 10 feet of wall height.

(b) Wire-faced walls. Place backing mats and 1/4-inch hardware cloth in successive horizontal lifts as backfill placement proceeds. Connect, tighten, and anchor soil reinforcement elements to the wall facing units before placing backfill. Do not exceed an individual lift vertical tolerance and an overall wall (top to bottom) vertical tolerance of 1 inch per 10 feet of wall height. Place reinforcement elements within 1 inch vertically above the corresponding connection elevation at the wall face. Do not place reinforcing elements below the corresponding connection elevations. Do not deviate from the designed batter of the wall by more than 1 inch per 10 feet of wall height. Do not deviate more than 2 inches at any point in the wall from a 10-foot straightedge placed horizontally on the theoretical plane of the design face.

(c) Gabion-faced walls. Place the first lift of backfill before filling the gabion baskets. Construct gabion structures according to Section 253. Lay reinforcement mesh horizontally on compacted fill and normal to the face of the wall. Connect the gabion facing unit to reinforcement mesh with spiral binders or tie wire at 4-inch nominal spacing with alternating single and double locked loops. Pull and anchor the reinforcement mesh taut before placing additional backfill.

255.05 Backfilling. Backfill the stabilized volume with select granular backfill according to Subsection 209.10. Ensure that no voids exist below the reinforcing mesh or strips. Compact each layer according to Subsection 209.11, except use an acceptable lightweight mechanical or vibratory compactor within 3 feet of the wall face. Where the stabilized volume supports spread footings for bridges or other structural loads, compact the top 5 feet to at least 100 percent of the maximum density.

Do not damage or disturb the facing or reinforcing elements. Do not operate equipment directly on top of the reinforcing mesh or strips. Correct all damaged, misaligned, or distorted wall elements.

Backfill and compact behind the stabilized volume with structural backfill according to Subsection 209.10. At the end of the day's operation, slope the last lift of backfill away from the wall face to direct surface runoff away from the wall. Do not allow surface runoff from adjacent areas to enter the wall construction area.

255.06 Acceptance. Material for mechanically-stabilized earth walls listed under Subsection 720.01 will be evaluated under Subsections 106.02 and 106.03. Furnish a production certification with each shipment of concrete face panels.

Construction of mechanically-stabilized earth wall and services will be evaluated under Subsections 106.02 and 106.04.

Survey work will be evaluated under Section 152.

Geotextile will be evaluated under Section 207.

Structure excavation, select granular backfill, and structural backfill will be evaluated under Section 209.

Gabions will be evaluated under Section 253.

Concrete leveling pad will be evaluated under Section 601.

Measurement

255.07 Measure the Section 255 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure mechanically-stabilized earth walls by the square foot of front wall face.

Measure select granular backfill within the stabilized volume by the cubic yard in place.

Measure foundation fill under Section 208.

Payment

255.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 255 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 255-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Backfill (704)	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type	Source of material	Yes	Before using in work
		Gradation	—	AASHTO T 27 & T 11	"	"	"	"
		Moisture-density	—	AASHTO T 180, method D(1) or T 99, method C(1)	"	"	"	"
		Compaction	—	AASHTO T 310 or other approved procedures	2 per lift	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Section 256. — PERMANENT GROUND ANCHORS

Description

256.01 This work consists of constructing permanent ground anchors.

Material

256.02 Conform to the following Subsection:

Ground anchors	722.02
Grout	722.02(e)

Construction Requirements

256.03 Qualifications. The Contractor or subcontractor performing the ground anchor work shall have completed at least 5 permanent ground anchor projects within the last 3 years. Submit a brief description of each project including the owning agency's name and current telephone number.

Provide a professional engineer with at least 3 years experience in the design and construction of permanent ground anchors. Provide on-site supervisors and drill operators with at least 1 year experience installing permanent ground anchors. At least 30 days before starting ground anchor work, identify the professional engineer, on-site supervisors, and drill operators assigned to the project and submit a summary of each individual's experience.

256.04 Drawings. At least 30 days before starting ground anchor work, submit drawings according to Subsection 104.03. Include the following:

(a) A ground anchor schedule giving the following information:

(1) Ground anchor number;

(2) Ground anchor design load;

(3) Type and size of tendon;

(4) Minimum total anchor length;

(5) Minimum bond length;

(6) Minimum tendon bond length; and

(7) Minimum unbonded length.

(b) Include the following details in the ground anchor system drawings:

(1) Spacers and their location;

(2) Centralizers and their location;

(3) Unbonded length corrosion protection system;

(4) Bond length corrosion protection system;

(5) Transition between the unbonded length and the bond length corrosion protection systems;

(6) Anchorage and trumpet; and

(7) Anchorage corrosion protection system.

256.05 Tendon Fabrication.

(a) General. Fabricate the tendons in either the shop or field as indicated on the drawings. Size the tendon so:

(1) The design load does not exceed 60 percent of the minimum required ultimate tensile strength of the tendon; and

(2) The maximum test load does not exceed 80 percent of the minimum specified ultimate tensile strength of the tendon.

(b) Bond length. Determine the bond length necessary to develop the design load indicated on the drawings. Use a minimum tendon bond length of 10 feet in rock and 15 feet in soil. Provide corrosion protection of the tendon bond length with a cement grout cover.

Where encapsulation of the tendon is required, protect the tendon bond length from corrosion by encapsulating it in a grout-filled corrugated plastic or deformed steel tube or by coating it with fusion-bonded epoxy. Place the grout inside the tube either before or after the tendon is placed in the drill hole. Centralize the tendon within the tube with a minimum 1/8-inch grout cover.

(c) Centralizers. Use spacers along the tendon bond length of a multi-element tendon to separate each of the individual elements of the tendon. Use centralizers to ensure a minimum of 1/2 inch of grout cover over the tendon bond length or tendon bond length encapsulation as appropriate. Use centralizers that do not impede the free flow of grout up the bore hole. Position centralizers so their center-to-center spacing does not exceed 10 feet.

Locate the upper centralizer a maximum of 5 feet from the top of the tendon bond length. Locate the lower centralizer a maximum of 12 inches from the bottom of the tendon bond length.

Centralizers are not required on pressure-injected tendons if the ground anchor is installed in coarse-grained soils using grouting pressures greater than 150 pounds per square inch.

Centralizers are not required on hollow-stem-augered tendons if the ground anchor is grouted through the auger and the hole is maintained full of a stiff grout during extraction of the auger. A grout is considered *"stiff"* if its slump is less than 9 inches.

(d) Unbonded length. Provide minimum unbonded length of 15 feet.

(1) If the entire drill hole is grouted in one operation, provide corrosion protection of the unbonded length with a sheath completely filled with corrosion-inhibiting grease or grout, or a heat-shrinkable tube internally coated with an elastic adhesive.

If grease is used under the sheath, completely coat the unbounded tendon length, fill spaces between individual elements of multi-element tendon with grease, and provide measures to prevent grease from escaping at the ends of the sheath.

If the sheath is grout filled, provide a separate bondbreaker along the unbonded length of the tendon.

(2) If a grease-filled sheath corrosion protection is provided and the drill hole above the bond length is grouted after the ground anchor is locked off, grout the tendon inside a second sheath.

Where restressable ground anchors are used, provide a restressable anchorage compatible with the post-tensioning system provided.

If multi-element tendons are used, properly seat the wedges as recommended for the post-tensioning system provided.

(e) Bearing plates. Size the bearing plates so:

(1) The bending stresses in the plate do not exceed the yield strength of the steel when a load equal to 95 percent of the minimum specified ultimate tensile strength of the tendon is applied; and

(2) The average bearing stress of the bearing plate does not exceed that recommended in section 3.1.7 of the PTI, *Guide Specification for Post-Tensioning Materials.*

Weld trumpet to bearing plate. Make the inside diameter of the trumpet equal to or larger than the hole in the bearing plate. Make the trumpet long enough to accommodate movements during stressing and testing. For multi-element tendons with encapsulation over the unbonded length, make the trumpet long enough to enable the tendon to make a transition from the diameter of the tendon in the unbonded length to the diameter of the tendon at the anchorhead without damaging the

encapsulation. Fill the trumpet of restressable ground anchors with corrosion-inhibiting grease. Provide a permanent Buna-N synthetic rubber seal or an approved equal between the trumpet and the unbonded length corrosion protection.

Fill the trumpets of non-restressable ground anchors with grout. Provide a 12-inch minimum tightly-fitting temporary seal between the trumpet and the unbonded length corrosion protection.

256.06 Storing and Handling. Handle and store tendons in a manner to avoid damage or corrosion. Replace tendons exhibiting abrasions, cuts, welds, weld splatter, corrosion or pitting. Repair or replace any tendons exhibiting damage to encapsulation or sheathing. Degrease the bond length of tendons, and remove solvent residue before installation.

256.07 Installation. Drill ground anchor holes within 12 inches of the required location. Drill the longitudinal axis of the drill hole parallel to the longitudinal axis of the tendon. Install the ground anchor within 3 degrees of the required inclination from horizontal. Install the ground anchor with a horizontal angle within 3 degrees of a line drawn perpendicular to the plane of the structure. Do not extend ground anchors beyond the right-of-way or easement limits.

Insert the tendon in the drill hole to the required depth without driving or forcing. Where the tendon cannot be completely inserted, remove the tendon, and clean or redrill the hole to permit insertion.

Use a positive displacement pump to grout tendons into drill holes using either a neat cement grout or a sand/cement grout. Use a grout pump equipped with a pressure gauge capable of measuring pressures of at least 150 pounds per square inch or twice the actual grout pressure, whichever is greater. Use well-mixed grout that is free of lumps or other indications of prior cement hydration. Continuously agitate the grout during placement. Place the grout in one continuous operation.

Inject the grout from the lowest point of the drill hole. The grout may be placed either before or after insertion of the tendon. Record the quantity of the grout and the grout pressure for each ground anchor. Control the grout pressures to avoid excessive heaving or fracturing.

Except as indicated below, the grout above the top of the bond length may be placed at the same time as the bond length grout, but it shall not be placed under pressure. Do not place grout at the top of the drill hole in contact with the back of the structure or the bottom of the trumpet.

If the ground anchor is installed in a fine-grained soil using drill holes larger than 6 inches in diameter, place the grout above the top of the bond length after the ground anchor has been tested and stressed. The entire drill hole may be grouted at one time if it can be demonstrated that the ground anchor does not derive a significant portion of its load-carrying capacity from the soil above the bond length.

Use pressure grouting for grout protected tendons anchored in rock. After sealing the drill hole, pressure inject grout until a 50-pound per square inch grout pressure at the top of the drill hole is maintained for 5 minutes.

After grouting is complete, fill the grout tube with grout if it will remain in the hole. Wait a minimum of 3 days before loading the tendon.

Extend the corrosion protection surrounding the unbonded length up beyond the bottom seal of the trumpet or 12 inches into the trumpet if no trumpet seal is provided.

Trim the corrosion protection surrounding the unbonded length of the tendon as necessary so that it does not contact the bearing plate of the anchorhead during testing and stressing.

Place the bearing plate and anchorhead so the axis of the tendon is within 3 degrees of perpendicular to the bearing plate and the axis of the tendon passes through the center of the bearing plate without bending the tendon.

If grout protected tendons or fusion-bonded epoxy encapsulations are used, electronically isolate the bearing plate, anchorhead, and trumpet from the surrounding concrete, soldier pile, or any metallic element embedded in the structure.

Place trumpet grease any time during construction. Place trumpet grout after the ground anchor has been tested and stressed.

Completely cover all anchorages permanently exposed to the atmosphere with a corrosion-inhibiting grease or grout.

256.08 Testing and Stressing. Test each ground anchor using a maximum test load not to exceed 80 percent of the minimum ultimate tensile strength of the tendon. Simultaneously apply the test load to the entire tendon and all elements of multi-element tendons.

(a) Testing equipment. The testing equipment shall consist of:

(1) A dial gauge or vernier scale capable of measuring to 0.001 inch. Use a movement-measuring device having a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum test load. Use a device with sufficient travel so the anchor movement is measured without resetting the device.

(2) A hydraulic jack and pump. Use a jack and a calibrated pressure gauge to measure the applied load. Have the jack and pressure gauge calibrated as a unit by an independent firm within 45 days of the start of ground anchor work. Use a pressure gauge graduated in 100-pound per square inch increments or less. Use a jack having a minimum ram travel equal to the theoretical elastic elongation of the total anchor length at the maximum test load.

(3) A calibrated reference gauge. Have the reference gauge calibrated with the test jack and pressure gauge. Keep it at the project site.

(b) Performance tests. Place stressing equipment over the ground anchor tendon so that the jack, bearing plates, load cells, and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment.

Performance test 5 percent of the ground anchors or a minimum of 3 anchors, whichever is greater, at each separate structure. The CO will select the ground anchors to be performance tested.

Perform the performance test as indicated in Table 256-1.

Raise the load from one increment to another immediately after recording the ground anchor movement. Measure and record the ground anchor movement to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load and at each load increment. Monitor the load with a pressure gauge. Place the reference pressure gauge in series with the pressure gauge during each performance test. If the load measured by the pressure gauge and the load measured by the reference pressure gauge differ by more than 10 percent, recalibrate the jack, pressure gauge, and reference pressure gauge. At load increments other than the maximum test load, hold the load just long enough to obtain the movement reading.

Table 256-1
Performance Test Load Sequence

Test Sequence	Test Load Increment							
	A	**0.25D**	**0.50D**	**0.75D**	**1.00D**	**1.20D**	**1.33D**	**Reduce to Lock-Off Load**
1	•	•						
2	•	•	•					
3	•	•	•	•				
4	•	•	•	•	•			
5	•	•	•	•	•	•		
6	•	•	•	•	•	•	•	•

Note: A = Alignment load; D = Design load.

Hold the maximum test load for a minimum of 10 minutes. Repump the jack as necessary in order to maintain a constant load. Begin the load-hold period as soon as the maximum test load is applied.

Measure and record the ground anchor movement at 1, 2, 3, 4, 5, 6, and 10 minutes. If the ground anchor movement between 1 and 10 minutes exceeds 0.04 inches, continue holding the maximum test load and record ground anchor movement at 15, 20, 25, 30, 45, and 60 minutes.

Plot the ground anchor movement versus the maximum load for each test sequence in Table 256-1, and plot the residual movement of the tendon at each alignment load versus the highest previously applied load.

(c) Proof tests. Proof test all ground anchors that are not performance tested. Perform the proof test as indicated in Table 256-2.

Raise the load from one increment to another immediately after recording the ground anchor movement. Measure and record the ground anchor movement to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load, and at each load increment. Monitor the load with a pressure gauge.

Hold the maximum test load for a minimum of 10 minutes. Repump the jack as necessary in order to maintain a constant load. Begin the load-hold period as soon as the maximum test load is applied.

Measure and record the ground anchor movement at 1, 2, 3, 4, 5, 6, and 10 minutes. If the anchor movement between 1 and 10 minutes exceeds 0.04 inches, continue holding the maximum test load and record anchor movements at 15, 20, 25, 30, 45, and 60 minutes.

Table 256-2
Proof Test Load Sequence

Test Load Increment							
A	**0.25D**	**0.50D**	**0.75D**	**1.00D**	**1.20D**	**1.33D**	**Reduce to Lock-Off Load**
•	•	•	•	•	•	•	•

Note: A = Alignment load; D = Design load.

Plot the ground anchor movement versus load for each load increment in Table 256-2.

(d) Lock off. Upon completion of performance and proof tests, reduce the load to the specified lock-off load and transfer the load to the anchorage device. After transferring the load and before removing the jack, measure the lift-off load. If the load is not within 10 percent of the specified lock-off load, reset the anchorage and remeasure the lift-off load. Repeat as necessary.

256.09 Acceptance. See Table 256-3 for sampling and testing requirements.

Material for ground anchors will be evaluated under Subsections 106.02 and 106.03.

Construction of ground anchors and services will be evaluated under Subsections 106.02 and 106.04.

Grouting will be evaluated under Subsection 106.02 and 106.04.

Installed ground anchors will be evaluated based on one of the following performance or proof test results:

(a) After a 10-minute hold, the ground anchor carries the maximum test load with less than 0.04 inches of movement between 1 and 10 minutes and the total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

(b) After a 60-minute hold, the ground anchor carries the maximum test load with a creep rate that does not exceed 0.08 inches per log cycle of time and the total movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

Replace all ground anchors with unacceptable performance or proof test results. Do not retest failed ground anchors.

Measurement

256.10 Measure the Section 256 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure performance tests that indicate acceptable installations.

Payment

256.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 256 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 256-3
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate source quality (fine) (703.01)	Measured and tested for conformance (106.04)	Quality	—	AASHTO M 6	1 per material type	Source of material	Yes	Before producing
Grout mix design (722.02(e))	Measured and tested for conformance (106.04)	Flow	—	ASTM C 939	1 per mix design	Source of material	Yes, when requested	Before producing
		7-day compressive strength	—	AASHTO T 106	"	"	"	"

Section 257. — ALTERNATE RETAINING WALLS

Description

257.01 This work consists of constructing various types of retaining walls at the Contractor's option. The alternate wall types are gabions, crib walls, mechanically-stabilized earth walls, permanent ground anchor walls, and reinforced concrete retaining walls.

Material

257.02 Conform to the following Sections:

Crib walls	254
Driven piles	551
Gabions	253
Mechanically-stabilized earth walls	255
Permanent ground anchors	256
Reinforced concrete retaining walls	258
Reinforcing steel	554
Structural concrete	552

Construction Requirements

257.03 General. The designer/supplier furnishing the proposed wall is responsible for the stability of the wall. Do not qualify the responsibility for the design or restrict the use of the drawings or calculations for the proposed alternate. Indemnify the Government from all claims for infringement of proprietary rights by others without the consent of the patent holders or licensees.

257.04 Submittal. Submit a proposal using any of the wall types listed. Submit wall type proposals on a site-by-site basis. Different types may be used at individual sites on the project.

Survey according to Section 152, and verify the limits of the wall installation. Provide drawings of the proposed wall according to Subsection 104.03 within 120 days of the notice to proceed and at least 90 days before starting wall construction.

All drawings shall be signed by a professional engineer.

Include all details, dimensions, quantities, ground profiles, and cross-sections necessary to construct the wall. Submit design calculations on sheets about 8½ by 11 inches in size

with the project number, wall location, designation, date of preparation, initials of designer and checker, and page number at the top of the page.

Provide an index page with the design calculations. The drawings must include, but not be limited to, the following items:

(a) Plan and elevation drawings for each wall containing the following:

(1) A plan view of the wall identifying:

(a) Offset from the construction centerline to the face of the wall at its base at all changes in horizontal alignment;

(b) Limit of widest module, mesh, strip, or anchor; and

(c) Centerline of any drainage structure or drainage pipe behind, passing through, or passing under the wall.

(2) An elevation view of the wall identifying:

(a) Elevation at the top of the wall, at all horizontal and vertical break points, and at least every 50 feet along the wall;

(b) Elevations at the wall base, the top of leveling pads and footings, or the bottom of soldier piles;

(c) Wall batter;

(d) Distance along the face of the wall to all steps in the wall base, footings, leveling pads, or lagging;

(e) Type of panel or depth of module or lagging;

(f) Length and type of mesh, strips, or anchors;

(g) Distance along the face of the wall to where changes in length of the mesh, strips, or anchors occur; and

(h) Original and final ground line.

(3) General notes for constructing the wall.

(4) Horizontal and vertical curve data affecting the wall. Match lines or other details to relate wall stationing to centerline stationing.

(5) A listing of the summary of quantities on the elevation drawing of each wall.

(b) Dimensions and schedules of all reinforcing steel including reinforcing bar bending details, dowels, and studs for attaching the facing.

(c) Details and dimensions for foundations and leveling pads including steps in the footings or leveling pads.

(d) Details and dimensions for all:

(1) Panels, modules, soldier piles, and lagging necessary to construct the element;

(2) Reinforcing steel in the element;

(3) Location of mesh, strip attachment, or anchor devices embedded in the panels; and

(4) Anchors and soldier piling including the spacing and size of piles and the spacing and angle of anchors.

(e) Details for constructing walls around drainage facilities.

(f) Details for terminating walls and adjacent slope construction.

(g) Architectural treatment details.

(h) Design notes including an explanation of any symbols and computer programs used in the design of the walls. Specify the factors of safety for sliding, pullout, and overturning. Specify the bearing pressure beneath the wall footing, stabilized earth mass, or soldier piles.

(i) Verification of design criteria for the site specific wall locations with test procedures, results, and interpretations. Include results from creep, durability, construction induced damage, and junction strength tests.

(j) Other design calculations.

Process all submissions through the Contractor unless the Contractor gives written permission for the wall designer/supplier and the CO to communicate directly.

Submit 3 sets of the wall drawings with the initial submission. One set will be returned with any indicated corrections. If revisions are necessary, make the necessary corrections and resubmit 3 revised sets.

When the drawings are accepted, furnish 5 sets and a mylar sepia set of the drawings.

257.05 Construction. Construct the wall according to the accepted drawings and the following Sections, as applicable:

(a) Gabions. Section 253.

(b) Crib walls. Section 254.

(c) Mechanically-stabilized earth walls. Section 255.

(d) Permanent ground anchor walls. Sections 256, 551, and 552.

(e) Reinforced concrete retaining walls. Section 258.

Revise the drawings when plan dimensions are revised due to field conditions or for other reasons.

257.06 Acceptance. Material for alternate retaining walls will be evaluated under Subsection 106.02, 106.03, or 106.04 according to the applicable sections listed in Subsection 257.05.

Construction of alternate retaining walls and services will be evaluated under Subsections 106.02 and 106.04 according to the applicable sections listed in Subsection 257.05.

Structure excavation and backfill will be evaluated under Section 209.

Measurement

257.07 Measure the Section 257 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure foundation fill under Section 208.

Payment

257.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 257 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

When plan dimensions are changed by the CO during construction to account for field conditions, the lump sum price of the wall will be adjusted by applying a calculated per square foot cost adjustment factor to the added or decreased wall front face area.

The adjustment factor will be determined by dividing the lump sum price bid for each wall by its estimated area.

The alternate retaining wall lump sum will be paid based on the progress of the work under this Section.

Section 258. — REINFORCED CONCRETE RETAINING WALLS

Description

258.01 This work consists of constructing reinforced concrete retaining walls.

Material

258.02 Conform to the following Sections and Subsections:

Concrete	552
Forms and falsework	562
Joint fillers and sealants	712.01
Reinforcing steel	709.01
Structural backfill	704.04
Tie bars, dowel bars, and hook bolts	709.01

Construction Requirements

258.03 General. Survey according to Section 152, and verify the limits of the wall installation. Prepare and submit forms and falsework drawings according to Section 562. Perform the work under Section 209.

258.04 Reinforcing Steel. Submit all order lists and bending diagrams according to Subsections 104.03 and 554.03. Fabricate reinforcing steel according to Subsection 554.05. Ship and protect material according to Subsections 554.04 and 554.06. Place, fasten, and splice reinforcing steel according to Subsections 554.08 and 554.09.

258.05 Structural Concrete. Design concrete mixture according to Subsection 552.03. Store, handle, batch, and mix material and deliver concrete according to Subsections 552.04 through 552.08. Provide quality control according to Section 153 and Subsection 552.09. Construct wall according to Subsections 552.10 through 552.16.

258.06 Backfilling. Backfill the area behind the wall with structural backfill according to Subsection 209.10. Compact each layer according to Subsection 209.11 except use an approved lightweight mechanical or vibratory compactor within 3 feet of the wall.

258.07 Acceptance. Reinforced concrete retaining wall material, construction, and services will be evaluated as follows:

Survey work will be evaluated under Section 152.

Forms and falsework drawings will be evaluated under Section 562.

Structure excavation and backfill will be evaluated under Section 209.

Concrete will be evaluated under Section 552.

Reinforcing steel will be evaluated under Section 554.

Material for joint fillers, sealants, tie bars, dowel bars, and hook bolts will be evaluated under Subsections 106.02 and 106.03.

Measurement

258.08 Measure the Section 258 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure by the cubic yard of concrete in the structure including footings.

Measure the square foot area by the length of the front wall face and the height excluding footings.

Measure foundation fill under Section 208.

Payment

258.09 The accepted quantities will be paid at the contract price per unit of measurement adjusted according to Subsection 106.05 for the Section 258 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

The accepted quantities of reinforced concrete retaining wall will be paid for at the contract unit bid price multiplied by an adjusted pay factor (PF_a) determined as follows:

$$PF_a = 1 - 0.5\,(1-PF)$$

where:

PF = Pay factor for concrete as determined under Section 552.

Section 259. — SOIL NAIL RETAINING WALLS

Description

259.01 This work consists of constructing soil nail retaining walls.

Material

259.02 Conform to the following Section and Subsections:

Bolts and nuts	717.01(d)
Centralizers	722.02(f)
Geocomposite sheet drain	714.02(b)
Grout	722.02(e)
Shotcrete	566
Soil nails	722.04
Structural backfill	704.04
Structural steel (bearing plates)	717.01(a)
Welded stud sheer connectors	717.05

Construction Requirements

259.03 Qualifications. The Contractor or subcontractor must demonstrate satisfactory completion of at least 5 permanent soil nail-retaining wall projects during the past 3 years, totaling at least 10,000 square feet of wall face area and at least 500 permanent soil nails. Submit a brief description of each project including the owning agency's name, contact person, and current telephone number.

Provide a professional engineer with experience in constructing at least 3 soil nail-retaining walls over the past 5 years. Provide on-site supervisors and drill operators with experience installing permanent soil nails on at least 3 projects over the past 5 years. At least 30 days before starting soil nail work, identify the engineer, on-site supervisors, and drill operators assigned to the project and submit a summary of each individual's experience.

259.04 General. Survey according to Section 152 and verify the limits of the wall installation.

259.05 Construction Plan. At least 30 days before starting soil nail-retaining wall work, submit the following according to Subsection 104.03:

(a) Start date and proposed retaining wall construction sequence. Include the proposed method of excavating to ensure wall and slope stability.

(b) Drilling methods and equipment. Include drill hole diameter to achieve the specified pullout resistance values and any variation of drill hole diameter or specific pullout resistance along the wall alignment.

(c) Nail grout mix design, placement procedures, and equipment. Include test results conducted according to AASHTO T 106 and supplied by a qualified testing lab verifying grout 3-day and 28-day compressive strengths. Previous test results for the same grout mix completed within one year of grouting are acceptable.

(d) Soil nail testing methods and equipment setup.

(e) Identification number and calibration test results for each test jack, pressure gauge, and load cell. Calibrate the test jack and pressure gauge as one unit. Submit results from calibration tests conducted by an independent testing laboratory within the previous 90 days.

(f) Ultimate strength of proposed soil nail tendons.

259.06 Excavation. Complete any clearing and excavation above the wall area according to Sections 201 and 204 before commencing wall excavation. Do not perform any of the wall excavation before beginning the wall construction. A work bench for the drilling equipment may be provided by placing material excavated from elsewhere on the project in front of the soil nail wall area.

Perform excavation for the wall in lifts concurrent with soil nail installation and shotcrete placement. Do not allow the exposed unsupported final excavation face cut height to exceed the vertical nail spacing plus the required reinforcing lap or the short-term stand-up height of the ground, whichever is less. Complete excavation to the final wall excavation line and application of the shotcrete in the same work shift. Application of the shotcrete may be delayed up to 24 hours if it can be demonstrated the delay will not adversely affect the excavation face stability. A stabilizing berm of soil may be left in place to contain the lift face during nail installation.

Do not excavate to the next lower lift until nail installation, reinforced shotcrete placement, attachment of bearing plates and nuts, and nail testing have been completed and accepted in the current lift. Cure grout and shotcrete at least 72 hours or attain the specified 3-day compressive strength before excavating the next underlying lift.

259.07 Nail Installation.

(a) Storing and handling. Store and handle soil nail tendons in a manner that avoids damage or corrosion. Replace tendons exhibiting abrasions, cuts, weld splatter, corrosion, or pitting. Repair or replace any tendons exhibiting damage to the encapsulation or epoxy coating.

(b) Fabrication. Provide tendons threaded a minimum of 6 inches to allow proper attachment of bearing plate and nut. Threading may be continuous spiral deformed ribbing provided by the bar deformations or may be cut into the reinforcing bar. Use the next larger bar size if threads are cut into the reinforcing bar. When appropriate, repair damage to the epoxy coating with a minimum 12 mil-thick coating.

Provide centralizers sized to position the tendon within 1 inch of the center of the drill hole. Position centralizers a maximum of 10 feet apart and within 24 inches from the top and bottom of the tendon. Use centralizers that do not impede the free flow of grout into the drill hole.

(c) Drilling. Drill holes for the soil nails at the locations and to the orientation shown on the plans. Select drilling equipment and methods suitable for the ground conditions. Do not use water, drilling mud, or other fluids for drilling or removing cuttings. If unstable ground is encountered, use cased drilling methods to support the circumference of the drill holes. Self-drilling tendons are not acceptable.

(d) Grouting. Insert the nail tendon into the hole and grout the drill hole within 2 hours of completing drilling. Inject the grout at the lowest point of each drill hole through a grout tube, casing, hollow-stem auger, or drill rods. Completely fill the drill hole in one continuous operation. To prevent voids, keep the outlet end of the grout conduit below the surface of the grout as the conduit is withdrawn. Cold joints in the grout column are only allowed at the top of the test bond length of proof-tested production nails.

Maintain the temporary unbonded length of proof test nails open for subsequent grouting. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing, install a new nail in its place.

259.08 Nail Testing. Perform both verification and proof testing of designated test nails. Do not test any nail until the nail grout and shotcrete facing have cured for at least 72 hours and attained the specified 3-day compressive strength.

(a) Testing equipment. Furnish two dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The load cell is required for verification tests only.

Use pressure gauges graduated in no greater than 100-pound per square inch increments. Measure the nail head movement with a minimum of two dial gauges capable of measuring to 0.001 inch.

(b) Verification test. Perform verification tests on sacrificial test nails at locations shown on the plans. Perform verification tests before installation of production nails to verify drilling and installation methods, nail pullout resistance, and design assumptions.

Provide verification test nails with both bonded and unbonded lengths. The minimum unbonded length is 3 feet and the minimum bonded length is 10 feet. Determine the maximum bonded length based on the verification nail bar grade and size to avoid exceeding the allowable bar structural load during testing. Provide larger bar sizes if required to safely accommodate the 10-foot minimum test bond length and testing to twice the allowable pullout resistance.

Use the following formula to determine the maximum bonded length:

$$L_{BV\max} = \frac{Cf_y A_s}{2Q_d}$$

where:

L_{BVmax}	=	Maximum verification test nail bonded length (feet)
C	=	0.9 for grades 60 and 75 bars and 0.8 for grade 150 bars
f_y	=	Bar yield or ultimate stress (pounds per square inch)
A_s	=	Bar steel area (square inches)
Q_d	=	Allowable pullout resistance (pounds per foot)

Determine the design test load by the following equation:

$$DTL = L_{BV} \times Q_d$$

where:

DTL	=	Design test load (pounds)
L_{BV}	=	As-built bonded test length (feet)
Q_d	=	Allowable pullout resistance (pounds per foot)

Perform tests by incrementally loading the verification test nails as indicated in Table 259-1. Measure and record soil nail movement at each load increment.

The alignment load is the minimum load required to align the testing apparatus and should not exceed 5 percent of the design test load. Set dial gauges to “zero” after applying the alignment load. Following application of the maximum load, reduce the load to the alignment load and record the permanent set.

Hold each load increment for at least 10 minutes. Monitor the verification test nail for creep at the 1.50 DTL load increment by measuring and recording nail movement at 1, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. Maintain the load during the creep test within 2 percent of the intended load by use of the loadcell.

Table 259-1
Verification Test Load Schedule

Test Load Increment	Hold Time (minutes)
AL (0.05DTL max.)	1
0.25DTL	10
0.50DTL	10
0.75DTL	10
1.00DTL	10
1.25DTL	10
1.50DTL (creep test)	60
1.75DTL	10
2.00DTL (maximum load)	10
AL	1

Note: AL = Alignment load; DTL = Design test load.

(c) Proof testing of production nails. Perform proof tests on production nails at locations selected by the CO. Perform successful proof testing on 5 percent of the production nails in each nail row or a minimum of 1 per row.

Provide production proof test nails with both bonded and temporary unbonded lengths. The minimum temporary unbonded length is 3 feet. Determine the maximum bonded length based on the production nail bar grade and size to avoid exceeding the allowable bar structural load during testing. Provide a test nail bonded length of 10 feet or L_{BPmax}, whichever is less.

Use the following formula to determine the maximum bonded length:

$$L_{BP\,\max} = \frac{Cf_y A_s}{1.5Q_d}$$

where:

L_{BPmax} = Maximum proof test nail bonded length (feet)

C = 0.9 for grade 60 and 75 bars and 0.8 for grade 150 bars

f_y = Bar yield or ultimate stress (pounds per square inch)

A_s = Bar steel area (square inches)

Q_d = Allowable pullout resistance (pounds per foot)

Determine the design test load by the following equation:

$$DTL = L_{BP} \times Q_d$$

where:

DTL = Design test load (pounds)

L_{BP} = As-built bonded test length (feet)

Q_d = Allowable pullout resistance (pounds per foot)

Perform proof tests by incrementally loading the proof test nail to 150 percent of the design load as indicated in Table 259-2. Measure and record soil nail movement at each load increment.

Table 259-2
Proof Test Load Schedule

Test Load Increment	Hold Time (minutes)
AL (0.05DTL max.)	Until stable
0.25DTL	Until stable
0.50DTL	Until stable
0.75DTL	Until stable
1.00DTL	Until stable
1.25DTL	Until stable
1.50DTL (maximum load)	See below

Note: AL = Alignment load; DTL = Design test load.

The alignment load should be the minimum load required to align the testing apparatus and should not exceed 5 percent of the design test load. Set dial gauges to "zero" after the alignment load has been applied.

Perform either 10-minute or 60-minute creep tests at the maximum load. Start the creep period after the maximum test load is applied. Measure and record nail movement at 1, 2, 3, 5, 6, and 10 minutes. When the nail movement between 1 minute and 10 minutes exceeds 0.04 inches, maintain the maximum test load an additional 50 minutes, recording movement at 20, 30, 50, and 60 minutes. Maintain all load increments within 5 percent of the intended load.

259.09 Wall Drainage Network. Install drain strips, PVC connector pipes, wall footing drains, and weepholes as shown on the plans. Exclusive of the wall footing drains, install all elements of the drainage network, as appropriate, before shotcreting each lift.

Install geocomposite sheet drain strips centered between nail columns with the geotextile side against the ground. Add additional drain strips at locations where seepage is obvious. Secure strips to the excavated face to prevent shotcrete from contaminating the ground side of the geotextile. Construct drain strip splices with a 12-inch overlap so that the drain is vertically continuous and the splice does not impede the flow of water. Install a drain plate and connector pipe at the base of each strip.

Place PVC pipe sections, as required, to act as weepholes through the construction shotcrete face.

Install footing drains at the bottom of the wall according to Section 605.

259.10 Wall Construction. Place steel welded wire mesh and reinforcing steel according to Section 554.

Construct shotcrete facing according to Section 566. Completely fill the top ungrouted zone of any nail drill holes or other voids with shotcrete.

Attach a bearing plate and nut to each nail head. While the shotcrete is still plastic, uniformly seat the plate by tightening the nut with a hand wrench. Where uniform contact between the plate and the shotcrete cannot be provided, set the plate in a bed of grout and tighten the nut with a hand wrench after the grout has set for 24 hours.

Construction tolerances for wall elements are shown in Table 259-3.

Table 259-3
Wall Element Construction Tolerances

Wall Element	Tolerance
Horizontal location of headed studs, from plan location	3/8 inch
Location of headed studs on bearing plate, from plan location	1/4 inch
Nail head bearing plate, deviation from parallel to wall face	10 degrees

259.11 Permanent Wall Facing. Construct the permanent wall facing according to the applicable Subsection below. When applicable, finish surfaces with simulated stone masonry according to Section 613.

(a) Shotcrete-faced walls. Construct shotcrete facing according to Section 566. Construction tolerances for the permanent shotcrete facing are shown in Table 259-4.

(b) Concrete-faced walls. Construct according to Section 258.

Table 259-4
Permanent Shotcrete Facing Construction Tolerances

Facing Finish	Tolerance
Complete thickness of shotcrete, from plan dimension:	
Troweled or screeded finish	5/8 inch
Shot finish	1⅛ inches
Planeness of finish face, surface gap under a 10-foot straightedge:	
Troweled or screeded finish	5/8 inch
Shot finish	1⅛ inches

259.12 Backfilling Behind Wall Facing Upper Cantilever Section. Where the wall facing has an upper cantilever section, backfill with structural backfill according to Subsection 209.10. Compact backfill according to Subsection 209.11 within 3 feet behind this wall facing section using light mechanical tampers.

259.13 Acceptance. Soil nail retaining wall material, construction, and services will be evaluated as follows:

Survey work will be evaluated under Section 152.

Material for the soil nails will be evaluated under Subsections 106.03 and 106.04.

Construction of soil nails and services will be evaluated under Subsections 106.02 and 106.04.

Installed soil nails will be evaluated based on the criteria in Table 259-5.

Table 259-5
Nail Acceptance Criteria

Type of Nail Test	Total Creep Movement	Total Movement at Maximum Load[2]	Pullout Failure?[3]
Verification	< 0.080 inches between 6 and 60 minutes[1]	>80%	No
Proof	< 0.040 inches between 1 and 10 minutes, or < 0.080 inches between 6 and 60 minutes[1]	>80%	No

(1) And the creep rate is linear or decreasing throughout the creep test load hold period.
(2) Percent of the theoretical elastic elongation of the test nail unbonded length.
(3) Pullout failure is defined as the inability to further increase the test load while there is continued pullout movement of the test nail. Record the pullout failure load as part of the test data.

If a verification test fails, propose alternate installation methods before installing additional verification test nails and install a replacement verification test nail.

If a proof test fails, replace some or all of the installed production nails between the failed proof test nail and the next proof test nail in the row, as directed. Alternatively, install additional proof test nails within this area to ensure that the acceptance criteria is being met within this area. Propose alternative methods before installing additional soil nails.

Measurement

259.14 Measure the Section 259 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure soil nail retaining walls by the square foot of front wall face.

Measure verification test nails by the each. Do not measure failed verification test nails or additional verification test nails installed to verify alternative nail installation methods proposed by the Contractor.

Measure production soil nails by the linear foot. Measure along bar centerline from the line of the wall excavation face to the tip of the nail.

Do not measure temporary stabilization berms.

Do not measure wall excavation.

Payment

259.15 The accepted quantities will be paid for at the contract unit price per unit of measurement for the Section 259 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 259-6
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Centralizers	Certification of compliance (106.03)	Quality & performance	—	Subsection 722.02(f)	Each shipment	Source	—	Before using in work
Soil nails	Certification of compliance (106.03)	Quality & performance	—	Subsection 722.04	Each shipment	Source	—	Before using in work
Epoxy coating	Certification of compliance (106.03)	Quality & performance	—	Subsection 722.04(c)	Each shipment	Source	—	Before using in work
Geocomposite sheet drain	Certification of compliance (106.03)	Quality & performance	—	Subsection 714.02(b)	Each shipment	Source	—	Before using in work
Grout mix design	Certification of compliance (106.03)	Quality & strength	—	Subsection 259.05	1 per source of material	—	—	30 days before beginning soil nail work

Table 259-6 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Nail grout	Measured and tested for conformance (106.04)	Compressive strength	—	Subsection 722.02(e) AASHTO T 106	1 per mix design	Mixer	—	30 days before beginning soil nail work
Verification test nail	Measured and tested for conformance (106.04)	Performance	—	Subsection 259.08(b) Table 259-5	Each verification nail	Installation	—	—
Proof test nail	Measured and tested for conformance (106.04)	Performance	—	Subsection 259.08(c) Table 259-5	Each proof nail	Installation	—	—
Wall elements	Measured and tested for conformance (106.04)	Installation	—	Table 259-3	—	Installation	—	—
Permanent shotcrete facing	Measured and tested for conformance (106.04)	Placement	—	Table 259-4	—	Installation	—	—

Section 260. — ROCK BOLTS

Description

260.01 This work consists of furnishing and installing tensioned rock bolts.

Material

260.02 Conform to the following Subsections:

Grout	722.02(e)
Rock Bolts	722.03

Construction Requirements

260.03 Submittal. At least 14 days before the installation of rock bolts, submit the following information:

(a) Evidence that the foreman has a minimum of 1500 hours and the drill operator has a minimum of 1000 hours of satisfactory work in similar installation of post-tensioned rock bolts.

(b) Construction sequence and schedule.

(c) Drilling methods and type of equipment.

(d) Proposed rock bolt, couplers, bearing plate, anchor unit, flat washer, and beveled washer specifications including manufacturer's data sheets and specifications for any additional hardware items.

(e) If using cartridged polyester-resin adhesives, include manufacturer's data sheets and placement procedures.

(f) Proposed grout mix design.

(g) Calibration data for each torque wrench to be used. Submit results of calibration test performed by an independent testing laboratory within the last 60 days.

Allow 7 days for acceptance or rejection. Do not begin work until submittals have been approved.

260.04 Rock Bolt. Size the bolt so the design load does not exceed 60 percent of the minimum guaranteed ultimate tensile strength of the bolt. Select and fabricate bolts to carry the specified loads.

Couple only grouted bolts. Couple sections together when standard, commercially-available lengths are exceeded. Provide a center stop for connecting sections so that an equal length of thread connects each section. Provide couplings that equal the manufacturer's guaranteed ultimate strength for the rock bolt. Do not fabricate couplings in a manner that interferes with the flow of grout.

260.05 Handling and Storage. Protect bolts from dirt, mud, water, and other harmful substances to avoid damage and corrosion. Do not use rock bolts that are heavily corroded, pitted, damaged due to welding, or show signs of abrasions, cuts, or nicks.

260.06 Installation. Drill holes at the locations and orientations shown in the plans or as directed by the CO and to the diameter specified by the bolt manufacturer. Clean holes of all drill cuttings, sludge, and debris before the rock bolt is inserted or grout is injected into the hole. Insert bolt into the hole. Attach the bearing plate, washer, and nut to the bolt with the threaded outer end of the bolt projecting beyond the nut at least 2 inches.

For grout-anchored bolts, inject sufficient grout into the drill hole to fill the bond zone around the bolt. Apply tension to bolt after the time specified in Table 260-1.

Table 260-1
Grout Curing Time

Cement Type	Curing Time (Days)
I	5
II	5
III	3

For bolts anchored with polyester resin, use fast-setting polyester resin cartridges in the bond zone and slow-setting polyester resin cartridges in the no load zone with gel times consistent with rapid installation. Select cartridge diameters in accordance with the manufacturer's recommendations to ensure complete encapsulation of the rock bolt and satisfactory in-hole mixing. Break and mix resin cartridges by spinning the bolt as it is inserted into the drill hole according to the manufacturer's instructions.

For mechanically-anchored, hollow-stem rock bolts, tension the bolt before grouting. After grouting, inject grout through the hollow core of the bolt or through a grout tube until the space between the bolt and drill hole wall is filled and grout is forced out of the de-airing tube at the face of the hole.

260.07 Tensioning. Apply tension to the bolt with a calibrated torque wrench to 125 percent of the design load. After tensioning, lock bolt off at the specified design load.

Tension polyester resin-anchored bolts immediately after the fast-set resin in the bond zone has set up and before the slow-set resin in the unbonded zone has set up.

Tension grouted bolts after the bonded length has been grouted and the grout has set up but before the unbonded length is grouted.

Tension mechanically-anchored rock bolts immediately after insertion into the drill hole according to the manufacturer's recommendations.

Allow the bolt to remain in place if:

(a) The bolt can be tensioned to 125 percent of the design load and the load can be held for 10 minutes.

(b) The design load is maintained after final grouting has been accomplished.

Replace any bolt that does not meet (a) or (b) in a manner and in a location approved by the CO.

260.08 Acceptance. Material for rock bolts will be evaluated under Subsection 106.02 and 106.03.

Installation of rock bolts will be evaluated under Subsections 106.02 and 106.04.

Measurement

260.09 Measure the Section 260 items listed in the bid schedule according to Subsection 109.02.

Payment

260.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 260 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 261. — ROCK DOWELS

Description

261.01 This work consists of furnishing and installing rock dowels.

Material

261.02 Materials. Conform to the following Sections and Subsections:

Concrete	601
Grout	722.02(e)
Reinforcing steel	709.01(b)
Shotcrete	566

Supply reinforcing steel for dowels in the form of deformed or threaded bar.

Construction Requirements

261.03 General. Install dowels at the locations and to the depths shown on the plans or directed by the CO.

261.04 Drilling. Drill holes for dowels perpendicular to the supporting rock surface and as close as possible to the rock that is to be supported. Drill holes for rock dowels a minimum of 1 inch larger than the dowel diameter.

261.05 Installation. Partially fill the dowel hole with grout. Place and center the dowel in the drill hole. Inject sufficient grout to fill the remainder of the hole. Encase the length of dowel protruding from the hole with a sufficient amount of shotcrete or hand-packed concrete to completely encapsulate the dowel and fill the space between the dowel and the surface of the rock to be supported. Construct forms as necessary to contain the shotcrete or concrete until it has hardened.

261.06 Acceptance. Material for dowels will be evaluated under Subsections 106.02 and 106.03.

Installation of rock dowels will be evaluated under Subsections 106.02 and 106.04.

Measurement

261.07 Measure the Section 261 items listed in the bid schedule according to Subsection 109.02.

Payment

261.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 261 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

DIVISION 300

AGGREGATE COURSES

Section 301. — UNTREATED AGGREGATE COURSES

Description

301.01 This work consists of constructing one or more courses of aggregate on a prepared surface.

Subbase and base aggregate grading is designated as shown in Table 703-2.

Material

301.02 Conform to the following Subsections:

Aggregate	703.05
Water	725.01

Construction Requirements

301.03 General. Prepare the surface on which the aggregate course is placed according to Section 204 or 303 as applicable.

After a representative quantity of aggregate is produced, submit proposed target values for the appropriate sieve sizes along with a representative 300-pound sample at least 14 days before incorporating the aggregate into the work.

Set target values within the gradation ranges shown in Table 703-2 or 703-3 for the required grading.

301.04 Mixing and Spreading. Determine the optimum moisture content according to AASHTO T 180, method D. Mix the aggregate and adjust the moisture content to obtain a uniform mixture with a moisture content within 2 percent of the optimum moisture content. Spread and shape the mixture on the prepared surface in a uniform layer.

Do not place the mixture in a layer exceeding 6 inches in compacted thickness. When more than one layer is necessary, compact each layer according to Subsection 301.05 before placing the next layer. Route hauling equipment uniformly over the full width of the surface to minimize rutting or uneven compaction.

301.05 Compacting. Determine the maximum density of the mixture according to AASHTO T 180, method D.

Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.

Compact each layer to at least 95 percent of maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures.

301.06 Surface Tolerance. If grade finishing stakes are required, finish the surface to within ±0.05 feet from staked line and grade elevation.

If grade finishing stakes are not required, shape the surface to the required template and check the surface with a 10-foot straightedge. Defective areas are surface deviations in excess of 1/2 inch in 10 feet between any two contacts of the straightedge with the surface.

Correct all defective areas by loosening the material, adding or removing material, reshaping, and compacting.

301.07 Maintenance. Maintain the aggregate course to the correct line, grade, and cross-section by blading, watering, rolling, or any combination thereof until placement of the next course. Correct all defects according to Subsection 301.06.

301.08 Acceptance. See Table 301-1 for sampling and testing requirements and the acceptance quality characteristic category.

Aggregate gradation and surface course plasticity index will be evaluated under Subsection 106.05. Other aggregate quality properties will be evaluated under Subsections 106.02 and 106.04.

(a) Aggregate gradation. The upper and lower specification limits are equal to the calculated mean of all test results plus or minus the allowable deviations shown in Tables 703-2 and 703-3, except as follows:

(1) If the calculated mean value for any tested sieve exceeds the maximum gradation value shown in Table 703-2 or 703-3, the upper specification is equal to the maximum gradation value plus the allowable deviation, and the lower specification is equal to the maximum gradation value minus the allowable deviation.

(2) If the calculated mean value for any tested sieve is less than the minimum gradation value shown in Table 703-2 or 703-3, the upper specification is equal to the minimum gradation value plus the allowable deviation and the lower specification is equal to the minimum gradation value minus the allowable deviation.

(b) Plasticity index. The upper and lower specification limits for surface courses are shown in Table 703-3.

Construction of untreated aggregate courses will be evaluated under Subsections 106.02 and 106.04.

Preparation of the surface on which the aggregate course is placed will be evaluated under Section 204 or 303 as applicable.

Measurement

301.09 Measure the Section 301 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure aggregate by the cubic yard in the hauling vehicle.

Measure square yard width horizontally to include the top of aggregate width including designed widenings. Measure the square yard length horizontally along the centerline of the roadway.

Payment

301.10 The accepted quantities will be paid at the contract price per unit of measurement adjusted according to Subsection 106.05 for the Section 301 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 301-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate source quality 703.05(a)	Measured and tested for conformance (106.04& 105)	LA abrasion (coarse)	—	AASHTO T 96	1 per type & source of material	Source of material	Yes, when requested	Before using in work
		Sodium sulfate soundness loss (coarse & fine)	—	AASHTO T 104	"	"	"	"
		Durability index (coarse & fine)	—	AASHTO T 210	"	"	"	"
		Fractured faces	—	ASTM D 5821	"	"	"	"
Subbase courses grading A & B	Statistical (106.05)	Gradation		AASHTO T 27 & T 11	1 per 1000 tons	From windrow or road bed after processing	Yes	4 hours
		No. 4	I					
		No. 200	I					
		Other specified sieves	II					

Table 301-1 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Base course grading C, D, & E	Statistical (106.05)	Gradation		AASHTO T 27 & T 11	1 per 1000 tons	From windrow or roadbed after processing	Yes	4 hours
		3/8 inch	I					
		No. 4	I					
		No. 200	I					
		Other specified sieves	II					
Subbase & base course grading A, B, C, D & E	Measured and tested for conformance (106.04)	Liquid limit	—	AASHTO T 89	1 per 1000 tons	From windrow or roadbed after processing	Yes	4 hours
		Moisture-density (max. density)	—	AASHTO T 180, method D (1)	1 per type & source of material	Material source before using	Yes	
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 500 tons	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Table 301-1 (continued)
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Surface course aggregate	Statistical (106.05)	Gradation		AASHTO T 27 & T 11	1 per 1000 tons	From windrow or roadbed after processing	Yes	4 hours
		No. 4	I					
		No. 40	I					
		No. 200	I					
		Other specified sieves	II					
		Liquid limit	II	AASHTO T 89	"	"	"	"
		Plasticity index	I	AASHTO T 90	"	"	"	"
	Measured and tested for conformance (106.04)	Moisture-density (max. density)	—	AASHTO T 180, method D (1)	1 per type & source of material	Source of material	Yes	Before using in work
		Density	—	AASHTO T 310 or other approved procedures	1 per 500 tons	In-place	—	Before placing next layer
		Fractured faces	—	ASTM D5821	1 per 1000 tons	From windrow on roadbed after processing	Yes	Before using in work

(1) Minimum of 5 points per proctor.

Section 302. — TREATED AGGREGATE COURSES

Description

302.01 This work consists of constructing one or more courses of an aggregate and cement mixture or an aggregate, fly ash, lime, and cement (AFLC) mixture on a prepared roadbed.

Treated aggregate courses are designated as cement or AFLC.

Aggregate grading is designated as shown in Table 703-2.

Material

302.02 Conform to the following Subsections:

Aggregate	703.05
Blotter	703.13
Chemical admixture (set-retarding)	711.03
Emulsified asphalt	702.03
Fly ash	725.04
Hydraulic cement	701.01
Lime	725.03
Water	725.01

Construction Requirements

302.03 Proportioning. Submit a treated aggregate course mix design 30 days before production.

Provide a minimum average compressive strength of 500 pounds per square inch with no single test lower than 400 pounds per square inch. Mold, cure, and test samples of the AFLC mixture according to ASTM C 593, parts 10 and 11 except revise the curing period from 7 to 28 days at 100±3 ºF.

For aggregate and cement mixtures, meet the design parameters in Table 302-1.

Table 302-1
Range of Aggregate/Cement
Mix Design Parameters

Material	Percent(1)
Aggregate	90 - 96
Hydraulic cement	4 - 10

(1) By mass of total dry mix.

For AFLC mixtures, meet the design parameters in Table 302-2.

Table 302-2
Range of AFLC Mix Design Parameters

Material	Percent(1)
Aggregate	75 - 92
Fly ash	6 - 20
Lime and hydraulic cement	2 - 5

(1) By mass of total dry mix.

Include the following with the mix design, as applicable:

(a) Source of each component material;

(b) Results of the applicable tests;

(c) Target values for each aggregate sieve size specified as applicable;

(d) 200-pound sample of aggregate;

(e) 50-pound sample of fly ash;

(f) 25-pound sample of lime;

(g) 25-pound sample of hydraulic cement; and

(h) 5-pound sample of the retarder or other admixtures.

Begin production only after the mix design is approved. Furnish a new mix design if there is a change in a material source.

302.04 General. Store chemical additives and admixtures in closed, weatherproof containers. Prepare the surface on which the treated aggregate course is placed according to Section 204 or 303 as applicable. Determine the optimum moisture content according to AASHTO T 180, method D.

302.05 Mixing. Do not begin mixing operations when the atmospheric temperature is expected to fall below 40 ºF within 48 hours. Do not place a treated aggregate course when the underlying surface is frozen, muddy, or when it is raining or snowing.

Mix the components with suitable equipment until a uniform mixture is obtained. During mixing, add sufficient water to obtain the optimum moisture content for compaction plus 2 percent.

Equip the mixer with batching or metering devices for proportioning the components either by mass or volume. Maintain the accuracy of the amounts of aggregate, chemical additives, and water (based on total dry mass) within the following tolerances:

Aggregate	±2.0% by mass
Fly ash	±1.5% by mass
Lime or cement	±0.5% by mass
Retarder or other additive	±2.0% by mass
Water	±2.0% by mass

A retarder may be used to slow initial set for a maximum of 2 hours. Dissolve retarder in water, and uniformly add the solution to the mixture.

When a central plant is used, transport the mixture in vehicles that maintain moisture content and prevent segregation and loss of the fine material.

302.06 Placing, Compacting, and Finishing. Place, compact, and finish the treated aggregate course according to Subsections 301.04, 301.05, and 301.06. Maintain the moisture content (±2 percent of optimum) during placing and finishing.

Do not leave any treated aggregate that has not been compacted undisturbed for more than 30 minutes. Complete the compaction and finishing within 1 hour (longer with a retarder) from the time water is added to the mixture. Make the compacted surface smooth, dense, and free of compaction planes, ridges, or loose material.

If the time between placing adjacent partial widths exceeds 30 minutes, provide a construction joint.

302.07 Construction Joints. For lime and fly ash mixtures, tie each day's operation into the completed work of the previous day by remixing approximately 2 feet of the completed course before processing additional sections. Add 50 percent of the original amount of lime or fly ash to the remixed material.

For cement mixtures or when a lime or fly ash mixture remains undisturbed for more than 24 hours, make a transverse construction joint by cutting back into the completed work to form an approximately vertical face.

302.08 Curing. Do not allow traffic on the treated aggregate course. Keep the completed layer or course continuously moist until the next layer or course is placed. Apply water under pressure through a spray bar equipped with nozzles producing a fine, uniform spray. Place and compact the next layer or course within 7 days after compacting and finishing the treated aggregate course.

Placement of the next course may be deferred up to 21 days by sealing the surface with rapid setting emulsified asphalt. Do not seal intermediate layers of a course. Keep surface continuously moist for at least 7 days after compacting and finishing. After the 7 days, apply undiluted CRS-2 or RS-2 emulsified asphalt at a rate of 0.25 gallons per square yard according to Section 409. Provide a continuous film over the surface. If the surface is opened to public traffic, furnish and apply blotter according to Section 411.

If the treated aggregate course looses stability, density, or finish before placement of the next course or acceptance of the work, reprocess, recompact, and add additives as necessary to restore the strength of the damaged material. Reapply the emulsified asphalt seal where the continuous film is damaged.

302.09 Acceptance. See Table 302-3 for sampling and testing requirements and the acceptance quality characteristic category.

Fly ash, lime, cement, and chemical admixtures will be evaluated under Subsections 106.02 and 106.03. Emulsified asphalt will be evaluated under Subsections 106.03 and 702.09.

(a) Aggregate gradation. The upper and lower specification limits are equal to the calculated mean of all test results plus or minus the allowable deviations shown in Tables 703-2 and 703-3, except as follows:

(1) If the calculated mean value for any tested sieve exceeds the maximum gradation value shown in Table 703-2 or 703-3, the upper specification is equal to the maximum gradation value plus the allowable deviation, and the lower specification is equal to the maximum gradation value minus the allowable deviation.

(2) If the calculated mean value for any tested sieve is less than the minimum gradation value shown in Table 703-2 or 703-3, the upper specification is equal to the minimum gradation value plus the allowable deviation and the lower specification is equal to the minimum gradation value minus the allowable deviation.

Construction of treated aggregate courses will be evaluated under Subsections 106.02 and 106.04.

Preparation of the surface on which the treated aggregate course is placed will be evaluated under Section 204 or 303 as applicable.

Emulsified asphalt seal will be evaluated under Section 409.

Blotter will be evaluated under Section 411.

Measurement

302.10 Measure the Section 302 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure the square yard width horizontally to include the top of aggregate width including designed widenings. Measure the square yard length horizontally along the centerline of the roadway.

Measure emulsified asphalt under Section 409.

Measure blotter under Section 411.

Payment

302.11 The accepted quantities will be paid at the contract price per unit of measurement adjusted according to Subsection 106.05 for the Section 302 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 302-3
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate (703.05)	Statisical (106.05)	Gradation (1)		AASHTO T 27 & T 11	1 per 1000 tons	From windrow or roadbed after processing	Yes, when requested	4 hours
		3/8 inch	I					
		No. 4	I					
		No. 200	I					
		Other specified sieves	II					
		Liquid limit	—	AASHTO 89	1 per 3000 tons	"	"	"
Mixture (302)	Measured and tested for conformance (106.04)	Moisture-density	—	AASHTO T 180, method D (1)	1 per aggregate grading produced	Processed material before incorporating in work	Yes, when requested	Before using in work
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 500 tons	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Section 303. — ROAD RECONDITIONING

Description

303.01 This work consists of reconditioning ditches, shoulders, roadbeds, and aggregate surfaces.

Material

303.02 Conform to the following Subsection:

Water	725.01

Construction Requirements

303.03 Ditch Reconditioning. Remove all slide material, sediment, vegetation, and other debris from the existing ditches and culvert inlets and outlets. Reshape ditches and culvert inlets and outlets to achieve positive drainage and a uniform ditch width, depth, and grade. Dispose of waste according to Subsection 204.14.

303.04 Shoulder Reconditioning. Repair soft and unstable areas according to Subsection 204.07. Remove all slide material, vegetation, and other debris from existing shoulders including shoulders of parking areas, turnouts, and other widened areas. Reshape shoulders and dispose of waste according to Subsection 204.14.

303.05 Roadbed Reconditioning. Repair soft and unstable areas according to Subsection 204.07. Remove all organic, deleterious, or oversize material larger than 6 inches from the top 6 inches of subgrade. Dispose of waste according to Subsection 204.14. Scarify to a 6-inch depth, remove surface irregularities, and shape to provide a uniform surface. Finish earth surfaces to within 0.05 feet and rock surfaces to within 0.10 feet of the required line, cross-section, and grade. Compact according to Subsection 204.11.

303.06 Aggregate Surface Reconditioning. Repair soft and unstable areas to the full depth of the aggregate surface and according to Subsection 204.07. Scarify to the depth of the aggregate surface or to a depth of 8 inches, whichever is less, and remove surface irregularities. Reshape, finish, and compact the entire aggregate surface according to Section 308.

303.07 Roadway Reconditioning. Perform all the applicable work described in Subsections 303.03 through 303.06.

303.08 Pulverizing. Scarify the surface to the designated depth and width. Pulverize all material to a size one and one half times the maximum sized aggregate or to 1½ inches, whichever is greater. Mix, spread, compact, and finish the material according to Section 301.

303.09 Acceptance. See Table 303-1 for sampling and testing requirements. Road reconditioning work will be evaluated under Subsections 106.02 and 106.04.

Measurement

303.10 Measure the Section 303 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure ditch reconditioning and shoulder reconditioning by the station or foot horizontally along the centerline of the roadway for each side of the roadway.

Measure roadbed reconditioning, aggregate surface reconditioning, roadway reconditioning, and pulverizing by the station or by the square yard. Measure the square yard area on a horizontal plane. Do not measure isolated areas less than 20 square yards.

Measure waste under Section 204.

Payment

303.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 303 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 303-1
Sampling and Testing and Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Existing roadbed	Measured and tested for conformance (106.04)	Classification	—	AASHTO M 145	1 per soil type	Roadbed	Yes, when requested	Before using in work
		Moisture-density	—	AASHTO T 180, method D (1)	1 for each mixture or change in material	Processed material before incorporating in work	—	Before using in work
		In-place density & moisture content	—	AASHTO T 310 or other approved procedures	1 per 3000 yd^2	Compacted material	—	End of shift

(1) Minimum 5 points per proctor.

Section 304. — AGGREGATE STABILIZATION

Description

304.01 This work consists of constructing a stabilized aggregate layer with either imported or in-place aggregate. The aggregate layer is stabilized by incorporating cement (aggregate cement) or fly ash plus lime, and cement (AFLC).

Aggregate stabilization is designated as imported aggregate course or in-place aggregate course.

Imported aggregate stabilization and in-place aggregate stabilization are designated as aggregate cement or AFLC.

Aggregate grading is designated as shown in Table 703-2.

Material

304.02 Conform to the following Subsections:

Aggregate	703.05
Blotter	703.13
Chemical admixtures (set-retarding)	711.03
Emulsified asphalt	702.03
Fly ash	725.04
Portland cement	701.01(a)
Lime	725.03
Water	725.01

Construction Requirements

304.03 Proportioning. Submit a mix design 30 days before production.

(a) Aggregate cement mixtures. Estimate the median cement content required for maximum density of the mixture and select cement contents by mass at 2 percentage points above and below the estimated median cement content.

At these 3 cement contents:

(1) Use a minimum of 4 points to determine the maximum density and optimum moisture content of the 3 mixtures according to AASHTO T 134.

(2) Determine the loss in mass of the 3 mixtures according to AASHTO T 135 and T 136.

(3) Determine the 7-day unconfined compressive strength of the 3 mixtures according to ASTM D 633, method A.

Design and use a mixture that meets the requirements of Table 304-1.

Table 304-1
Aggregate Cement Mix Design Parameters

Material or Property	Requirement
Aggregate	90 – 96 %(1)
Portland cement	4 – 10 %(1)
Loss in mass, AASHTO T 135 & T 136 (12 cycles) A-1, A-2-4, A-2-5, & A-3 A-2-6, A-2-7, A-4, & A-5 A-6 & A-7	 14% max. 10% max. 7% max.
7-day unconfined compressive strength, ASTM D-1633, method A	400 pounds per square inch min.

(1) By mass of total dry mix.

(b) AFLC mixtures. Determine the optimum fly ash plus lime and cement content according to ASTM C 593, Section 10 using several mixtures with varying fly ash plus lime and cement contents. The peak of the density fly ash plus lime and cement content curve is the optimum fly ash plus lime and cement content.

Determine the lime and cement fly ash ratio according to ASTM C 593, Sections 10 and 11 using a series of mixtures at the optimum fly ash plus lime and cement content and varying lime and cement fly ash ratio. Use a curing period from 7 to 28 days at 97 to 104 °F.

Design a mixture that meets the requirements of Table 304-2.

Use a mixture with a fly ash plus lime and cement content that exceeds the optimum fly ash plus lime and cement content by 0.5 percent.

Table 304-2
AFLC Mix Design Parameters

Material or Property	Requirement
Aggregate	75 – 92 %(1)
Fly ash	6 – 20 %(1)
Lime and portland cement	2 – 5 %(1)
Average compressive strength, ASTM C 593	500 psi min.
Single compressive strength, ASTM C 593	400 psi min.

(1) By mass of total dry mix.

(c) Job-mix formula.

(1) Submit the following for each job-mix formula:

(a) Source of each component;

(b) Results of applicable tests; and

(c) Target values for:

(1) Each aggregate sieve size specified as applicable; and

(2) Stabilizing agent.

(2) At the request of the CO, submit the following:

(a) 200-pound sample of aggregate;

(b) 50-pound sample of fly ash;

(c) 25-pound sample of lime;

(d) 25-pound sample of Portland cement; and

(e) 5-pound sample of retarder or other admixtures.

Furnish a new mix design if there is a change in a material source. Begin production only after the mix design is approved.

304.04 General. Store stabilizing agents and admixtures in closed, weatherproof containers. Do not construct the stabilized aggregate layer when the underlying surface is frozen, muddy, or when it is raining or snowing. Do not begin application or mixing operations when the atmospheric temperature is expected to fall below 40 ºF within 48 hours.

(a) Imported aggregate course. Prepare the underlying surface according to Section 204, Subsection 303.05, or Subsection 303.06, as applicable.

(b) In-place aggregate course. Recondition the aggregate according to Subsection 303.06. Shape the scarified aggregate into a windrow or blanket that is suitable for applying stabilizing agents.

304.05 Applying stabilizing agents.

(a) Imported aggregate course. Equip the mixer with batching or metering devices for proportioning the components either by mass or volume. Maintain the accuracy of the amounts of aggregate, chemical additives, and water (based on the total dry mass) within the following tolerances:

Aggregate	±2.0% by mass
Fly ash	±1.5% by mass
Lime and cement	±0.5% by mass
Retarder or other additive	±2.0% by mass
Water	±2.0% by mass

In aggregate cement mixtures, a retarder may be used to slow initial set for a maximum of 2 hours. Dissolve the retarder in water and then uniformly add it to the mixture.

(b) In-place aggregate course. Apply the moisture content of the aggregate to at least 3 percent below optimum. Do not apply stabilizing agents when conditions allow excessive loss to washing or blowing. Apply stabilizing agents at the required rates by one of the following methods:

(1) Dry method. Uniformly apply the stabilizing agents with an approved spreader. Apply water using approved methods to obtain the proper moisture content for mixing and compaction.

(2) Slurry method. Mix stabilizing agents with water and apply as a thin water suspension or slurry using either trucks with approved distributors or rotary mixers. Equip the distributor truck or rotary mixer tank with an agitator to keep the stabilizing agents suspended in water. Make successive passes over the material to obtain the moisture and stabilizing agents content for mixing and compacting.

304.06 Mixing. Mix the components with suitable equipment until all additives are distributed uniformly within the aggregate to create a homogeneous mixture. When a central plant is used, transport the mixture in vehicles that maintain moisture content and prevent segregation and loss of the fine material.

(a) Aggregate cement mixtures. Add water and thoroughly mix to adjust the moisture content of the mixture as determined from the mix design and approved by the CO. Complete the mixing within 2 hours of cement application.

(b) AFLC mixtures. Add water and thoroughly mix to adjust the moisture content of the mixture to optimum moisture content plus any necessary hydration moisture as determined from the mix design and approved by the CO. Complete the mixing within 6 hours of additive application. Cure the mixture for 2 to 4 days by keeping it moist.

304.07 Placing, Compacting, and Finishing. While placing and spreading the mixture, maintain the moisture content within 2 percent of optimum. Do not leave uncompacted aggregate cement mixtures undisturbed for more than 30 minutes, and complete their compaction and finishing within 1 hour from the time water is added. Additional time may be permitted if a retarder is used. Compact the mixture to at least 95 percent of the maximum density. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures.

Finish the aggregate course according to Subsection 301.06 to produce a surface that is smooth, dense, and free of compaction planes, ridges, or loose material.

304.08 Construction Joints. For AFLC mixtures, tie each day's work into the completed work of the previous day by remixing approximately 2 feet of the completed course before processing additional sections. Add 50 percent of the original amount of lime or fly ash to the remixed material.

For aggregate cement mixtures or when an AFLC mixture remains undisturbed for more than 24 hours, make a transverse construction joint by cutting back into the completed work to form an approximately vertical face.

304.09 Curing. Do not allow traffic on the stabilized aggregate surface. Apply water under pressure through a spray bar equipped with nozzles producing a fine, uniform spray. Keep the surface continuously moist until the next layer is placed.

Place the next layer within 7 days of finishing the aggregate stabilization. This may be deferred up to 21 days by sealing the surface with rapid-setting emulsified asphalt or cutback asphalt. Apply undiluted CRS-2 emulsified asphalt or RS-2 cutback asphalt at a rate of 0.2 gallons per square yard according to Section 409. Provide a continuous film over the surface. Furnish and apply blotter according to Section 411.

If the stabilized aggregate looses stability, density, or finish, reprocess, re-compact, and add additives as necessary to restore the strength of the damaged material. Reapply the asphalt seal where the continuous film is damaged.

304.10 Acceptance. See Table 304-3 for sampling and testing requirements.

Material for blotter, chemical admixtures, fly ash, lime, hydraulic cement, and water will be evaluated under Subsections 106.02 and 106.03. Emulsified asphalt will be evaluated under Subsections 106.03 and 702.09.

New imported aggregate will be evaluated for gradation according to Subsection 301.08(a).

Stabilized imported and in-place aggregate courses will be evaluated under Subsections 106.02 and 106.04.

Reconditioning of the aggregate course for in-place aggregate will be evaluated under Section 303.

Preparation of the surface on which the treated imported aggregate course is placed will be evaluated under Sections 204 or 303.

Emulsified asphalt seal will be evaluated under Section 409.

Blotter will be evaluated under Section 411.

Measurement

304.11 Measure the Section 304 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure square yard width horizontally to include the top of aggregate width including designed widening. Measure the square yard length along the centerline of the roadway.

Measure emulsified asphalt under Section 409.

Measure blotter under Section 411.

Payment

304.12 The accepted quantities measured as provided in Subsection 109.02, will be paid at the contract price per unit of measurement for the Section 304 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 304-3
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate Cement Mixtures								
Proportioning (304.03)	Measured and tested for conformance (106.04)	Moisture-density	—	Cement: AASHTO T 134 (minimum of 4 points)	1 for each mixture or change in material	Processed material before incorporating in work	Yes, when requested	Before using in work
Aggregate, Fly Ash, Lime, and Cement (AFLC)								
Proportioning (304.03)	Measured and tested for conformance (106.04)	Moisture-density	—	AFLC ASTM C 593 Section 10 & 11 (minimum of 4 points)	1 for each mixture or change in material	Processed material before incorporating in work	Yes, when requested	Before using in work
Imported Aggregate								
Aggregate (703.05)	Statisical (106.05)	Gradation		AASHTO T 27 & T 11	1 per 1000 tons	Processed aggregate before stabilizing	Yes, when requested	4 hours
		3/8 inch	I					
		No. 4	I					
		No. 200	I					
		Other specified sieves	II					
	Measured and tested for conformance (106.04)	Liquid limit	—	AASHTO T 89	1 per 3000 tons	Processed aggregate before stabilizing	—	4 hours
Stabilized Aggregate								
Mixture (304)	Measured and tested for conformance (106.04)	In-place density & moisture content	—	AASHTO T 310 or other approved procedures	1 per 500 tons or 3000 yd^2	Compacted material	—	End of shift

Section 305. — AGGREGATE-TOPSOIL COURSE

Description

305.01 This work consists of furnishing and placing an aggregate, topsoil, and seed mixture on a prepared shoulder or other surface.

Material

305.02 Conform to the following Subsections:

Aggregate	703.14
Seed	713.04
Topsoil	713.01
Water	725.01

Construction Requirements

305.03 Preparing Surface. Complete the adjoining pavement before placing an aggregate-topsoil mixture on the shoulder. Scarify the area where the mixture is to be placed to a depth of 3 inches. Reduce all clods and sod to a maximum size of 4 inches.

305.04 Mixing, Placing, and Compacting. Furnish a mixture of 50±10 percent aggregate and 50±10 percent topsoil by volume with sufficient water for compaction.

Mix the components into a uniform mixture. Spread the mixture on the prepared surface in a uniform layer. Shape the mixture to the line, grade, and cross-section. Remove all clods and stones greater than 2 inches in diameter. Before compaction, dry seed the mixture surface at a rate of 75 pounds per acre according to Section 625.

Uniformly compact the mixture so that it does not exhibit heaving, pumping, rutting, or shearing. After compaction, dry seed the surface again at a rate of 75 pounds per acre.

305.05 Acceptance. See Table 305-1 for sampling and testing requirements.

Aggregate for aggregate-topsoil will be evaluated under Subsections 106.02 and 106.04. Seed and topsoil will be evaluated under Subsections 106.02 and 106.03.

Construction of aggregate-topsoil course will be evaluated under Subsection 106.02.

Measurement

305.06 Measure the Section 305 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure aggregate-topsoil course by the cubic yard in the hauling vehicle.

Payment

305.07 The accepted quantities will be paid at the contract price per unit of measurement for the Section 305 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 305

Table 305-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate – Topsoil	Measured and tested for conformance (106.04)	Moisture-Density	—	AASHTO T 99, method C (1)	1 per soil blend	Production output or stockpile	—	36 hours
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 4000 yd^2	In-place	—	24 hours

(1) Minimum of 5 points per proctor.

Section 306. — DUST PALLIATIVE

Description

306.01 This work consists of furnishing and applying one or more applications of a dust palliative on a prepared surface.

Material

306.02 Conform to the following Subsections:

Blotter	703.13
Calcium chloride	725.02
Calcium chloride flake	725.02
Emulsified asphalt	702.03
Lignosulfonate	725.20
Magnesium chloride	725.02
Water	725.01

Construction Requirements

306.03 General. Use distributor equipment conforming to Subsection 409.04 except heating capability is not required. Equip the distributor with a hose and nozzle for areas inaccessible to the distributor and for touch-up work. Do not apply a dust palliative when the weather is foggy or when rain is anticipated within 24 hours of application. Do not apply chloride brines, emulsified asphalt, or lignosulfonate when the ground is frozen.

Protect the surfaces of structures and trees from splatter or marring during application. Use multiple applications at a reduced rate if necessary to prevent runoff. Do not discharge dust palliative into streams.

306.04 Preparation and Application. Prepare the roadbed by blading and shaping to leave 1 to 2 inches of relatively loose material on the surface.

(a) Emulsified asphalt. When a slow setting emulsified asphalt is used, dilute it with water until the emulsion contains 20 to 30 percent residual asphalt. The CO will approve the exact proportion. Thoroughly blend the emulsified asphalt with the added water. Apply according to Subsection 409.08 when the ambient air temperature is 40 °F or above.

(b) Lignosulfonate, calcium chloride, or magnesium chloride. Water the loose material so it is visibly moist.

When lignosulfonate is used, dilute it with water until the mixture contains a minimum 48 percent concentration. When calcium chloride brine is used, provide a minimum 36 percent concentration. When magnesium chloride brine is used, provide a minimum 28 percent concentration. When calcium chloride flake is used, provide flakes with a minimum 77 percent purity.

Thoroughly mix the components. Apply when the ambient air temperature is 40 °C or above. Apply liquid concentrations at a rate of 0.25 to 0.50 gallons per square yard as approved. Apply the chloride flakes at the rate of 1.0 to 2.0 pounds per square yard as approved.

Process the dust palliative uniformly throughout the layer, moisten as necessary, and compact the surface.

306.05 Maintenance and Opening to Traffic. Do not permit traffic on the treated surface until the dust palliative has penetrated and cured enough to prevent excessive pickup under traffic. If it becomes necessary to permit traffic before that time, apply blotter as necessary.

306.06 Acceptance. Dust palliative material (emulsified asphalt, lignosulfonate, calcium chloride, calcium chloride flake, and magnesium chloride) will be evaluated under Subsection 106.03. Provide a commercial certification that includes the date, identification number (truck or trailer), net mass, and brand name with each shipment. For liquid, non-petroleum dust palliatives also provide the net volume and specific gravity at 60 ºF, percent solids by mass, and pH. For solid dust palliatives also provide the concentration of the product.

Application of dust palliative will be evaluated under Subsections 106.02 and 106.04.

Measurement

306.07 Measure the Section 306 items listed in the bid schedule according to Subsection 109.02.

Payment

306.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 306 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 307. — Reserved

Section 308. — MINOR CRUSHED AGGREGATE

Description

308.01 This work consists of furnishing and placing crushed aggregate for bedding, backfill, and roadway aggregate courses.

The roadway aggregate compaction method is designated as shown in Subsection 308.05(a).

Material

308.02 Conform to the following Subsections:

Crushed aggregate	703.06
Water	725.01

Construction Requirements

308.03 Preparing Surface.

(a) Roadway aggregate. Prepare the surface on which the aggregate course is placed according to Subsection 303.07.

(b) Bedding and backfill aggregate. Shape, compact, and finish the surface to the required lines, grade, elevation, and cross-section according to Section 209.

308.04 Placing Crushed Aggregate.

(a) Roadway aggregate. Mix the aggregate and adjust the moisture content to obtain a uniform mixture with a moisture content suitable for compaction. Spread and shape the mixture on the prepared surface in a uniform layer.

Do not place the mixture in a layer exceeding 6 inches in compacted thickness. When more than one layer is necessary, compact each layer according to Subsection 308.05(a) before placing the next layer.

(b) Bedding and backfill aggregate. Place and shape the mixture in layers that, when compacted, do not exceed 6 inches in depth.

308.05 Compacting and Finishing Crushed Aggregate.

(a) Roadway aggregate. Compact using the specified method. When no method is specified, use either method. Finish the surface according to Subsection 301.06.

(1) Method 1. Compact each layer according to Subsection 204.11. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, and walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.

Compactive effort may be decreased if inplace densities show that less compactive effort is required under Method 2.

(2) Method 2. Compact each layer according to 301.05.

(b) Bedding and backfill aggregate. Compact each layer according to Subsection 209.11.

308.06 Acceptance. See Table 308-1 for sampling and testing requirements.

Crushed aggregate will be evaluated under Subsections 106.02 and 106.03. Furnish a production certification including gradation and quality properties for each source.

Construction of roadway aggregate courses will be evaluated under Subsections 106.02 and 106.04. Method 2 compaction will be evaluated under Section 106.04.

Placement of bedding and backfill aggregate will be evaluated under Subsection 106.02 and Section 209.

Preparation of the surfaces on which crushed aggregate is placed will be evaluated under Section 303 and 209 as applicable.

Measurement

308.07 Measure the Section 308 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure crushed aggregate by the cubic yard in the hauling vehicle.

Measure square yard width horizontally to include the top of aggregate width including designed widenings. Measure the square yard length horizontally along the centerline of the roadway.

Payment

308.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 308 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 308-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Crushed aggregate	Measured and tested for conformance (106.04)	Moisture-density	—	AASHTO T 180, method D(1)	1 for each aggregate supplied	Production output or stockpile	—	Before using in work
		Compaction	—	AASHTO T 310 or other approved procedures	1 per 500 tons	In-place	—	Before placing next layer

(1) Minimum of 5 points per proctor.

Section 309. — EMULSIFIED ASPHALT-TREATED BASE COURSE

Description

309.01 This work consists of constructing an emulsified asphalt-treated base course on a prepared surface.

Base aggregate grading is designated as shown in Table 703-2.

Material

309.02 Conform to the following Subsections:

Base course aggregate	703.05
Emulsified asphalt	702.03
Water	725.01

Construction Requirements

309.03 General. Prepare the surface on which the treated aggregate base course is placed according to Section 204 or 303 as applicable.

After a representative quantity of aggregate is produced, submit proposed target values for the appropriate sieve sizes along with a representative 300-pound sample at least 14 days before incorporating the aggregate into the work.

Set target values within the gradation ranges shown in Table 703-2 for the required grading.

309.04 Mixing and Spreading. Use a stationary pugmill with weighing, volumetric, or other gauging equipment capable of accurately controlling the material entering the mixer. Interlock the controls for the aggregate feed with the emulsified asphalt and water controls to ensure uniform introduction of material into the mixer. Determine the optimum moisture content of the mixture according to AASHTO T 180, method D.

Add the aggregate and water to the mixer before the emulsified asphalt. Add 1 percent emulsified asphalt by mass of aggregate. Adjust the total liquid content (emulsified asphalt and water) so that, at the time of compaction, the total liquid content is within 2 percent of the optimum moisture content. Mix until all particles are uniformly coated.

Immediately after mixing, spread the mixture on the prepared surface in a uniform layer. Shape the mixture to the line, grade, and cross-section. Route hauling equipment uniformly over the full width of the surface to minimize rutting or uneven compaction.

309.05 Compacting. Determine the maximum density of the mixture according to AASHTO T 180, method D.

Compact the full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.

Compact the mixture to at least 95 percent of maximum density. Determine the inplace density and moisture content according to AASHTO T 310 or other approved test procedures.

309.06 Surface Tolerance. Finish the surface according to Subsection 301.06.

309.07 Maintenance. Maintain the treated aggregate course to the correct line, grade, and cross-section by blading, watering, rolling, or any combination thereof until placement of the next course. Correct all defects according to Subsection 301.06.

309.08 Acceptance. See Table 309-1 for sampling and testing requirements.

Emulsified asphalt will be evaluated under Subsections 106.03 and 702.09.

Aggregate gradation will be evaluated under Subsection 106.05. The aggregate gradation upper and lower specification limits are the approved target values plus or minus the allowable deviations shown in Table 703-2. See Table 309-1 for the acceptance quality characteristic categories. All other aggregate quality properties will be evaluated under Subsections 106.02 and 106.04.

Construction of emulsified asphalt treated base course will be evaluated under Subsections 106.02 and 106.04.

Preparation of the surface on which the treated aggregate base course is placed will be evaluated under Section 204 or 303 as applicable.

Measurement

309.09 Measure the Section 309 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure emulsified asphalt treated aggregate base by the cubic yard in the hauling vehicle.

Measure the square yard width horizontally to include the top of base width including designed widening. Measure the square yard length horizontally along the centerline of the roadway.

Payment

309.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 309 pay items listed in the bid schedule except the emulsified asphalt-treated aggregate base unit bid price will be adjusted according to Subsection 106.05. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 309-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate quality	Measured and tested for conformance (106.04 & 105)	LA abrasion (coarse)	—	AASHTO T 96	1 for each source	Source of material	Yes, when requested	Before using in work
		Durability index (coarse & fine)	—	AASHTO T 210	"	"	"	"
		Sodium sulfate soundness	—	AASHTO T 104	"	"	"	"
Emulsified asphalt-treated aggregate base, grading C, D & E	Statistical (106.05)	Gradation		AASHTO T 30	1 per 1000 tons	In-place	Yes, when requested	4 hours
		3/8 inch	I	"				
		No. 4	I	"				
		No. 40	II	"				
		No. 200	—	"	"	"	"	"
		Fractured faces	I	ASTM D 5821	"	"	"	"
		Sand equivalent	—	AASHTO T 176, alternate method no. 2, reference method	"	Belt feed before adding emulsified asphalt	"	"
		SE/P_{200} index	I	Note 1		—	—	—
Emulsified asphalt-treated aggregate base, grading D	Measured and tested for conformance (106.04)	Compaction	—	AASHTO T 310 or other approved procedures	1 per 500 tons but not less than 1 per layer	In-place	—	Before placing next layer

(1) SE/P_{200} index (SEP) is a measure of a material's ability to perform based on the quality and quantity of fines present. The quality is represented by the sand equivalent (SE) and quantity is represented by the percent passing the No. 200 sieve (P_{200}). The SEP is computed as follows:

For an $SE \geq 29$, $SEP = SE/(P_{200} + 25)$ and for an $SE < 29$, $SEP = (SE + 4)/(SE + P_{200})$.

Where: SE = Plastic fines in graded aggregates and soils by using the sand equivalent test AASHTO T 176, alternate method no.2, referee method

P_{200} = Material finer than the No. 200 sieve in mineral aggregates by washing AASHTO T 11

DIVISION 400
ASPAHLT PAVEMENTS AND SURFACE TREATMENTS

NOT USED

DIVISION 500
RIGID PAVEMENTS

281

NOT USED

DIVISION 550

BRIDGE CONSTRUCTION

DIVISION 600

INCIDENTAL CONSTRUCTION

Section 601. — MINOR CONCRETE STRUCTURES

Description

601.01 This work consists of constructing minor concrete structures.

Material

601.02 Conform to the following Subsections:

Air-entraining admixtures	711.02
Chemical admixtures	711.03
Coarse aggregate	703.02
Concrete coloring agents	711.05
Curing material	711.01
Fine aggregate	703.01
Fly ash	725.04
Hydraulic cement	701.01
Joint fillers	712.01
Precast concrete curbing	725.06
Precast concrete units	725.11
Reinforcing steel	709.01
Structural steel	717.01
Water	725.01

601.03 Concrete Composition. Conform to Table 601-1. Before batching concrete, submit the proposed concrete proportions for approval on Form FHWA 1606 *Minor Concrete Mix Design Trial Batch Summary* or other approved form. As a minimum, submit the following:

(a) Type and source(s) of all material proposed for use.

(b) Material certification for all material proposed for use.

(c) Saturated surface dry mass of the fine and coarse aggregate per cubic yard of concrete.

(d) Gradation of fine and coarse aggregate.

(e) Mass of mixing water per cubic yard of concrete.

(f) Mass of cement per cubic yard of concrete. Fly ash, ground iron blast-furnace slag, or silica fume may be substituted for cement according to Subsection 552.03(g).

(g) Entrained air content of plastic concrete in percent by volume.

(h) Maximum slump of plastic concrete in inches.

(i) When colored concrete is required, submit preliminary samples of the colored concrete. Prepare a 3-foot by 3-foot by 4-inch panel for each acceptable mix that is to be colored. Finish and cure the panels in the same manner as the concrete will be finished and cured on the project.

Table 601-1
Composition of Minor Structure Concrete

Property	Specification
Cement content	611 pounds per cubic yard minimum
Water/cement ratio	0.49 maximum
Slump	5 inches maximum
Air content	4 % minimum
Size of coarse aggregate	AASHTO M 43 with 100% passing the 1½-inch sieve
28-day compressive strength	3,000 pounds per square inch minimum

Construction Requirements

601.04 General. Excavate and backfill according to Section 209. When concrete is cracked, spalling, or scaling, remove concrete to the nearest joint.

Design and construct forms that are free of bulge and warp and allow for removal without injuring the concrete. When concrete contains a retarding admixture, fly ash, or other pozzolan replacement for cement, design the forms for a lateral pressure equal to that exerted by a fluid weighing 150 pounds per cubic foot.

Use wood, metal, or other suitable material for forms. Keep forms clean and coat with a form release agent or form oil before placing concrete.

Place and fasten reinforcing steel according to Subsection 554.08.

601.05 Placing Concrete. Conform to Subsection 552.10. Moisten the forms and foundation immediately before placing concrete. Discharge concrete within the time limit shown in Table 552-4.

Place concrete to avoid segregation of material. Consolidate with vibrators according to Subsection 552.11(d). Do not use aluminum pipe for transporting or placing concrete. The intervals between deliveries of batches for a single pour on a structure shall not exceed 30 minutes.

Do not apply water to plastic concrete surfaces during finishing operations.

601.06 Curing Concrete. Cure concrete a minimum of 7 days. If high early strength cement is used, cure concrete a minimum of 3 days. Cure according to Subsection 552.15. Finish exposed concrete surfaces according to Subsection 552.16(a) or (b), as applicable.

601.07 Acceptance. See Table 601-2 for sampling and testing requirements.

Material for minor concrete structures including reinforcing steel, and structural steel for minor structures will be evaluated under Subsections 106.02 and 106.03.

The concrete mixture's slump, air content, compressive strength, unit mass, and temperature will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Construction of minor concrete structures will be evaluated under Subsections 106.02 and 106.04.

Measurement

601.08 Measure the Section 601 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure concrete by the cubic yard in the structure.

Payment

601.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 601 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

The concrete lump sum item will be prorated based on the progress of the work under this Section.

Table 601-2
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Concrete	Measured and tested for conformance (106.04)	Unit mass	—	AASHTO T 121	1 set per 30 yd^3 but not less than 1 per day	Point of discharge	—	Upon completing tests
		Air content	—	AASHTO T 152 or T 196	"	"	—	"
		Slump	—	AASHTO T 119	"	"	—	"
		Temperature	—	Field measured	"	"	—	"
		Compressive strength	—	AASHTO T 23 & T 22	"	Discharge stream at point of placing	—	"

Section 601

Section 602. — CULVERTS AND DRAINS

Description

602.01 This work consists of constructing culverts, drains, and precast concrete box culverts.

Material

602.02 Conform to the following Section and Subsections:

Aluminum-alloy corrugated pipe	707.03
Aluminum-alloy spiral rib pipe	707.12
Asphalt-coated pipe	707.04
Asphalt mastic	702.07
Concrete-lined corrugated steel pipe	707.13
Fiber-bonded asphalt coated steel pipe	707.09
Invert-paved corrugated steel pipe	707.14
Joint fillers, sealants, and preformed joint seals	712.01
Joint mortar	712.02
Metallic-coated corrugated steel pipe	707.02
Metallic-coated spiral rib pipe	707.11
Non-reinforced concrete pipe	706.01
Plastic pipe	706.08
Polymer-coated steel pipe	707.08
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 elliptically-shaped concrete pipe	706.05
Slotted drain pipe	707.10
Lean concrete backfill	614
Watertight gaskets	712.03

Construction Requirements

602.03 General. Furnish culvert pipe with a wall thickness not less than that shown on the plans or determined from the fill-height tables included in the plans. Use the same material and coating on all contiguous pipe sections and special sections such as elbows and branch connections. For culvert extensions, furnish the same material as the existing culvert.

The plans show the size, approximate location, and length of culverts. Determine final location, skew, length, elevations, and grade according to Subsection 152.03(g). Do not order culvert material until the CO has accepted the final structure size, length, and alignment.

Excavate and backfill according to Section 209.

602.04 Laying Concrete Pipe and Precast Concrete Box Culverts. Start at the lower end and lay the bell or groove end upgrade. Fully join all sections. Place circular pipe with elliptical reinforcement with the minor axis of the reinforcement in a vertical position. Construct the joints by one of the following methods:

(a) Mortared joints. Clean the lower portion of the receiving end of the pipe. Plaster the inside with sufficient joint mortar to bring the inner surfaces of the abutting pipe sections flush and even. Fit the sections as close as the construction of the culvert permits. Fill and seal joints with mortar inside and out. Clean excess mortar from the inside of the joint.

Cure mortar outside of joints by covering with polyethylene sheeting or spraying with a curing compound. Backfill while mortar is plastic or, if mortar sets before backfilling, wait at least 24 hours before backfilling.

(b) Gasket joints. Protect the joint ends from mud, silt, gravel, or other unwanted material. Lay the pipe sections with gaskets attached. Remove, clean, relubricate, and reseat gaskets disturbed or contaminated.

Align the pipe sections. Force the joints home using the pipe manufacturer's recommended procedure. Do not drive or ram by hand or machinery. Block the last section of each day's run to prevent creep.

602.05 Laying Metal Pipe. Lay pipe with outside laps of circumferential joints upgrade and longitudinal laps positioned other than in the invert. Place elongated pipes with major axis within 5 degrees of vertical.

Join pipe sections together with soil tight bell and spigot joints or coupling bands according to AASHTO M 36 or M 196. Limit the use of bell and spigot joints to slopes of 10 percent or less. Limit the use of coupling bands with projections (dimples) to attaching prefabricated flared end sections.

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

602.06 Laying Plastic Pipe. Lay plastic pipe according to the pipe manufacturer's recommendation.

Provide soil-tight and spigot joints for plastic pipe culverts.

If plastic end sections are used, reinforce and stiffen them such that inward buckling during construction is less than 3/8 inch with a 100 pounds of force.

602.07 Laying Slotted Drain Pipe. Join the sections together with coupling bands. Cover the slots with roofing paper or other approved covering during backfilling and paving to keep material out of the pipe. Backfill with a lean concrete backfill.

602.08 Acceptance. Material for culverts, drains, and precast concrete box culverts furnished will be evaluated under Subsections 106.02 and 106.03.

Installation of culverts, drains and precast concrete box culverts will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Measurement

602.09 Measure the Section 602 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure pipe and box culverts by the linear foot along the invert.

Measure end sections, elbows, and branch connections by the each. If there is no pay item for elbows or branch connections, measure them as additional pipe length along the invert.

Payment

602.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 602 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 603. — STRUCTURAL PLATE STRUCTURES

Description

603.01 This work consists of constructing structural plate pipes, arches, pipe arches, boxes, and underpasses.

Material

603.02 Conform to the following Subsections:

Aluminum-alloy structural plate structures	707.06
Asphalt-coated structural plate structures	707.07
Steel structural plate structures	707.05

Construction Requirements

603.03 General. Excavate and backfill according to Section 209.

603.04 Erecting. Furnish steel, aluminum alloy, asphalt coated steel, or asphalt-coated aluminum alloy structural plate structures.

Provide a copy of manufacturer's assembly instructions before assembly. The instructions shall show the position of each plate and 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. The plates shall have a proper fit-up.

Where aluminum alloys come in contact with other types of metal, coat the contacting surfaces according to Subsection 602.05.

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

Torque steel bolts and aluminum bolts on 0.1-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 0.1-inch thick and heavier aluminum plates to a minimum of 90 foot·pounds and a maximum of 115 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 suitable survey control on the structure to check structure movement.

(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 to monitor the erecting and backfilling of the structure.

603.05 Acceptance. Material for structural plate structures will be evaluated under Subsections 106.02 and 106.03.

Installation of structural plate structures will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Measurement

603.06 Measure the Section 603 items listed in the bid schedule according to Subsection 109.02.

Payment

603.07 The accepted quantities will be paid at the contract price per unit of measurement for the Section 603 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 604. — MANHOLES, INLETS, AND CATCH BASINS

Description

604.01 This work consists of constructing or adjusting manholes, inlets, catch basins, junction boxes, and spring boxes.

Material

604.02 Conform to the following Section and Subsections:

Concrete	601
Concrete brick	725.08
Concrete masonry blocks	725.09
Corrugated metal units	725.13
Frames, grates, covers, and ladder rungs	725.12
Grout	725.22
Joint fillers, sealants, and preformed joint seals	712.01
Joint mortar	712.02
Precast concrete units	725.11(a)
Reinforcing steel	709.01
Watertight gaskets	712.03

Construction Requirements

604.03 General. Excavate and backfill according to Section 209.

604.04 Concrete Construction. Construct concrete manholes, inlets, and catch basins according to Section 601. Concrete units may be cast-in-place or precast. Finish the surface according to Subsection 552.16(a) or (b) as applicable.

Where a pipe enters through an existing concrete wall, cut the concrete and steel reinforcement in a manner that does not loosen the reinforcement in the wall. Cut the steel reinforcement flush with the opening wall face. Grout all joints and openings cut in the wall.

Finish the channel flow line in manholes, inlets, and catch basins accurately to match the pipe flow line.

Assemble precast concrete manhole sections with flexible watertight gaskets or mastic joint fillers in the tongue and groove joints. If gaskets are used, handle the precast units carefully after the gasket has been attached to avoid damaging the gasket or contaminating the joint. Attain the proper alignment before the joints are forced home. Maintain partial support during the insertion of the tongue or spigot to minimize the unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. If mastic is used, apply mastic joint filler according to the manufacturer's recommendations.

Set metal frames in a full joint mortar bed.

Grout or use a preformed joint seal to make all joints and openings watertight. Finish mortar joints with a bead on the outside and a smooth finish on the inside.

Space ladder rungs uniformly on 12-inch centers and align vertically. Grout ladder rungs into precast concrete walls.

604.05 Masonry Block Construction. Construct concrete footings according to Section 601. Construct block masonry plumb. Stagger vertical joints and set block with the cells vertical. Dampen block to reduce the rate of absorption. Butter bearing members and vertical joints full of mortar. Bond block with mortar on all sides. Construct joints straight, level, plumb, flush, and 1/4 to 1/2 inch thick. Backfill the structure after the masonry block has cured according to Subsection 552.15 for 7 days.

604.06 Metal Construction. Fabricate metal drop inlets from the same material as adjoining metal pipes.

604.07 Grade Adjustment of Existing Structures. Adjust metal frames and grates to grade before placing the surface course.

Remove and clean the frames, covers, and grates. Trim the walls down to solid material. Reconstruct the walls with the same material as existing and reset the cleaned frames at the required elevation.

When the existing casting and supporting walls are in good condition, an approved device may be used to adjust the manhole casting cover to the correct grade without reconstructing the walls or resetting the frame.

When catch basins and inlets are adjusted to grade and abut existing concrete construction, separate the castings from the adjacent concrete with a preformed expansion joint no less than 1/2 inch thick.

Clean each structure of all accumulated silt, debris, or foreign matter.

When an existing structure is abandoned, seal all pipes entering the structure with a tight fitting plug of concrete not less than 6 inches thick or water tight masonry not less than 8 inches thick. Fracture the base of concrete structure to prevent entrapment of water. Obliterate the top of the structure to an elevation at least 3 feet below finished grade and backfill according to Section 209.

604.08 Acceptance. Precast concrete units (including manholes, inlets, catch basins, junction boxes, and spring boxes) furnished will be evaluated under Subsections 106.02 and 106.03.

Material (except concrete) for cast-in-place concrete units (including manholes, inlets, catch basins, junction boxes, and spring boxes) will be evaluated under Subsections 106.02 and 106.03. Construction of cast-in-place concrete units will be evaluated under Subsections 106.02 and 106.04.

Concrete for cast-in-place units will be evaluated under Section 601.

Excavation and backfill will be evaluated under Section 209.

Installation and adjustment of concrete units (including manholes, inlets, catch basins, junction boxes, and spring boxes) will be evaluated under Subsections 106.02 and 106.04.

Measurement

604.09 Measure the Section 604 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure manholes from finished grade to the flow line surface of the manhole.

Measure metal frames and grates and removing and resetting metal frames and grates unless included as part of the original inlet, manhole, or catch basin construction.

Payment

604.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 604 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 605. — UNDERDRAINS, SHEET DRAINS, AND PAVEMENT EDGE DRAINS

Description

605.01 This work consists of furnishing and installing underdrains, sheet drains, and pavement edge drains.

Material

605.02 Conform to the following Subsections:

Aluminum-alloy corrugated pipe	707.03
Asphalt-coated pipe	707.04
Geocomposite drains	714.02
Geotextile type I	714.01
Granular backfill	703.03
Metallic coated corrugated steel pipe	707.02
Perforated concrete pipe	706.03
Plastic pipe	706.08
Sand	703.15
Structural backfill	704.04

Construction Requirements

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

Drain material, size, and approximate location are shown on the plans. Determine the final location and length in the field.

Do not install drain material until the CO has accepted the final location and length.

Excavate and backfill according to Section 209.

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 according to the manufacturer's recommendations.

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

Furnish nonperforated pipe for outlet pipe. Install outlet pipe according to Section 602. Immediately place and secure a screen made of 17 gage diameter galvanized wire having approximately 1/2 by 1/2-inch mesh openings over the outlet ends of all exposed pipes and weep holes.

605.04 Placing Underdrain. Join pipe sections securely with coupling fittings or bands. Join polyvinyl chloride (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.

Backfill and compact all trenches within the limits of the roadbed according to Section 209 except use granular backfill material. Trenches for geocomposite underdrains within the limits of the roadbed may also be backfilled with clean sand and compacted.

When underdrain is placed in ditch lines, prevent infiltration of surface water by placing material conforming to AASHTO M 145, 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, 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 facing downward.

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 according to Section 209.

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

(b) Geocomposite underdrain. Extend the geotextile from the bottom of the drainage core around the collector pipe.

Construct splices and install outlet fittings according to the manufacturer's recommendations. Prevent infiltration of soil into the geocomposite core.

Place the assembled geocomposite in the trench with the face of the geocomposite against the inflow side of the trench. If the trench wall is irregular, smooth the trench wall or place a layer of granular backfill between the geocomposite and the trench wall. Temporarily support the drain against the trench wall while backfilling.

When the trench is less than 18 inches wide, backfill the trench using clean sand. Backfilling and compacting in layers is not required. Compact the sand by vibrating, tamping with a mechanical tamper, or flooding with water.

When the trench is 18 inches wide or more, place granular backfill or clean sand to a height of 12 inches above the top of the collector pipe and compact. Place and compact the remainder of the granular backfill material or clean sand according to Section 209.

605.05 Placing 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 water flow. For vertical splices, overlap the geotextile in the direction 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 and compact according to Subsections 208.10 and 208.11.

605.06 Placing Geocomposite Pavement Edge Drain. Assemble the geocomposite pavement edge drain and outlet material according to the manufacturer's recommendations and place it in the trench. If the trench wall is irregular, smooth the trench wall or place a layer of clean sand between the geocomposite and the trench wall. Temporarily support the drain against the trench wall while backfilling.

When the trench is less than 18 inches wide, backfill the trench using clean sand. Backfilling and compacting in layers is not required. Compact the sand by vibrating, tamping with a mechanical tamper, or flooding with water.

When the trench is 18 inches wide or more, place and compact granular backfill or clean sand according to Section 209.

605.07 Acceptance. See Table 605-1 for sampling and testing requirements.

Material (except granular backfill) for underdrains, sheet drains, and edge drains will be evaluated under Subsections 106.02 and 106.03.

Granular backfill will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Sections 208 and 209.

Geotextile will be evaluated under Section 207.

Outlet pipes will be evaluated under Section 602.

Installation of underdrains, sheet drains, and edge drains will be evaluated under Subsections 106.02 and 106.04.

Measurement

605.08 Measure the Section 605 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

When measurement is for a system, do not measure geotextiles, collector pipes, backfill, and outlet pipes that are part of the system.

Measure granular backfill and sand by the cubic yard in place.

Payment

605.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 605 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 605-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Granular backfill	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes	4 hours

Section 606. — CORRUGATED METAL SPILLWAYS

NOT USED

Section 607. — CLEANING, RECONDITIONING, AND REPAIRING EXISTING DRAINAGE STRUCTURES

Description

607.01 This work consists of cleaning, reconditioning, and repairing existing culverts and appurtenant structures.

Construction Requirements

607.02 General. Dispose of material according to Subsection 203.05.

607.03 Removing and Cleaning Culverts. Carefully remove the culvert and clean all foreign material from within the barrel and at the jointed ends.

607.04 Cleaning Culverts in Place. Remove and dispose of all foreign material within the barrel and appurtenances of the culvert by any method that does not damage the culvert.

All or part of a culvert designated to be cleaned in place may be removed, cleaned, and relayed according to Section 602.

607.05 Relaying or Stockpiling Salvaged Pipe. Relay removed and cleaned pipe according to Section 602. Furnish all jointing material and replace damaged pipe according to Section 602.

Place salvaged pipe at a designated stockpile location. Dispose of pipe that is damaged.

607.06 Reconditioning Drainage Structures. Remove all debris from structures designated to be reconditioned. Repair all leaks and structural damage and replace missing or broken metalwork according to Section 602.

607.07 Acceptance. Cleaning, reconditioning, and repairing existing drainage structures will be evaluated under Subsection 106.02.

Relaying culverts will be evaluated under Section 602.

Measurement

607.08 Measure the Section 607 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure removing, cleaning, and stockpiling culvert in the stockpile.

Payment

607.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 607 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 608. — PAVED WATERWAYS

Description

608.01 This work consists of constructing paved ditches, gutters, spillways, and similar waterways not contiguous to the traveled way.

Paved waterways are designated as follows:

Type 1 — Grouted rubble

Type 2 — Mortared rubble

Type 3 — Concrete and rubble

Type 4 — Concrete

Type 5 — Asphalt

Type 6 — Placed riprap

Material

608.02 Conform to the following Sections and Subsections:

Asphalt mixtures	404
Bed course	704.09
Concrete	601
Granular backfill	703.03(b)
Grout	725.22(e)
Mortar	712.05
Reinforcing steel	709.01
Riprap rock	705.02
Rubble	620

Construction Requirements

608.03 General. Excavate and backfill according to Section 209. Place and compact bed course material. Compact the bed course with at least three passes of a lightweight mechanical tamper, roller, or vibratory system. Form the bed parallel to the finished surface of the waterway.

608.04 Grouted Rubble Paved Waterway (Type 1). Embed pavement stones on the bed in a broken pattern with no continuous joint across the waterway or parallel to the flow line. Make the joints 1 to 2 inches wide. Place the stones with the flat faces up and the longest dimension at right angles to the centerline of the waterway.

Ram each stone until it is firm and reasonably true to the surface in grade, alignment, and cross-section. Remove and relay stone having an irregular or uneven surface.

Fill the joints with granular backfill to within 4 inches of the surface. Pour and broom grout into the joints until the grout is 1/2 inch below the surface. Clean the excess grout from the surface.

608.05 Mortared Rubble Paved Waterway (Type 2). Embed each pavement stone with its flat face up and its longest dimension parallel to the gutter line. Place stones alternately so that there is not a continuous joint across the waterway or parallel to the flow line. Limit joint widths from 1 inch minimum to 2 inches maximum.

Ram the stone until it is firm and reasonably true to the surface in grade, alignment, and cross-section.

Apply mortar to the exposed stone sides in such quantities that when the adjacent stone is placed and rammed into position, the mortar is within 1/2 inch of the surface but not protruding above the surface. Clean the excess mortar from the surface.

608.06 Concrete and Rubble Paved Waterway (Type 3). Place the concrete foundation, reinforcing steel, and pavement stone in a progressive operation. Secure the reinforcing steel within the middle third of the depth of the concrete foundation. Clean and wet the pavement stone to near saturation.

Embed the stone in the concrete foundation before it hardens. Place stones alternately so there is not a continuous joint across the waterway or parallel to the flow line. Limit joint widths from 1 inch minimum to 2 inches maximum. Fill the joints between stones with mortar to 1 inch below the top of the stone.

608.07 Concrete Paved Waterway (Type 4). Perform the work according to Section 601.

608.08 Asphalt Paved Waterway (Type 5). Perform the work according to Section 404. Before overlaying existing asphalt paved waterway, clean and seal the cracks according to Section 414.

608.09 Placed Riprap Waterway (Type 6). Use class I riprap. Perform the work according to Subsections 251.03 and 251.04.

608.10 Acceptance. See Table 608-1 for sampling and testing requirements.

Material for mortar will be evaluated under Subsections 106.02 and 106.03. Mortar will be evaluated under Subsection 106.04.

Bed course and granular backfill will be evaluated under Subsections 106.02 and 106.04.

Construction of paved waterways will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Riprap will be evaluated under Section 251.

Asphalt mixture will be evaluated under Section 404.

Concrete will be evaluated under Section 601.

Rubble will be evaluated under Section 620.

Measurement

608.11 Measure the Section 608 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure the square yard width horizontally to include the total width. Measure the length parallel to the flow line.

Payment

608.12 The accepted quantities will be paid at the contract price per unit of measurement for the Section 608 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 608-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Bed course	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes, when requested	24 hours
	"	Liquid limit	—	AASHTO T 89	"	"	"	"
Granular backfill	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes, when requested	24 hours
Mortar	Measured and tested for conformance (106.04)	Making test specimens Compressive strength (2)	—	AASHTO T 23 & T 22	1 per installation (1)	Job site	Yes, when requested	24 hours

(1) Sample consists of 2 test specimens.

(2) The compressive strength will be the average of two test specimens.

Section 609. — CURB AND GUTTER

Description

609.01 This work consists of constructing or resetting of curb, combination curb and gutter, or wheelstops.

Stone curb is designated as type I or II according to Subsection 705.06.

Material

609.02 Conform to the following Sections and Subsections:

Asphalt mixtures	404
Bed course	704.09
Concrete	601
Joint filler	712.01
Mortar	712.05
Precast concrete curbing and wheelstops	725.06
Reinforcing steel	709.01
Stone curbing	705.06

Construction Requirements

609.03 General. Excavate and backfill according to Section 209. Place and compact the bed course material. Compact the bed course with at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

609.04 Stone and Precast Concrete Curb. Clean the curb material thoroughly and wet it just before setting. Set the curb in bed course so the face and top lines are to line and grade. Make the joints 1/2 to 1 inch wide and fill the joints with mortar.

Complete the first 25 feet of curb to demonstrate the ability to build a curb meeting these requirements. Do not continue construction until the 25-foot test section is approved.

Where a concrete pavement is constructed contiguous to the curb, construct the joints in the curb directly in line with the pavement expansion joints.

Make the curb joint 3/4 inch wide and fill it with expansion joint filler of the same nominal thickness as the pavement joint. Fill all voids between the joint filler and the curb with mortar.

609.05 Concrete Curb or Curb and Gutter. Perform work according to Section 601. The curb or curb and gutter may be cast-in-place or slip-formed.

(a) Cast-in-place. Use forms that extend for the full depth of the concrete. Use curved forms for curb with a radius of 300 feet or less.

(1) Contraction joints. Construct curb in sections of uniform 10-foot lengths. Construct contraction joints 1/8 inch wide. Use metal divider plates. When the curb is constructed adjacent to or on concrete pavement, match the contraction joints in the pavement.

(2) Expansion joints. Form expansion joints at intervals of 60 feet using a 3/4-inch thick preformed expansion joint filler. Where the curb is constructed adjacent to or on rigid pavement, match the expansion joints in the pavement.

Finish the concrete smooth and even with a wood float. Broom finish parallel to the curb line according to Subsection 552.14(c)(2). When an exposed aggregate finish is required, finish according to Subsection 552.14(c)(4). Leave forms in place for 24 hours or until the concrete has set sufficiently so the forms can be removed without harming the curb.

(b) Slip-formed. Use a self-propelled automatic curb machine or a paver with curb attachments. Use a machine that is heavy enough to obtain consolidation without the machine riding above the foundation.

Adjust the concrete aggregate gradation, if necessary, to produce a curb or curb and gutter that has well-defined web marks of water on the surface. Remove and replace sections with craters larger than 3/16 inch or other sections determined to be damaged or defective. Repairing surface craters and other defective sections by plastering is not permitted.

After the concrete has hardened sufficiently to permit sawing without damage, saw contraction joints according to (a)(1) above. Construct expansion joints according to (a)(2) above.

609.06 Asphalt Concrete Curb. Where curb is constructed on a pavement, place a tack coat according to Section 412 on the area under the curb.

Construct asphalt concrete curb according to Section 404. Use a self-propelled automatic curb machine or a paver with curb attachments that is heavy enough to compact a curb without riding above the foundation. Make the curb uniform in texture, shape, and density. Curb may be constructed by other means only in short sections or sections with short radii.

609.07 Resetting Stone or Precast Concrete Curb. Carefully remove, clean, and store the curb. Cut or fit the curb as necessary for installation. Replace all lost, damaged, or destroyed curb. Reset the curb according to Subsection 609.04.

609.08 Wheelstops. Pin the wheelstops in place with two 3.5-foot sections of No. 6 reinforcing steel or 3/4-inch steel rods. Reset wheelstops in the same manner.

609.09 Acceptance. See Table 609-1 for sampling and testing requirements.

Material for mortar will be evaluated under Subsections 106.02 and 106.03. Mortar will be evaluated under Subsection 106.04.

Precast units (curb and wheel stops) will be evaluated under Subsections 106.02 and 106.03.

Bed course material will be evaluated under Subsections 106.02 and 106.04.

Stone for stone curbing will be evaluated under Subsections 106.02 and 106.04.

Construction of curb and gutter, and wheelstops will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Asphalt mixture will be evaluated under Section 404.

Concrete will be evaluated under Section 601.

Measurement

609.10 Measure the Section 609 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Make no deduction in length for drainage structures installed in the curb section or for driveway and handicap access ramp openings where the gutter is continuous across the opening.

Measure bed course material by the cubic yard in place.

Payment

609.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 609 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 609-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Bed course	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes	4 hours
	"	Liquid limit	—	AASHTO T 89	"	"	"	"
Mortar	Measured and tested for conformance (106.04)	Making test specimens Compressive strength (2)	—	AASHTO T 23 & T 22	1 per installation (1)	Job site	—	—

(1) Sample consists of two test specimens.

(2) The compressive strength will be the average of two test specimens.

Section 610. — HORIZONTAL DRAINS

NOT USED

Section 611. — WATER SYSTEMS

Description

611.01 This work consists of constructing or reconstructing water systems.

Material

611.02 Conform to the following Section and Subsections:

Bedding material	704.02
Cast iron soil pipe and fittings	725.17
Concrete	601
Polyvinyl chloride (PVC) pipe and fittings	725.15
Seamless copper water tube and fittings	725.18
Steel pipe and fittings	717.06

Construction Requirements

611.03 General. Furnish material and workmanship conforming to the standards of APWA, the AWWA, *National Building Code,* and local plumbing and safety codes.

At the preconstruction conference, submit a certified cost breakdown of the individual items involved in the lump sum item for use in making progress payments and price adjustments.

Obtain permits, arrange for inspections, and pay all fees necessary to obtain water service.

Excavate and backfill according to Section 209. Bed the pipe according to Subsection 209.09(b).

611.04 Laying Waterline. Where it is necessary to cross a waterline over a sewer line, construct the waterline a minimum vertical distance of 18 inches above the sewer line.

Inspect each joint or fixture and clean the interior of the pipe before placing in the trench. Do not allow dirt, water, rodents, or other contaminants to enter the pipe during installation. Center and push each joint completely together, and fasten the joint according to the manufacturer's recommendations.

Brace major fixtures or fixtures that could blow off the line under pressure with a cast-in-place concrete wedge block. Cast the block between the fixture and the undisturbed vertical trench wall with a minimum bearing surface of 2 square feet against the vertical wall. Do not pressure test lines until concrete has established its required strength.

611.05 Testing and Disinfecting Lines. Test all joints under pressure before backfilling. Repair all leaks.

Disinfect all lines that are to carry water for human consumption. Fill the lines with a water solution containing a residual chlorine level of at least 50 parts per million for at least 24 hours. Drain and flush the line after the disinfecting period. Do not dispose of disinfectant water in live streams.

611.06 Backfilling. Backfill according to Subsection 209.10 except hand-place the backfill to 12 inches over the top of the pipe. Remove all rocks and hard lumps from the hand-placed layer.

During backfilling, place a plastic locator strip approximately 12 inches above the pipe. If nonmetallic waterline is installed, use a locator strip containing metal that allows detection with a metal detector. Hold hydrants, valve boxes, and other vertical fixtures vertical with the tops adjusted to the required elevation.

611.07 Acceptance. Material for water systems will be evaluated under Subsections 106.02 and 106.03.

Installation of water systems will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Measurement

611.08 Measure the Section 611 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure waterlines and encasement pipes with no deduction for the length through tees, bends, valves, or other fixtures.

Payment

611.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 611 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment for lump sum items will be prorated based on the total work completed.

Section 612. — SANITARY SEWER SYSTEMS

Description

612.01 This work consists of constructing sanitary sewer systems.

Material

612.02 Conform to the following Section and Subsections.

Bedding material	704.02
Cast iron soil pipe	725.17
Concrete	601
Plastic Pipe	706.08
Precast concrete units	725.11(e)
Watertight gaskets	712.03

Construction Requirements

612.03 General. Furnish either cast iron or plastic sanitary sewer lines. Furnish material and workmanship conforming to the standards of the AWWA, *National Building Code,* and local plumbing and safety codes. At the preconstruction conference, submit a certified cost breakdown of items involved in the lump sum item for use in making progress payments and price adjustments.

Obtain permits, arrange for inspections, and pay all fees necessary to obtain sewerage service.

Excavate and backfill according to Section 209. Bed the pipe according to Subsection 209.09(b).

612.04 Laying Sewer Lines. Separate waterlines and sewer lines according to Subsection 611.04.

Inspect each joint and clean the pipe and bell before placing in the trench. Lay the sewer line from the lower end with the spigot ends pointing in the direction of flow. Fully support each length between joints and check for line and grade before placing the next length.

Where premolded watertight gaskets are used, check the gasket for proper positioning and shove sewer pipe into proper position. When poured joints are used, position the pipe and fill the joint completely with joint sealer. Allow the sealer to cool completely before removing the runner.

612.05 Backfilling. Backfill according to Subsection 611.06. After backfilling, flush the lines with water to ensure that they are unobstructed.

612.06 Acceptance. Material for sanitary sewer systems will be evaluated under Subsections 106.02 and 106.03.

Installation of sanitary sewer systems will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Measurement

612.07 Measure the Section 612 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure sewer lines with no deduction for length through valves, ells, tees, valve boxes, reducers, manholes, or other fixtures. Where two different sizes enter or exit a manhole, measure each size to the center of the manhole.

Payment

612.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 612 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment for lump sum items will be prorated based on the total work completed.

Section 613. — SIMULATED STONE MASONRY SURFACE

NOT USED

Section 614. — LEAN CONCRETE BACKFILL

Description

614.01 This work consists of constructing lean concrete backfill.

Material

614.02 Conform to the following Subsections:

Aggregate	703.16
Hydraulic cement	701.01
Water	725.01(a)

Construction Requirements

614.03 Composition of Mix. Design a well-graded, flowable, self-leveling, mix conforming to Table 614-1. Verify the mix design with trial batches prepared from the same sources proposed for the mix. Submit the following for approval at least 21 days before production:

(a) Type and source(s) of aggregates;

(b) Type and source of cement;

(c) Mix proportions;

(d) Type of cement and fly ash (if used in the mix);

(e) Commercial certifications for cement, fly ash, admixtures, and aggregate;

(f) Target values for water/cement ratio and slump; and

(g) Compressive strength at 7 and 28 days.

Table 614-1
Composition of Lean Concrete Backfill

Property	Specification
Cement content	50 pounds per cubic yard min.
Slump	6 – 8 inches
Aggregate particle size	1 inch max.
Aggregate passing No. 200 sieve	10 % max.
7-day compressive strength	220 pounds per square inch max.

614.04 General. Perform the work described under Section 209.

Do not place lean concrete backfill in contact with aluminum or aluminum-coated structures.

Do not use lean concrete backfill above the top of subgrade.

614.05 Mixing and Placing Lean Concrete Backfill. Mix lean concrete backfill by pugmill, rotary drum, or other approved mixer to obtain a uniform mix.

Place lean concrete backfill in a uniform manner that prevents voids in, or segregation of, the backfill.

When backfilling around culverts and other structures, place lean concrete backfill in a manner that does not float or shift the structure. Bring the backfill up evenly on all sides of the structure.

When placing lean concrete backfill at or below an atmospheric temperature of 35 ºF, perform the work under Subsection 552.10(a).

Wait at least 4 hours before backfilling over lean concrete backfill.

614.06 Acceptance. Material for lean concrete backfill will be evaluated under Subsections 106.02 and 106.03.

Lean concrete backfilling will be evaluated under Subsection 106.02.

Measurement

614.07 Measure the Section 614 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure lean concrete backfill by the cubic yard in the hauling vehicle.

Payment

614.08 The accepted quantities will be paid at the contract price per unit of measurement for the Section 614 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 615. — SIDEWALKS, DRIVE PADS, AND PAVED MEDIANS

Description

615.01 This work consists of constructing sidewalks, drive pads, and paved medians.

Sidewalks, drive pads, and paved medians are designated as concrete, asphalt, concrete brick, or clay brick.

Material

615.02 Conform to the following Sections and Subsections:

Asphalt mixtures	404
Bed course	704.09
Clay or shale brick	725.07
Concrete	601
Concrete brick	725.08
Curing material	711.01
Masonry and mortar cement	701.02
Sealants, fillers, seals, and sleeves	712.01
Reinforcing steel	709.01

Construction Requirements

615.03 General. Excavate and backfill according to Section 209. Place bed course material in layers not exceeding 4 inches in compacted thickness. Compact each layer with at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

615.04 Concrete Sidewalks, Drive Pads, and Medians. Perform the work according to Section 601. Use forms that extend for the full depth of the concrete.

(a) Joints. Construct joints perpendicular to the outside slab edges and other joints. Match the joints in adjacent curb or pavements. Tool and remove all free mortar and concrete from joints.

(1) Expansion joints. Construct at intervals not exceeding 20 feet. Use 3/4-inch thick preformed expansion joint filler for the full depth of the joints. When joints are to be sealed, use multi-component joint sealant.

(2) Contraction joints. Construct at intervals not exceeding 10 feet. Form the joint with a jointing tool or saw the joints to a depth of 1/4 to 1/3 of the thickness of the concrete and about 1/8 inch wide.

(3) Construction joints. Form construction joints around all appurtenances such as manholes, utility poles, buildings, and bridges. Use 1/2-inch, thick preformed expansion joint filler for the full depth of the joints.

When joints are to be sealed, use multi-component joint sealant.

(b) Finishes. Provide a sidewalk finish unless otherwise required. Edge outside edges of slab and all joints with a 1/4-inch radius edging tool.

(1) Sidewalk finish. See Subsection 552.14(c)(2).

(2) Exposed aggregate finish. See Subsection 552.14(c)(4).

Cure the concrete for at least 72 hours according to Subsection 552.15(b) or (c). Protect the work from pedestrian traffic for 72 hours and from vehicular traffic for 7 days.

615.05 Asphalt Concrete Sidewalks, Drive Pads, and Medians. Perform the work according to Section 404.

615.06 Brick Sidewalks, Drive Pads, and Medians. Lay brick in successive courses on a prepared surface. Lay each course of brick to grade. Relay any course that deviates from a straight line by more than 2 inches in 30 feet.

Sweep and inspect the brick surface before the bed sets. Remove each imperfect brick and replace.

Chock the joints flush with a dry mixture of 4 parts sand and 1 part cement by mass and carefully water the surface to saturate the joint filler.

615.07 Acceptance. See Table 615-1 for sampling and testing requirements.

Clay or shale brick, concrete brick, curing material, joint fillers, and reinforcing steel will be evaluated under Subsections 106.02 and 106.03.

Bed course material will be evaluated under Subsections 106.02 and 106.04.

Construction of sidewalks, drive pads, and medians will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill will be evaluated under Section 209.

Asphalt mixture will be evaluated under Section 404.

Concrete will be evaluated under Section 601.

Measurement

615.08 Measure the Section 615 items listed in the bid schedule according to Subsection 109.02.

Payment

615.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 615 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 615-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Bed course (704.09)	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes, when requested	—
		Liquid limit	—	AASHTO T 89	“	“	“	—

Section 616. — SLOPE PAVING

Description

616.01 This work consists of constructing concrete, brick, masonry block, rubble, or cellular concrete block slope paving.

Material

616.02 Conform to the following Sections and Subsections:

Bed course	704.09
Cellular concrete blocks	725.10
Concrete	601
Concrete brick	725.08
Concrete masonry blocks	725.09
Geotextile type IV	714.01
Grout	725.22(c)
Mortar	712.05
Precast concrete units	725.11(f)
Rubble	620
Topsoil	713.01(a) or (b)
Welded steel wire fabric	709.01(h)

Construction Requirements

616.03 General. Excavate and backfill according to Section 209. Place and compact bed course material with at least three passes of a lightweight mechanical tamper, roller, or vibratory system.

616.04 Geotextile. When required by the contract, place geotextile according to Subsection 207.05. Bury the ends of the geotextile for anchorage. Pin the strips at 5-foot intervals to hold the geotextile lap in place until slope paving is placed. Replace or repair all geotextile that is torn or punctured.

616.05 Concrete Slope Paving. Construct toe walls. Place welded wire fabric at the center of slab. Run the welded steel wire fabric continuously through the joints. Lap adjacent runs of fabric by at least 6 inches.

Perform concrete work according to Section 601. Place slabs starting at the bottom of the slope. Construct horizontal joints parallel to the bottom of the slope and the vertical joints perpendicular to the horizontal joints. Construct cold joints without filler.

Finish the surface with a sidewalk finish according to Subsection 552.14(c)(2). Edge the outside edges of the slab and all joints with a 1/4-inch radius edging tool.

616.06 Brick, Masonry Block, or Rubble Slope Paving. Place bricks, masonry blocks, or rubble starting at the bottom of the slope. Place them on the foundation bed with flat faces up and the longest dimension parallel to the bottom of the slope.

Ram each brick, masonry block, or stone into place. Apply mortar on the exposed side in such quantities that when the adjacent brick, masonry block, or stone is placed and rammed into position, the mortar is within 1/2 inch of the surface and not protruding above the top. Make the brick and masonry block joints 1/2 inch wide or less and rubble joints 1 inch or less. Clean all mortar stain from the surface.

616.07 Cellular Concrete Block Slope Paving. Place the blocks starting in a trench or against a suitable anchorage at the bottom of the slope. Lay each block perpendicular to the slope and bed firmly against adjoining blocks. Grout to fill misaligned joints or breaks at slope changes. Do not grout individual blocks to each other.

Spread topsoil loosely over the cellular block slope paving, partially filling the cell openings. When required by the contract, establish turf according to Section 625.

616.08 Acceptance. See Table 616-1 for sampling and testing requirements.

Cellular concrete blocks, concrete brick, concrete masonry blocks, material for mortar, and welded steel wire fabric will be evaluated under Subsections 106.02 and 106.03.

Mortar will be evaluated under Subsections 106.02 and 106.04.

Bed course material will be evaluated under Subsections 106.02 and 106.04.

Slope paving construction will be evaluated under Subsections 106.02 and 106.04.

Geotextile will be evaluated under Section 207.

Excavation and backfill will be evaluated under Section 209.

Concrete will be evaluated under Section 601.

Rubble will be evaluated under Section 620.

Topsoil will be evaluated under Section 624.

Turf will be evaluated under Section 625.

Measurement

616.09 Measure the Section 616 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure topsoil under Section 624.

Measure turf establishment under Section 625.

Payment

616.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 616 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Table 616-1
Sampling and Testing Requirements

Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Bed course (704.09)	Measured and tested for conformance (106.04)	Gradation	—	AASHTO T 27 & T 11	1 per 600 yd^3	Production output or stockpile	Yes, when requested	—
		Liquid limit	—	AASHTO T 89	"	"	"	—
Mortar (712.05)	Measured and tested for conformance (106.04)	Making test specimens Compressive strength	—	AASHTO T 23 & T 22	1 per installation	Job site	—	—

Section 617. — GUARDRAIL

Description

617.01 This work consists of constructing guardrail systems and modifying, removing, resetting, and raising 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 block-out

SBTB — Steel-backed timber guardrail/timber posts and no block-out

CRT — W-beam guardrail and no blockout

SBLG — 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:

G4-CRT — Cable releasing terminal

G4-BAT — Back slope anchor terminal

SBT-FAT-30— Flared anchor terminal, 30 feet long

SBT-FAT-20— Flared anchor terminal, 20 feet long

SBT-BAT — Back slope anchor terminal

Flared — Straight or parabolic flared W beam terminal

Tangent — Tangent W beam terminal

Material

617.02 Conform to the following Section and Subsections:

Box beam rail	710.07
Concrete	601
Corrosion resistant steel rail	710.06(b)
Galvanized steel rail	710.06(a)
Guardrail hardware	710.10
Guardrail posts	710.09
Precast concrete anchors	725.11
Reflector tabs	710.10
Retroreflective sheeting, type III	718.01
Steel-backed timber rail	710.08
Welding	555.03
Wire rope or wire cable	709.02
Wood preservative treatment	716.03

Construction Requirements

617.03 Posts. Treat field cuts for wood posts with two coats of preservative applied with a brush or sprayer. Do not place field cuts in contact with the ground.

Where the pavement surface is within 3 feet of the guardrail face, install posts before placing the pavement surface.

Punch or drill pilot holes no more than 1/2 inch larger than the post dimensions. Drive the posts into the pilot holes and set the posts plumb. Backfill and compact around the posts with acceptable material.

Where it is not possible to maintain a 24-inch minimum distance between the back of the guardrail post and the top of a 1V:2H or steeper slope, increase the standard post length by 12 inches. Where an impenetrable object is encountered, use a short post with a concrete anchor, decrease the post spacing, or nest two rail elements as approved by the CO. Do not change the post lengths and spacings in terminal sections.

617.04 Rail Elements. Install the rail elements after the pavement adjacent to the guardrail is complete. Do not modify specified hole diameters or slot dimensions.

(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 1/4 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 2 coats of zinc-oxide paint.

(b) Steel-backed timber rail. Equally space bolts along the front face of the timber rail to match the holes in the steel backing. Align timber guardrail along the top and front of the timber rail.

Field cut timber rails to produce a close fit at joints. Treat field cuts with 2 coats of chromated copper arsenate.

When required, field drill holes in the steel backing on curved sections to correspond to the field cut wood rails at the joints. Do not use a torch to cut holes.

(c) Log rail. Construct log rail according to the plans.

617.05 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.

When flared or tangent terminals are required, submit drawings from the manufacturer for the terminals according to Subsection 104.03.

When required by the contract, construct earth berms according to Section 204.

617.06 Connection to Structure. Construct connection to structure and, where required by the contract, reinforced concrete transition according to the plans.

617.07 Removing and 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 according to Section 209.

617.08 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.

617.09 Acceptance. Material for guardrail will be evaluated under Subsections 106.02 and 106.03.

Construction of guardrail will be evaluated under Subsections 106.02 and 106.04.

Earth berm construction will be evaluated under Section 204.

Structural excavation will be evaluated under Section 209.

Welding will be evaluated under Section 555.

Concrete will be evaluated under Section 601.

Measurement

617.10 Measure the Section 617 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure guardrail, excluding terminal sections. Measure transition sections from G9 rail to G4 rail as G9 rail.

Measure removing and resetting guardrail and raising guardrail including reset terminal sections.

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

Measure earth berms under Section 204.

Payment

617.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 617 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 618. — CONCRETE BARRIERS AND PRECAST GUARDWALLS

Description

618.01 This work consists of constructing and resetting concrete barrier and precast concrete guardwall systems.

Material

618.02 Conform to the following Section and Subsections:

Concrete class A(AE)	552
Guardrail hardware	710.10
Hydraulic cement	701.01
Precast concrete barrier	725.11(b)
Preformed joint filler	712.01(b)
Reinforcing steel	709.01

Construction Requirements

618.03 General. Excavate and backfill according to Section 209. Construct barriers and guardwalls that meet crash test requirements of NCHRP Report 350, *Recommended Procedures for Safety Performance and Evaluation of the Highway Features.*

618.04 Concrete Barriers. Concrete barriers may be cast-in-place, slip-formed, or precast according to Section 552. Finish the sides and top according to Subsection 552.16(a).

(a) Cast-in-place. Hand form or saw contraction joints 1/4 inch wide and 2 inches deep at 20-foot intervals. Saw as soon as possible after the concrete has set sufficiently to preclude raveling during sawing, but before shrinkage cracking occurs. Decrease the depth of the saw cut at the edge adjacent to the pavement to prevent pavement damage.

Place 3/4-inch preformed joint filler in all construction joints. Cut the joint filler to fit the cross-sectional area at structures and barrier construction joints. Tool construction joint edges. Seal joints according to Subsection 501.11.

(b) Slip-formed. Do not touch the barrier extruded concrete surface as it leaves the slip-form machine except to immediately remove offsets and fins by light troweling.

Make adjustments in the operation to correct any condition causing surface blemishes larger than 1/2 inch. Do not use water on the completed barrier to correct imperfections.

(c) Precast. Precast barriers in section lengths. Prepare the barrier foundation so it does not vary over 1/4 inch when a 10-foot straightedge is laid along the centerline of the barrier. Align the joints and connect adjacent sections.

Use cast-in-place barrier where transitions, split barriers, or gaps shorter than 10 feet require it. At each joint between precast and cast-in-place barrier, provide hardware in the cast-in-place section to tie its end to the abutting precast section.

618.05 Precast Concrete Guardwall.

(a) Fabrication. A full-size sample of the guardwall will be provided at a specified location. Fabricate the guardwall to match the sample's shape, color, and texture. The guardwall shall also conform to the following:

(1) Fabricate in a precast concrete production facility certified by the National Precast Concrete Association and according to the Association's *Manual of Quality Control.*

(2) Formulate the facing mixes, backing mixes, and structural concrete backup to produce concrete mix designs of similar aggregate-cement ratios to minimize differences in shrinkage factors and coefficients of thermal expansion and contraction. Formulate using hydraulic cement, limestone, quartz, mica, and silicious stones in such proportions as to match the sample.

(3) Use epoxy coated reinforcing steel at locations where the reinforcing steel is less than 2 inches from the exposed surface.

(4) Cast the segments straight and true to a line in strong permanent composite molds of steel, plastic resins, concrete, or rubber.

(5) Cast the facing mixes a minimum of 1 inch thick. Ensure a good bond between facing and backup mixes.

(6) Provide 4 lifting inserts in unexposed areas. Provide removable caps for the lifting inserts to allow for future segment replacement.

(b) Test section. Demonstrate the ability to match the sample by fabricating a 10-foot, full-scale guardwall test section and delivering it to the location of the sample for comparison. If the test section is not in reasonably close conformity to the sample, fabricate another test section according to (a) above. Test sections that do not match the sample may not be used in the wall installation.

(c) Installation. After the test section is approved, produce the guardwall sections to match the approved test section. Prevent damage to the segments during fabrication, handling, delivery, and installation. Repair or replace all damaged sections. Prepare the foundation and place the sections. Use backer rods and joint sealant in the section joints to match the false joints.

At 100-foot intervals and at low points in the guardwall, dig outlet ditches and fill them with 6 inches of aggregate conforming to AASHTO M 43, number 57.

618.06 Terminal Sections. Where barrier is being constructed next to roadway lanes open to traffic, connect an approved temporary terminal section to the barrier at the end of each day.

Construct permanent graded berms according to Section 204.

618.07 Resetting Barrier. Reset barrier and terminal sections according to Subsections 618.03 and 618.06. Store barrier sections in an approved location when resetting cannot immediately follow removal.

618.08 Acceptance. Material for concrete barrier and precast guardwall (except concrete and reinforcing steel) will be evaluated under Subsections 106.02 and 106.03.

Construction of concrete barriers and precast concrete guardwalls will be evaluated under Subsections 106.02 and 106.04.

Concrete barrier and precast concrete guardwall appearance will be evaluated under Subsection 106.02.

Precast concrete guardwall test sections will be evaluated under Subsection 106.02.

Concrete will be evaluated under Section 552.

Reinforcing steel will be evaluated under Section 554.

Measurement

618.09 Measure the Section 618 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure concrete barrier and precast concrete guardwall excluding terminal sections.

Measure reset barrier in the relocated position including terminal sections.

Measure earth berms under Section 204.

Payment

618.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 618 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 619. — FENCES, GATES, AND CATTLE GUARDS

Description

619.01 This work consists of constructing fences, gates, cattle guards, and bollard posts and removing and resetting fence.

Material

619.02 Conform to the following Section and Subsections:

Barbed wire	710.01
Chain link fence	710.03
Concrete	601
Fence gates	710.05
Fence posts and bollards	710.04
Cement grout	725.22(e)
Precast concrete units	725.11
Reinforcing steel	709.01
Temporary plastic fence	710.11
Woven wire	710.02

Construction Requirements

619.03 Fences and Gates.

(a) General. Clear along the fence line. Remove and dispose of trees, brush, logs, upturned stumps, roots of downed trees, rubbish, and debris according to Subsection 201.06. Clear a 10-foot width for chain link fence and a 3-foot width for wire fence.

Grubbing is not required except where short and abrupt changes in the ground contour require removal of stumps to properly grade the fence line. Remove or close cut stumps within the clearing limits.

Perform clearing and leveling with minimum disturbance to the terrain outside the fence line.

Schedule the fence installation, provide temporary fence, or other adequate means to prevent livestock from entering the project right-of-way, easements, or adjoining properties.

At bridges, cattle underpasses, and culverts, connect new fence to structure to permit free passage of livestock under or through the structure.

(b) Chain link fence and gates.

(1) Posts. Space posts at not more than 10-foot intervals. Measure the post spacing interval horizontally. Set posts vertically.

Set posts in concrete according to Section 601.

Where solid rock is encountered without overburden, drill line post holes at least 14 inches deep and drill end, corner, gate, and pull posts at least 20 inches deep in the solid rock. Make the hole width or diameter at least 1 inch greater than the post width or diameter. Cut the post to the required length before installation or drill the hole deep enough to set the post at the required height. Set and plumb the post and fill the hole with grout. Thoroughly work the grout into the hole to eliminate voids. Crown the grout to drain water away from the post.

Where solid rock is covered with soil or loose rock overburden, set posts to the plan depth or to the minimum depth into the solid rock as specified above, whichever is less. When solid rock is encountered before the plan depth, grout the portion of the post in solid rock and backfill the post hole from the solid rock to the top of the ground with concrete.

Provide end, gate, corner, and pull posts with adjacent brace posts as shown on the plans. A change in the fence alignment of 20 degrees or more is considered a corner.

(2) Top rail. Install top rails through the ornamental tops of the line posts, forming a continuous brace from end-to-end of each stretch of fence. Join lengths of top rail with sleeve-type couplings. Securely fasten top rails to terminal posts by pressed steel fittings or other appropriate means.

(3) Tension wire. Attach tension wire to end, gate, corner, or pull posts by bands and clamps. Either thread the top tension wire through the line post loop caps or hold in open slots in a manner to limit vertical movement. Tie or attach the bottom tension wire to the bottom of the line posts by ties or clamps in a manner that prevents vertical movement. Apply sufficient tension to avoid excess sag between posts. On the top tension wire, provide one turnbuckle or ratchet take-up in each run of fence.

(4) Fence fabric. For fences placed on the right-of-way, place fence fabric on the post face away from the highway. On curved alignment, place the fence fabric on the post face on the outside of the curve. For residential fences and fences off the right-of-way, place fence fabric on the post face designated by the CO.

Place the fabric approximately 1 inch above the ground and on a straight line between posts. Excavate high points of the ground to maintain grade. Do not fill in depressions without prior approval.

Stretch the fabric taut and securely fasten the fabric to the posts. Do not stretch using a motor vehicle. Use stretcher bars and fabric bands to fasten to end, gate, corner, and pull posts or weave the fabric into the fastening loops of roll-formed posts.

Fasten fabric to line posts using wire ties, metal bands, or other approved method. Fasten the top and bottom edge of the fabric with tie wires or hog rings to the top rail or tension wires, as applicable.

Join rolls of fabric by weaving a single strand into the ends of the rolls to form a continuous mesh.

(5) Gates. Fasten fabric to the end bars of the gate frame by stretcher bars and fabric bands. Fasten fabric to the top and bottom bars of the gate frame by tie wires similar to the method specified for fence fabric or by other approved standard methods.

Thoroughly clean welded connections on gate frames where the smelter coating has been burned with a wire brush. Remove traces of the welding flux and loose or cracked smelter. Paint the cleaned areas with two coats of zinc-oxide paint.

Provide a concrete footing for the drop-bar locking device on double metal gates. Make a hole to receive the locking bar to the depth specified by the manufacturer of the locking device.

Hinge each single gate to prevent removal of the gate without tools. Set the gate in an approximately horizontal plane. Set the gate so it swings freely inward and outward and fastens securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings. Set gates to swing open at least 90 degrees in each direction.

(c) Wire fences and gates.

(1) Posts. Excavate holes for posts, footings, and anchors as shown. Space posts at intervals shown for the type of fence being installed. Measure post spacing interval parallel to the existing ground slope. Set posts in a vertical position. Backfill post holes in 6-inch lifts. Tamp and compact each lift.

Wood posts may be driven in place if the method of driving does not damage the post. Metal posts may be driven. Set metal corner, gate, end, and pull posts in concrete.

Where solid rock is encountered without overburden, drill line post holes at least 14 inches deep and end, corner, gate, and pull posts at least 20 inches deep in the solid rock. Make the hole width or diameter at least 1 inch greater than the post width or diameter. Cut the post to the required length before installation or drill the hole deep enough to set the post at the required height. Set and plumb the post and fill the hole with grout. Thoroughly work the grout into the hole to eliminate voids. Crown the grout to drain water away from the post. Metal posts set in this manner do not require anchor plates and concrete footings.

Where solid rock is covered with soil or loose rock overburden, set posts to the plan depth or to the minimum depth into the solid rock as specified above, whichever is less. When the depth of overburden is greater than 12 inches, use an anchor plate on steel line posts and backfill steel end, corner, gate, and pull posts with concrete from the solid rock to top of the ground. When the depth of overburden is 12 inches or less, anchor plates and concrete backfill are not required. Grout the portion of the post in solid rock.

Install corner posts at changes in alignment of 30 degrees or more. Where new fence joins an existing fence, set end or corner posts, as necessary, and attach in a manner satisfactory to the CO.

(2) Braces. Limit fence runs to no more than 650 feet between adjacent corner braces, gate braces, end braces, or line braces. Install line braces at uniform intervals so the distance between any two braces is 650 feet or less. Construct braces before placing the fence fabric and wires on posts.

(a) Metal braces. Provide corner posts and pull posts with two braces, one each direction from the post in the main fence line. Provide end posts and gate posts with one brace in the line of the fence. Attach metal braces to the metal end, corner, pull, and gate posts and set in concrete as shown.

(b) Wood braces. Tap the posts to receive the braces. Anchor the brace to the post with three 16d nails or a 3/8 by 4-inch dowel. Install brace wires as shown and twist together until the entire assembly is taut and firm. Lightly notch the posts to position the brace wire. Drive three staples at each notch to secure wire.

(3) Barbed wire and woven wire. Place barbed wire and woven wire on the side of the post facing away from the highway. On curved alignment, place the barbed wire and the woven wire on the post face on the outside of the curve. Tightly stretch and fasten barbed wire and woven wire to the posts.

Apply tension according to the manufacturer's recommendations using a mechanical stretcher or other device designed for such use. Evenly distribute the pull over the longitudinal wires in the woven wire so not more than 50 percent of the original depth of the tension curves is removed. Do not use a motor vehicle to stretch the wire.

Splicing of barbed wire and woven wire between posts is permitted provided not more than two splices, spaced a minimum of 50 feet apart, occur in any one run of fence. Use wrap or telephone type splices for the longitudinal woven wire and barbed wire with each end wrapped around the other wire for not less than six complete turns.

(4) Fastening barbed wire and woven wire. Terminate the woven wire and barbed wire at each end, corner, gate, and pull post. Wrap each line of barbed wire and each longitudinal wire of the woven wire around the post and then itself with at least four turns. Where wood posts are used, staple the wires tightly to the posts.

At line posts, fasten the woven wire to the post at top and bottom and at intermediate points not exceeding 12 inches apart. Fasten each strand of barbed wire to each line post. Use wire ties or clamps to fasten the wires to metal posts. Securely splice tie wires to the fence on both sides of the post so there are two loops behind the post and one loop in front. On wood line posts, drive U-shaped staples diagonally across the wood grain so that both points do not enter between the same grain. In depressions where wire uplift occurs, drive staples with points slightly upward. On level ground and over knolls, slope the points slightly downward. Drive the staples just short of actual contact with the wires to permit free longitudinal movement of those lines and to prevent damage to the protective coating.

At grade depressions, alignment angles, and other locations where stresses tending to pull posts from the ground or out of alignment are created, snub or guy the wire fence. Attach the guy wire to each strand of barbed wire and to the top and bottom wires of woven wire in a manner to maintain the entire fence in its normal shape. Attach the guy wire to a deadman anchor buried not less than 24 inches in the ground or to an approved anchor at a point that best serves to resist the pull of the wire fence. If necessary to guy the fence in solid rock, grout the guy wire in a hole 2 inches in diameter and 10 inches deep. Deadman may also be fastened to posts. Place the deadman anchors at locations as directed.

Where required, install vertical cinch stays as shown. Twist the wire to permit weaving into the horizontal fence wires to provide rigid spacing. Weave barbed wires and the top, middle, and bottom wire of the woven wire, as applicable, into the cinch stay.

Where existing fence intersects the new fence, cut the existing fence materials or, splice in kind, new material as necessary, and fasten each longitudinal wire of the woven wire and each strand of the barbed wire to a new end post in line with or immediately adjacent to the new fence line.

(5) Gate installation.

(a) Wire gates. Construct wire gates of the same material as the fence and as shown. Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.

(b) Metal gates. Install metal gates and fittings to gate posts previously set. Firmly attach the fittings to the posts and gates. Hinge each single gate to prevent removal of the gate without tools. Set the gate in an approximately horizontal plane. Set the gate so it swings freely inward and outward and fastens securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates and their respective pintles to provide a common horizontal plane in which each single gate swings. Set gates to swing open at least 90 degrees in each direction.

For double gates, provide a drop-bar locking device with a concrete footing 12 inches in diameter and 12 inches deep. Crown the top of the footing and make a hole to receive the locking bar. Make the diameter and depth of the hole in the footing as specified by the manufacturer of the locking device.

(c) Wood gates. Install wood gates similar to metal gates and as shown.

619.04 Grounding Fences. Where an electric line crosses the fence line, ground the fence. Drive an 8-foot long, 1/2-inch minimum diameter galvanized or copper coated steel rod into the ground under the fence directly below the point of crossing. Drive the rod vertically until the top is 6 inches below the ground surface. Connect the grounding rod to each fence element with a 1/4-inch diameter solid copper conductor or equivalent. Either braze the connections or fasten with noncorrosive clamps.

Where an electric line runs parallel or nearly parallel to and above the fence, ground the fence at each end or gate post or at intervals not exceeding 1,600 feet.

Where vertical penetration of the grounding rod cannot be accomplished, use an equivalent horizontal grounding system.

619.05 Remove and Reset Fence. Remove existing fence and reset to approximately the same condition as the original fence. Salvage material in the existing fence and incorporate the material into the reset fence. When posts are set in concrete, remove concrete from old post and reset in concrete. Replace fence material damaged beyond reuse. Firmly reset posts on new alignment. Space posts and attach the horizontal members or wires to posts the same as the original fence. Furnish and use new material to fasten members or wires to posts.

619.06 Temporary Fence. When necessary, construct temporary fence to keep livestock and traffic off the road being constructed. Temporary fence is intended to remain in place only during the construction of the project or until the fence is directed to be removed.

Construct a temporary fence of a type that provides an adequate enclosure for the type of livestock to be confined.

619.07 Cattle Guards.

(a) Excavating and backfilling. Perform the work described under Section 209. Excavate foundation to depth with sufficient space for proper installation of formwork.

When the cattle guard is to be installed on new embankment, complete and compact the embankment according to Section 204 before excavating for footing.

(b) Concrete foundation. Construct cast-in-place concrete foundations according to Section 601. Concrete cattleguard units may be cast-in-place or precast. Set precast units in the foundation concrete before it hardens..

Finish stringer bearings to allow full bearing under each stringer. The cattle guard shall rest on the concrete without rocking.

(c) Cattle guard. Fabricate cattle guard according to Section 555. Assemble and place guards as shown on the plans. Securely fasten the cattle guard to the foundation. Fasten the metal wings to the cattle guard as shown on the plans. Connect fences and gates according to the plans. Weld according to ANSI/AASHTO/AWS D1.5.

Standard manufactured cattle guards may be used if approved. Designs shall provide for AASHTO loading M-18. Provide suitable cleanouts. Prepare and submit drawings according to Subsection 104.03. Acceptance of the drawings covers the requirements for strength and detail only. No responsibility is assumed for errors in dimensions.

(d) Painting. All metal parts shall receive one shop coat. Two additional coats are required and may be applied in the shop or in the field. Paint according to Section 563.

619.08 Bollards. Drill holes for bollards. Set posts plumb, backfill with approved material, and compact.

619.09 Acceptance. Material for fences, gates, cattle guards, and bollards will be evaluated under Subsections 106.02 and 106.03.

Construction and erection of fences, gates, cattle guards, and bollards will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill for cattle guards will be evaluated under Section 209.

Structural steel work for cattle guards will be evaluated under Section 555.

Painting of cattle guards will be evaluated under Section 563.

Concrete work for cattle guards will be evaluated under Section 601.

Measurement

619.10 Measure the Section 619 items listed in the bid schedule according to Subsection 109.02.

Payment

619.11 The accepted quantities will be paid at the contract price per unit of measurement for the Section 619 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 620. — STONE MASONRY

NOT USED

Section 621. — MONUMENTS AND MARKERS

Description

621.01 This work consists of constructing right-of-way monuments, maintenance markers, and similar monuments or posts.

Material

621.02 Conform to the following Section and Subsections:

Concrete	601
Reinforcing steel	709.01
Treated structural timber and lumber	716.03
Untreated structural timber and lumber	716.01

Construction Requirements

621.03 Monuments and Markers. Locate permanent points according to Section 152. Excavate and backfill according to Section 209. Set each monument and marker vertically at the required location and elevation. Monuments may be cast-in-place or precast according to Section 601. Backfill and compact around the monument or marker to ensure that it is held firmly in place.

621.04 Acceptance. Material (except concrete and paint) for monuments and markers will be evaluated under Subsections 106.02 and 106.03.

Construction of monuments and markers will be evaluated under Subsections 106.02 and 106.04.

Location of permanent points will be evaluated under Section 152.

Structural excavation and backfill will be evaluated under Section 209.

Concrete will be evaluated under Section 601.

Paint will be evaluated under Section 563.

Measurement

621.05 Measure the Section 621 items listed in the bid schedule according to Subsection 109.02.

Payment

621.06 The accepted quantities will be paid at the contract price per unit of measurement for the Section 621 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 622. — RENTAL EQUIPMENT

Description

622.01 This work consists of furnishing and operating equipment for construction work ordered by the CO and not otherwise provided for under the contract.

Construction Requirements

622.02 Rental Equipment. 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, etc., 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 of 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.

622.03 Acceptance. Rental equipment work will be evaluated under Subsection 106.02.

Measurement

622.04 Measure the Section 622 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Round portions of an hour up to the next half hour. Measure time in excess of 40 hours per week at the same rate as the first 40 hours.

Measure time for moving equipment between project work sites. Do not measure nonoperable equipment or equipment dependent upon another piece of nonoperable equipment.

Payment

622.05 The accepted quantities will be paid at the contract price per unit of measurement for the Section 622 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 623. — GENERAL LABOR

Description

623.01 This work consists of furnishing workers and hand tools for construction work ordered by the CO and not otherwise provided for under the contract.

Construction Requirements

623.02 Workers and Equipment. Furnish competent workers and appropriate hand tools for the work.

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

623.03 Acceptance. General labor work will be evaluated under Subsection 106.02.

Measurement

623.04 Measure the Section 623 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Round portions of an hour up to the next half hour. Measure time in excess of 40 hours per week at the same rate as the first 40 hours.

Do not measure time for workers' transportation.

Payment

623.05 The accepted quantities will be paid at the contract price per unit of measurement for the Section 623 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 624. — TOPSOIL

Description

624.01 This work consists of furnishing and placing topsoil and placing conserved topsoil.

Material

624.02 Conform to the following Subsections:

Furnished topsoil	713.01(a)
Conserved topsoil	713.01(b)

Construction Requirements

624.03 Preparing Areas. Shape all slopes and disturbed areas to be covered with topsoil. Disk or scarify slopes 1V:3H or flatter to a depth of 4 inches.

624.04 Placing Topsoil. Provide at least 7 days notice before the start of topsoil placement. Do not place topsoil when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Use all conserved topsoil before furnishing topsoil. Keep the roadway surfaces clean during hauling and spreading operations.

Spread topsoil to a depth that, after settlement, provides the required depth. Break clods and lumps with harrows, disks, or other appropriate equipment to provide a uniform textured soil. Remove and dispose of clods and stones larger than 2 inches, stumps, roots, and other litter according to Subsection 203.05.

Construct longitudinal depressions at least 2 inches deep perpendicular to the natural flow of water without overly compacting the topsoil surface.

624.05 Acceptance. Material for furnished topsoil will be evaluated under Subsections 106.02 and 106.03.

Material for conserved topsoil will be evaluated under Subsection 106.02.

Placing furnished and conserved topsoil material will be evaluated under Subsections 106.02 and 106.04.

Measurement

624.06 Measure the Section 624 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure furnishing and placing topsoil by the cubic yard in the hauling vehicle or by the acre on the ground surface.

Measure placing conserved topsoil by the cubic yard in the hauling vehicle or by the acre on the ground surface.

Payment

624.07 The accepted quantities will be paid at the contract price per unit of measurement for the Section 624 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 625. — TURF ESTABLISHMENT

Description

625.01 This work consists of soil preparation, watering, fertilizing, seeding, and mulching.

Seeding and mulching methods are designated as dry or hydraulic.

Material

625.02 Conform to the following Subsections:

Agricultural limestone	713.02
Fertilizer	713.03
Mulch	713.05
Seed	713.04
Stabilizing emulsion tackifiers	713.12
Water	725.01

Construction Requirements

625.03 General. Apply turf establishment to finished slopes and ditches within 14 days after completion of construction on a portion of the site. Do not seed during windy weather or when the ground is excessively wet, frozen, snow covered, extremely dry, cloddy, hard pan, or not friable.

625.04 Preparing Seedbed. Grade the seeding area to line and grade. Remove all weeds, sticks, stones 2 inches in diameter and larger, and other debris detrimental to application, growth, or maintenance of the turf.

If required by the contract, apply limestone and grubproofing.

Cultivate the seeding area to a minimum depth of 4 inches and prepare a firm but friable seedbed before seeding. Do not cultivate aggregate-topsoil courses that were previously dry seeded under Section 305.

625.05 Watering. Moisten seeding areas before seeding and maintain the moisture until 10 days after germination.

625.06 Fertilizing. Apply fertilizer by the following methods:

(a) Dry method. Incorporate the fertilizer into the upper portion of the seedbed before seeding.

(b) Hydraulic method. Add fertilizer to the slurry and mix before adding seed. Apply the seed and fertilizer in one application.

625.07 Seeding. Apply seed by the following methods:

(a) Dry method. Apply the seed with approved power driven seeders, drills, or other mechanical equipment. Hand-operated seeding methods are satisfactory on areas inaccessible to mechanical equipment. Lightly compact the seedbed within 24 hours after seeding.

(b) Hydraulic method. Use hydraulic-type equipment capable of providing a uniform application using water as the carrying agent. Add a tracer material consisting of either wood or grass cellulose fiber mulch to the water. Apply the tracer material at a rate of 400 pounds per acre to provide visible evidence of uniform application. Add the seed to the water slurry no more than 30 minutes before application. Seed by hand areas inaccessible to seeding equipment.

625.08 Mulching. Apply mulch within 48 hours after seeding by the following methods:

(a) Dry method. Spread all mulch material, except wood and grass cellulose fibers, by a mulch spreader utilizing forced air to blow the mulch material onto the seeded area. Apply straw mulch at a rate of 3200 pounds per acre. Anchor the mulch material with an approved stabilizing emulsion tackifier or approved mechanical method. Do not mark or deface structures, pavements, utilities, or plant growth with tackifier.

(b) Hydraulic method. Apply mulch in a separate application from the seed using hydraulic-type equipment according to Subsection 625.07(b).

Apply wood fiber or grass straw cellulose fiber mulch at a rate of 1500 pounds per acre.

Apply bonded fiber matrix hydraulic mulch at a minimum rate of 3000 pounds per acre. Apply so no hole in the matrix is greater than 0.04 inches. Apply so that no gaps exist between the matrix and the soil.

Mulch by hand areas inaccessible to mulching equipment.

625.09 Protecting and Caring for Seeded Areas. Protect and care for seeded areas including watering when needed until final acceptance. Repair all damage to seeded areas by reseeding, refertilizing, and remulching. Apply supplemental applications of seed, mulch, fertilizer, lime, or ammonium nitrate.

625.10 Acceptance. Seed will be evaluated under Subsections 106.02, 106.03, and 713.04.

Mulch, fertilizer, and other turf establishment material will be evaluated under Subsections 106.02 and 106.03.

Turf establishment work will be evaluated under Subsections 106.02 and 106.04.

Measurement

625.11 Measure the Section 625 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure seeding and mulching by the acre on the ground surface or by the slurry unit. A slurry unit consists of approximately 1,000 gallons of water plus the specified turf establishment material. Four slurry units contain the material to cover one acre.

Measure turf establishment and supplemental applications by the acre on the ground surface.

Measure water by the M-gallon in the hauling vehicle or by metering.

Payment

625.12 The accepted quantities will be paid at the contract price per unit of measurement for the Section 625 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 626. — PLANTS, TREES, SHRUBS, VINES, AND GROUNDCOVERS

Description

626.01 This work consists of furnishing and planting trees, shrubs, vines, groundcovers, and other plants.

Material

626.02 Conform to the following Subsections:

Fertilizer	713.03
Miscellaneous planting material	713.08
Mulch	713.05
Plant material	713.06
Topsoil	713.01
Water	725.01(b)

Construction Requirements

626.03 General. Do not plant in frozen ground, when snow covers the ground, or when the soil is saturated, extremely dry, cloddy, hard pan, not friable, or is otherwise unsatisfactory for planting.

Furnish stock with a fibrous, cohesive root system. Do not provide container-grown stock that is pot-bound, that has a top system out of proportion (larger) to the size of the container, or that has roots growing out of the container.

626.04 Inspecting and Delivering. Notify the CO 30 days in advance of the delivery of material to permit the CO the opportunity to select material at the source. Submit commercial certifications and complete written information concerning the source of supply for all plant material at least 15 days before delivery of plants to the project.

626.05 Protection and Temporary Storage. Package plants to provide protection against climate and breakage during transit. When shipment is made by open vehicle, tie and cover plant materials to prevent wind damage and dehydration. Spray evergreen and deciduous trees in leaf with an anti-transpirant according to the manufacturer's instructions. When shipment is made by closed vehicle, carefully pack and adequately ventilate plants to prevent "sweating."

Keep all plant material moist and exercise care to prevent damage to bark, branches, and root systems. Replace all damaged plants including plants with cracked or crushed root balls.

Tag each plant delivered to the project with a weatherproof tag showing the plant name and date of delivery.

Protect plants delivered, but not scheduled for immediate planting, as follows:

(a) Open the bundles of bare root material, separate plants, and cover the roots in moist trenches.

(b) Cover the earth balls of balled and burlapped material with mulch or other suitable material and keep moist.

Install all plant material received on site within 30 days.

626.06 Excavation for Plant Pits and Beds. At least 14 days before planting, submit planting locations and methods of planting to the CO for approval. Mark planting locations with stakes or flagging. Remove all sod, weeds, roots, and other unsuitable material from the planting site. Excavate plant pits as follows:

(a) Width of excavation.

(1) For root spread or ball diameters up to 4 feet, dig the pits circular in outline to the root spread plus 2 feet.

(2) For root spreads or ball diameters over 4 feet, excavate 1.5 times the root spread.

(b) Depth of excavation. Dig the pits to a depth that permits a minimum of 6 inches of backfill under the roots or balls or dig the pits to the following depths, whichever is deeper:

(1) Deciduous trees.

(a) Under 1½-inch caliper. 2 feet deep

(b) Over1½-inch caliper. 3 feet deep

(2) Deciduous and evergreen shrubs.

(a) Under 2 feet height. 1 foot deep

(b) Over 2 feet height. 2 feet deep

(3) Evergreen trees.

(a) Under 5 feet height. 8 inches plus ball height

(b) Over 5 feet height. 12 inches plus ball height

(4) Vines and groundcovers. Double the size of the pot.

Loosen soil at the sidewalls and bottom of the plant pit to a depth of 6 inches before setting the plant.

Do not leave planting holes open overnight.

626.07 Setting Plants. Do not plant material until inspected and approved by the CO. Plants not meeting specifications, arriving on site in an unsatisfactory condition, or showing sign of improper handling will be rejected. Immediately remove and dispose of all rejected plants off site and replace with approved nursery stock.

Prepare a backfill mixture of 4 parts topsoil, loam, or selected soil to one part peat moss. Place backfill mixture in the bottom of the plant pit. Set all plants approximately plumb and at the same level or slightly lower than the depth at which they were grown in the nursery or collected in the field. Set plants as follows:

(a) Bare root stock. Place bare rooted plants in the center of the plant pit with the roots properly spread in a natural position. Cut broken or damaged roots back to sound root growth. Work backfill mixture around and over the roots, tamp as hole is being filled, and water thoroughly.

(b) Balled and burlapped stock. Handle and move plants by the ball. Place balled and burlapped plants in the prepared pits on tamped backfill mixture. Score the root ball to a depth of 1 inch along the entire side equally on 4 sides. Backfill around the plant ball to half the depth of the ball. Tamp and thoroughly water. Cut the burlap and remove it from the upper half of the ball or loosen the burlap and fold it back. If wire baskets are used cut the wire from the upper half of the basket. Backfill the remainder of the plant with backfill mixture.

(c) Container-grown stock. Remove the container just before planting. Place plants in the prepared pits on tamped backfill mixture. Backfill the remainder of the plant with backfill mixture and tamp.

626.08 Fertilizing. Fertilize using either of the following methods:

(a) Mix the fertilizer with the backfill mixture when it is prepared.

(b) Spread the fertilizer uniformly around the pit area of individual plants or over shrub beds. Cultivate the fertilizer into the top 2 inches of the backfill mixture.

626.09 Watering. Construct 4-inch deep water basins around trees and 3-inch deep water basins around shrubs. Make the diameter of the basin equal to that of the plant pit.

Water plants during and immediately after planting and throughout the plant establishment period. Saturate the soil around each plant at each watering.

626.10 Guying and Staking. When guying and staking is specified, guy deciduous trees just below the first lateral branch and guy evergreen trees half way up the height of the tree. Do not leave the guys and stakes on a tree for more than one growing season.

626.11 Pruning. Prune before or immediately after planting to preserve the natural character of each plant. Use experienced personnel to perform the pruning. Use accepted horticultural practice. Paint cuts over 3/4 inch in diameter with tree wound dressing.

626.12 Mulching. Place mulch within 24 hours after planting. Place mulch material over all pit or water basin areas of individual trees and shrubs and over the entire shrub bed. If wood fiber is used, apply nitrogen at the rate of 8 pounds per cubic yard to the mulch material.

626.13 Plant Establishment Period. The plant establishment period is a one-year period beginning at the completion of the project. Employ all necessary means to preserve the plants in a healthy growing condition during the plant establishment period. Care during the establishment period includes watering, cultivating, pruning, repairing, adjusting guys and stakes, and controlling insects and disease. At the end of the plant establishment period, remove all guys and stakes.

626.14 Acceptance. Plant material (including plants, fertilizer, mulch, and topsoil) will be evaluated under Subsections 106.02 and 106.03.

Planting of trees, shrubs, vines, groundcovers and other plants will be evaluated under Subsections 106.02 and 106.04 and as follows:

An inspection of the plant material will be made about 15 days before the end of the plant establishment period to identify all dead, dying, or diseased plants for removal and replacement. During the following planting season, remove and replace all identified plants according to this Section. A final inspection of all plant material within 15 days after completion of all replacement planting will be the basis for final acceptance.

Measurement

626.15 Measure the Section 626 items listed in the bid schedule according to Subsection 109.02.

Payment

626.16 The accepted quantities will be paid at the contract price per unit of measurement for the Section 626 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for plants will be made as follows:

(a) 75 percent of the unit bid price will be paid following initial planting.

(b) The remaining 25 percent of the unit bid price will be paid after the final inspection.

Section 627. — SOD

Description

627.01 This work consists of furnishing and placing living sod of perennial turf-forming grasses.

Sod placement is designated as solid, strip, or spot according to Subsection 627.06.

Material

627.02 Conform to the following Subsections:

Agricultural limestone	713.02
Fertilizer	713.03
Pegs for sod	713.11
Sod	713.10
Water	725.01

Construction Requirements

627.03 General. Move and lay sod during dry weather and on dry, unfrozen ground.

627.04 Inspecting and Delivering. Provide at least 3 days notice before cutting sod. The CO will approve the sod in its original position before cutting. Do not deliver sod until the soil is prepared.

627.05 Preparing the Soil. Clear and grade the area to be sodded. 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 the proper placement or subsequent growth.

Topsoil according to Section 624.

Apply fertilizer and agricultural limestone uniformly over the sodding area. 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.

627.06 Placing Sod. Place sod within 24 hours after cutting or within 5 days after cutting when the sod is stored in moist stacks, grass-to-grass and roots-to-roots. Protect sod against drying and from freezing.

(a) Solid sod. Place sod perpendicular to drainage flows. Place sections of solid sod edge to edge with staggered joints. Plug openings with sod or fill openings with acceptable loamy seeded topsoil. Roll or tamp sod to eliminate air pockets and provide an even surface. On slopes 1V:2H or steeper and in channels, peg sod on 2-foot centers after rolling or tamping. Drive pegs flush with the sod bed surface.

(b) Strip sod. Lay strip sod in shallow trenches in parallel rows. Firmly roll or tamp until the surface of the sod is level with or below the adjacent soil. Seed the soil between the strips of sod according to Section 625. Rake or drag the seeded areas to cover the seed.

(c) Spot sod. Place sod blocks. Roll or tamp the blocks into the soil until the sod surfaces are slightly below the surrounding ground surface.

Blend final grades with existing adjacent areas. Leave the entire area drainable and free from abrupt changes in slope.

627.07 Maintaining Sodded Areas. Water sod when placing and keep moist. Avoid erosion when watering.

Erect warning signs and barriers to protect newly sodded areas. Do not allow wheeled vehicles on newly sodded areas.

Mow sodded areas and repair or replace sodded areas that are damaged or fail to show a uniform growth of grass. Maintain sodded areas and replace all nonliving sod until final acceptance of the project.

627.08 Acceptance. Material, including lime and fertilizer, for sodding will be evaluated under Subsections 106.02 and 106.03.

Sod placement will be evaluated under Subsections 106.02 and 106.04.

Topsoil will be evaluated under Section 624.

Seed will be evaluated under Section 625.

Measurement

627.09 Measure the Section 627 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Do not measure non-sodded areas adjacent to strip and spot sodding.

Measure topsoil under Section 624.

Measure water and seeding under Section 625.

Payment

627.10 The accepted quantities will be paid at the contract price per unit of measurement for the Section 627 pay item listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 628. — Reserved

Section 629. — ROLLED EROSION CONTROL PRODUCTS AND CELLULAR CONFINEMENT SYSTEMS

Description

629.01 This work consists of constructing temporary and permanent installations to control erosion and enhance vegetation establishment and survivability on slopes and channels. This work includes installing rolled erosion control products (RECP) and cellular confinement systems.

RECP are designated according to Subsections 713.17, 713.18, and the following:

(a) Mulch control netting. A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable RECP to anchor loose fiber mulches.

(b) Open weave textile. A temporary degradable RECP composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.

(c) Erosion control blanket. A temporary degradable RECP composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment.

(d) Turf reinforcement mat. A long term non-degradable RECP composed of UV stabilized, non-degradable, synthetic fibers, filaments, nettings, or wire mesh processed into three dimensional reinforcement matrices designed for permanent and critical hydraulic applications where design discharges exert velocities and shear stresses that exceed the limits of mature, natural vegetation. Turf reinforcement mats provide sufficient thickness, strength and void space to permit soil filling and retention and the development of vegetation within the matrix.

Cellular confinement system cell depths are designated according to Table 713-2.

Material

629.02 Conform to the following Sections and Subsections:

Cellular confinement systems	713.07
Permanent RECP	713.18
Temporary RECP	713.17
Topsoil	624
Turf establishment	625

Construction Requirements

629.03 General. Make the soil surface stable, firm, and free of rocks and other obstructions. Install RECP and cellular confinement systems according to the manufacturer's recommendations and to the following minimum guidelines. Apply turf establishment according to Section 625.

In areas to be mowed soon after installation, use ultra-short term temporary RECP consisting of rapidly degrading nettings with a service life of 3 months or less.

629.04 Mulch Control Netting (RECP, Types 1.A, 2.A, and 3.A). Apply mulch according to Subsection 625.08(a). Immediately after mulching, install mulch control netting according to Subsection 629.05.

629.05 Erosion Control Blanket, Open Weave Textile, and Turf Reinforcement Mat (RECP, Types 1.B, 1.C, 1.D, 2.B, 2.C, 2.D, 3.B, 4, 5.A, 5.B, and 5.C). Unless soil in-filling is required, complete turf establishment work before installing RECP.

If soil in-filling is required, first install RECP. Then apply seed and lightly brush or rake 1/4 to 3/4 inch of topsoil into the voids in the RECP filling the full product thickness.

Use staples that are at least 6 inches long to secure the RECP. Longer staples may be necessary in sandy, loose, or wet soils.

Unroll the RECP parallel to the primary direction of flow and place it in direct contact with soil surface. Do not stretch or allow RECP to bridge over surface inconsistencies. Overlap edges of adjacent RECP by 2 to 4 inches. Use a sufficient number of staples to prevent seam separation. Overlap roll ends of joining RECP 2 to 6 inches in the direction of flow.

(a) Slope Installations. At the top of slope, anchor the RECP by one of the following methods:

(1) Staples. Install the RECP 36 inches over the shoulder of the slope onto flat final grade. Secure with a single row of staples on 12-inch centers.

(2) Anchor trench. Construct a 6-inch by 6-inch trench. Extend the upslope terminal end of the RECP 36 inches past the trench. Use staples on 12-inch centers to fasten the RECP into the trench. Backfill the trench and compact the soil. Secure the terminal end with a single row of staples on 12-inch centers and cover the end with soil. Apply turf establishment.

(3) Check slot. Install two rows of staples 4 inches apart on 4-inch centers across the top edge of the RECP. Drive all staple heads flush with soil surface.

Securely fasten all RECP to the soil by installing staples at a minimum rate of 1.5 per square yard.

(b) Channel Installations. At the beginning of the channel, construct a full width anchor trench according to paragraph (a)(2) above. Construct additional anchor trenches or check slots at intervals along the channel reach and at the channel end according to paragraph (a)(2) or (a)(3) and the manufacturer's installation guidelines.

Securely fasten all RECP to the soil by installing staples at a minimum rate of 2.0 per square yard. Significantly higher anchor rates may be necessary in sandy, loose, or wet soils and in severe applications.

Repair all damaged areas immediately by restoring soil to finished grade, re-applying turf establishment, and replacing the RECP.

629.06 Cellular Confinement Systems. Excavate to the depth of the cellular confinement system and smooth and compact the slope. Install the top of the system flush or lower than the adjacent slope. Expand the geocell down the slope. Connect adjacent geocell sections with hog rings or staples in every other cell.

Anchor the system with wooden stakes across the top at every other cell. Repeat the anchoring pattern in every tenth row and in the bottom row. Drive stakes to a minimum embedment of 1 foot below the base of the cellular confinement layer.

Backfill the system with topsoil. Hand-compact the topsoil within each cell and apply turf establishment.

629.07 Acceptance. RECP and cellular confinement system material will be evaluated under Subsection 106.02 and 106.03.

Installation of RECP and cellular confinement systems will be evaluated under Subsections 106.02 and 106.04.

Topsoil will be evaluated under Section 624.

Turf establishment will be evaluated under Section 625.

Measurement

629.08 Measure the Section 629 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

Measure topsoil under Section 624.

Measure turf establishment under Section 625.

Payment

629.09 The accepted quantities will be paid at the contract price per unit of measurement for the Section 629 pay items shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 630. — Reserved

Section 631. — Reserved

Section 632. — Reserved

Section 633. — PERMANENT TRAFFIC CONTROL

NOT USED

Section 634. — PERMANENT PAVEMENT MARKINGS

Description

634.01 This work consists of applying 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

Material

634.02 Conform to the MUTCD and the following Subsections:

Conventional traffic paint	718.13
Epoxy markings	718.15
Epoxy resin adhesives	718.23
Glass beads	718.19
Polyester markings	718.16
Preformed plastic markings	718.18
Raised pavement markers	718.20
Thermoplastic markings	718.17
Waterborne traffic paint	718.14

Construction Requirements

634.03 General. 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. In curve widening areas, apply the pavement edge markings at the edge of the traveled way and the centerline markings midway between the pavement lines.

Remove loose particles, dirt, tar, grease, and other deleterious material from the surface to be marked. Where markings are placed on rigid 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.

At least 7 days before applying pavement markings, furnish a written copy of the marking manufacturer's recommendations for use. 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 mass 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; and

(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.

Remove all conflicting pavement markings according to Subsection 635.13.

634.04 Conventional Traffic Paint (Type A). Apply paint when the pavement and air temperatures are above 40 ºF. Spray paint at 15 mil minimum wet film thickness before glass beads or at a rate of 107square feet per gallon. Immediately apply type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

On new asphalt pavements or new asphalt surface treatments, apply two coats. Apply the first coat at 360 square feet per gallon and the second coat at 150 square feet per gallon.

634.05 Waterborne Traffic Paint (Type B and C). Apply paint when the pavement and air temperatures are above 50 ºF. 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.

On new asphalt pavements or new asphalt surface treatments, apply two coats. Apply each coat at 210 square feet per gallon.

634.06 Epoxy Markings (Types D and E). Heat components A and B separately at 110±30 ºF and mix. Discard all material heated over 140 ºF. Apply epoxy when the pavement and air temperatures are above 50 ºF. Apply as a spray at 110±30 ºF (gun tip temperature) at a 15 mil minimum dry film thickness or 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 and G). Apply polyester when the pavement and air temperatures are above 50 ºF. Spray at 128±7 ºF (gun tip temperature) at a 15 mil minimum dry film thickness or 107 square feet per gallon. Discard all material heated over 150 ºF. Do not use fast dry polyester markings on asphalt pavements 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 (Type H and I). On areas to be marked on rigid 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 ºF. Spray or extrude the thermoplastic at 430±5 ºF. For centerlines and lane lines, spray or extrude 90 mil minimum dry film thickness or at a rate of 17.8 square feet per gallon. For edge lines, spray or extrude 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 pound 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.

The minimum bond strength of the thermoplastic shall be 175 pounds per square inch on rigid 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 ºF. Roll the marking into the surface with a steel wheel 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 ºF. 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 ºF. Discard all material heated over 120 ºF or stiffened by polymerization.

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

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

The minimum bond strength will be 1.75 pounds per square inch or a total tensile strength of 25 pounds.

634.12 Acceptance. Material for permanent pavement markings will be evaluated under Subsections 106.02 and 106.03.

Placement of permanent pavement marking will be evaluated under Subsections 106.02 and 106.04.

Measurement

634.13 Measure the Section 634 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

When two coats of paint are required, measure each coat.

When pavement markings are measured by the linear foot or station, 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.

Payment

634.14 The accepted quantities will be paid at the contract price per unit of measurement for the Section 634 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Section 635. — TEMPORARY TRAFFIC CONTROL

Description

635.01 This work consists of furnishing, maintaining, relocating, and removing temporary traffic control devices and services as ordered for the control and protection of public traffic through the project.

Advance warning arrow panel, barricade, and warning light types are designated as shown in the MUTCD.

Material

635.02 Conform to the MUTCD and the following Sections and Subsections:

Construction sign panels	633
Retroreflective sheeting	718.01
Temporary concrete barrier	618
Temporary plastic fence	710.11
Temporary guardrail	617
Temporary pavement markings	718.21
Temporary traffic control devices	718.22
Traffic markings	634

Construction Requirements

635.03 General. Install and maintain temporary traffic control devices adjacent to and within the project as required by the traffic control plan, Section 156, and the MUTCD. Install and maintain traffic control devices as follows:

(a) Furnish and install traffic control devices before the start of construction operations.

(b) Install only those traffic control devices needed for each stage or phase.

(c) Relocate temporary traffic control devices as necessary.

(d) Remove devices that no longer apply to the existing conditions.

(e) Immediately replace any device that is lost, stolen, destroyed, or inoperative.

(f) Keep temporary traffic control devices clean.

(g) Furnish and maintain traffic control devices that meet the "acceptable" standard described in *Quality Standards for Work Zone Traffic Control Devices* published by ATSSA. Amend the ATSSA standards as follows:

(1) Repair or remove and replace "marginal" devices within 48 hours; and

(2) Repair or remove and replace "unacceptable" devices immediately.

(h) Remove all temporary traffic control devices upon contract completion or when approved.

(i) Furnish temporary traffic control devices that meet the NCHRP Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, for crashworthiness standards as applicable.

635.04 Advance Warning Arrow Panels. Perform the work described under MUTCD Part 6.

635.05 Barricades. Perform the work described under MUTCD Part 6. Use type III, VII, VIII, or IX retroreflective sheeting.

635.06 Cones and Tubular Markers. Perform the work described under MUTCD Part 6. Use 28-inch cones or tubular markers. Use type III, or VI retroreflective sheeting.

635.07 Construction Signs. Use type III, VII, VIII, or IX retroreflective sheeting. For roll-up signs, use type VI retroreflective sheeting. Remove or completely cover all unnecessary signs with metal, plywood, or other acceptable material.

Use crashworthy posts within the traversable area adjacent to traffic. Install posts according to Section 633.

635.08 Drums. Perform work described in MUTCD Part 6. Use plastic drums that are approximately 36 inches high and a minimum of 18 inches in diameter. Use type III or VI retroreflective sheeting.

635.09 Flaggers. Use flaggers certified by the American Traffic Safety Services Association, the National Safety Council, the International Municipal Signal Association, a state agency, or other acceptable organization. Perform the work described under MUTCD Part 6. Use type III, VII, VIII, or IX retroreflective sheeting on flagger paddles. Do not use flags.

635.10 Pilot Cars. Perform the work described under MUTCD Part 6. Use pilot car operators meeting the minimum qualifications of a flagger according to Subsection 635.09. Mount a rotating amber beacon on the roof of each pilot car. Do not use strobe light beacons.

635.11 Temporary Barriers. Perform the work described under MUTCD Part 6. Use temporary barriers that meet NCHRP Report 350 and are new or used provided they are not badly damaged. Lifting holes no larger than 4 inches or lifting loops are permitted. Individual sections may vary in length.

Mount 3-inch minimum dimension white or yellow retroreflectors, as applicable, to the top or side of the barrier on 25-foot centers. Mount the retroreflectors at a uniform height at least 2 feet above the pavement surface.

635.12 Temporary Guardrail. Construct temporary guardrail according to Section 617.

Mount 3-inch minimum dimension white or yellow retroreflectors, as applicable, to the top or side of the guardrail on 25-foot centers. Mount the retroreflectors at a uniform height at least 2 feet above the pavement surface.

635.13 Temporary Pavement Markings and Delineation. Before opening a pavement surface to traffic, remove all conflicting pavement markings by sandblasting or other methods that do not damage the surface or texture of the pavement. Make the removal pattern uneven so it does not perpetuate the outline of the removed pavement markings. Lightly coat sandblasted or removal areas on asphalt surfaces with emulsified asphalt.

Place and maintain temporary pavement markings that are neat, crack free, true, straight, and unbroken. For temporary pavement markings, use preformed retroreflective tape, traffic paint, or temporary raised pavement markers as follows:

(a) Preformed retroreflective tape. Apply according to the manufacturer's instructions. Remove all loose temporary preformed retroreflective tape before placing additional pavement layers.

(b) Traffic paint. Do not apply temporary traffic paint to the final surface. Apply traffic paint as the temporary pavement marking if no work will be performed on the project for at least 30 consecutive days. Apply temporary traffic paint at a 15 mil minimum wet film thickness (0.9 gallons per 100 square feet). Immediately apply type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

(c) Raised pavement markers. Do not use raised pavement markers during seasonal suspensions. When chip seals, slurry seals, or tack coats are used after marker placement, protect the markers with an approved protective cover, which is removed after the asphalt material is sprayed. Temporary raised pavement markers may be used as temporary pavement markings as follows:

(1) 10-foot broken line. Four pavement markers spaced 3.33 feet apart followed by a 30-foot gap.

(2) 2-foot broken line. Two pavement markers spaced 2 feet apart followed by an 18-foot gap.

(3) Solid line. Pavement markers on 5-foot centers.

Remove all temporary raised pavement markers before placing additional pavement layers.

Remove all temporary pavement markings from the surface course before placing permanent pavement markings.

635.14 Vertical Panels. Perform the work described under MUTCD Part 6. Use type III, VII, VIII, or IX retroreflective sheeting.

635.15 Warning Lights. Perform the work described under MUTCD Part 6. When type C, steady-burn, warning lights are installed on barricades or drums and used in a series for delineation, use type A, flashing, warning lights on the first 2 barricades or drums in the series. Mount batteries for type B warning lights a maximum of 12 inches from ground or roadway surface as measured to top of the battery casing.

635.16 Shadow Vehicle. Use a shadow vehicle (15,000 pound gross vehicle mass minimum) equipped with a truck-mounted attenuator (crash cushion) attached to the rear of the vehicle, exterior flashing yellow dome light, and an advance warning arrow panel. Use advance warning arrow panel according to Subsection 635.04.

Use the shadow vehicle to provide physical protection to workers from traffic approaching from the rear during moving operations (i.e., pavement markings, traffic control set up and removal, etc.). Use the following procedures to close a lane of traffic. Alternate procedures may be used if approved by the CO.

(a) Move the shadow vehicle to a point approximately 200 feet from the first advance warning sign for the lane closure and stop on the shoulder.

(b) Activate the flashing lights and flashing arrow panel. Begin the arrow panel in the caution mode and after approximately 2 minutes display the correct flashing pass arrow.

(c) Move the shadow vehicle (now acting as a protection vehicle) along the shoulder to the first sign location, stopping approximately 100 feet before the sign location in a blocking position.

(d) Place the first sign then proceed to the next advance sign location. Repeat step (c) for the second sign and install that sign. Repeat this procedure until all advance warning signs are installed.

(e) After installing all of the advanced warning signs for the lane closure, move the shadow vehicle into the lane that is to be closed to a position 100 feet in advance of the closing taper location. Install the channelizing devices for the taper in the shielded lane.

(f) Move the shadow vehicle off the roadway and past the taper on the shoulder and remain in position until the flashing arrow panel for the closure (if one is to be provided) is placed and operating. Move the shadow vehicle with the workers as they proceed to set up the remaining devices as additional protection.

635.17 Pavement Patch. Use an asphalt mix according to Section 404 or 417 to repair potholes and rough spots in the traveled way before reopening travel lanes to traffic.

635.18 Portable Changeable Message Sign. Conform to the MUTCD Part 6.

635.19 Temporary Crash Cushions. Install an FHWA-approved temporary crash cushion conforming to the appropriate level of crashworthiness per NCHRP Report 350. FHWA-approved crash cushions are available on the FHWA Safety website. Install according to manufacturer's recommendations.

635.20 Temporary Signal System. Use a temporary signal system according to Section 636 and MUTCD Parts 4 and 6.

Use signal heads with three lenses, minimum 8 inches diameter, indicating red, yellow, and green phases. Use a signal controller capable of operating in either the solid red, solid green, or a red/yellow/green mode for each signal.

635.21 Temporary Fence. Use temporary fence according to Section 619.

635.22 Portable Rumble Strip. Use a strip 10 feet long, 18 inches wide, and 1¼ inches high to alert drivers of an approaching flagger station or work area.

635.23 Opposing Traffic Lane Divider. Use type III, VII, VIII, or IX retroreflective sheeting.

635.24 Steel Plates. Use 1-inch or thicker steel plates capable of safely carrying traffic. Secure the plates to the pavement to prevent any movement.

635.25 Acceptance. Material (including signs, drums, barricades, cones, tubular markers, crash cushions, concrete barriers, dividers, fence, guardrail, pavement markings, rumble strips, traffic signals, lights, and vertical panels) for temporary traffic control devices will be evaluated under Subsections 106.02 and 106.03. Vehicles for pilot cars and shadow vehicles will be evaluated under Subsection 106.02.

Placement of temporary traffic control devices will be evaluated under Subsections 106.02 and 106.04.

Temporary traffic control services will be evaluated under Subsection 106.02.

Measurement

635.26 Measure the Section 635 items listed in the bid schedule according to Subsection 109.02 and the following as applicable when ordered by the CO and installed.

Measure temporary traffic control items only one time even if relocated or replaced, except for items paid by the hour.

Measure advance warning arrow panels by the hour or by the each. When measurement is by the hour, round portions of an hour up to the half hour.

Measure barricades by the linear foot of width.

Measure construction signs by the square foot of front face sign panel. Do not measure posts and temporary supports.

Measure flaggers, for each hour a person is actually performing the work. Round portions of an hour up to the half hour. Measure time in excess of 40 hours per week at the same rate as the first 40 hours.

Measure pilot cars (including operators) for each hour the car is actually performing the work. Round portions of an hour up to the half hour. Measure time measured in excess of 40 hours per week at the same rate as the first 40 hours.

When there is a pay item for moving temporary barriers, do not measure movement of temporary barriers for work access or the convenience of the Contractor.

Measure temporary guardrail from center-to-center of end posts.

Measure temporary pavement markings for only one application of pavement markings per lift. When temporary pavement markings are measured by the linear foot or mile, measure the number of linear feet or miles of lines applied along the centerline of each 4-inch wide line applied regardless of color. Measure solid lines from end to end of each continuous line. Measure broken lines from end to end including gaps. For line widths greater than 4 inches, adjust the measured length of line in the ratio of the required width to 4 inches. When temporary pavement markings are measured by the square foot, measure the number of square feet of symbols or letter markings 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 temporary raised pavement markers one time for each lift of pavement even if replaced. Measure temporary raised pavement markers used at the option of the Contractor in lieu of temporary pavement markings as equivalent temporary pavement markings and not as temporary raised pavement markers.

Measure pavement marking removal of actual line removed. Do not measure gaps.

Measure temporary crash cushions for each entire crash configuration.

When there is a pay item for moving temporary crash cushion, do not measure movement of temporary crash cushion for work access or the convenience of the Contractor.

Measure replacement barrels or cartridges for crash cushions for the barrels or cartridges damaged by public traffic.

Payment

635.27 The accepted quantities will be paid at the contract price per unit of measurement for the Section 635 pay items in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for temporary traffic control devices will be made as follows:

(a) 50 percent of the unit bid price will be paid upon installation.

(b) An additional 25 percent of the unit bid price will be paid following completion of 50 percent of the contract amount.

(c) Payment of the remaining portion of the unit bid price will be paid when the temporary traffic control devices are removed from the project.

Progress payments for items paid for by the hour will be paid at 100 percent of the unit bid price when ordered by the CO and furnished.

Section 636. — SIGNAL, LIGHTING, AND ELECTRICAL SYSTEMS

Description

636.01 This work consists of installing, modifying, or removing traffic signals, flashing beacons, highway lighting, sign illumination, communication conduits, and electrical systems or provisions for future systems.

Material

636.02 Conform to the following Subsections:

Backer rod	712.01(g)
Electrical material	721.01
Lighting material	721.02
Precast concrete units	725.11(d)
Sealant	712.01(a)

Construction Requirements

636.03 Regulations and Codes. Furnish material and workmanship conforming to the standards of the National Electrical Code, local safety code, UL, and the National Electrical Manufacturers Association.

Obtain permits, arrange for inspections, and pay all fees necessary to obtain electrical service.

Furnish luminaries with crashworthy supports.

Notify the CO, local traffic enforcement agency, local utility company, or railroad company 7 days before any operational shutdown to coordinate connections or disconnections to an existing utility or system.

636.04 General. At the preconstruction conference, submit a certified cost breakdown of items involved in the lump sum for use in making progress payments and price adjustments.

Fifteen days before installation, submit a list of proposed equipment and material. Include the manufacturer's name, size, and identification number of each item. Supplement the list with scale drawings, catalog cuts, and wiring diagrams showing locations and details of equipment and wiring.

The CO will establish the exact locations of the systems.

Remove structures and obstructions according to Section 203. Salvage all material acceptable for reuse in the work. Excavate and backfill according to Section 209. Construct concrete according to Section 601.

Where roadways are to remain open to traffic and existing systems will be modified, maintain the existing systems in operation until final connection to the modified circuit to minimize traffic disruptions.

636.05 Conduit. Cut conduit so the ends are smooth. Connect conduit sections with couplings to butt the ends of both conduits squarely against each other inside the couplings. Provide a metal expansion and deflection fitting where conduit crosses a structural expansion joint.

Install conduits continuous between outlets with a minimum of couplings to permit pulling conductors. Terminate conduit with bell fittings or bushings. Furnish pull wires for conduits designated for future cable installation.

Remove and replace crushed, deformed, or damaged conduit. Maintain conduits clean and dry and protect ends of conduit with plugs, caps, or fittings.

Size pull boxes to provide for termination of the conduit and connection of the conductors.

636.06 Installation of Signal and Lighting Systems. Design the control unit to energize the lighting circuit upon failure of any component of its circuit. Furnish a control with an "on" level adjustable between 1 and 5 foot candles. Operate luminaires with a series circuit distribution system at a potential not exceeding 2400 volts.

Control lights and luminaires by photocell controls. For current less than or equal to 10 amperes, furnish a photocell switch. For current greater than 10 amperes, furnish a photocell switch operating a magnetic relay for switching the lighting circuit.

636.07 Loop Installation. Do not install loops when the pavement is wet. Saw cut, wire, and seal for loop wires on the same day. Do not allow vehicular traffic to pass over an open saw cut unless covered by a protective panel.

Saw clean, smooth, well-defined, 5/16-inch wide, and 1¾-inch deep cuts without damaging the adjacent pavement. Overlap saw cuts to provide full depth at all corners. Saw cut the lead-in to the pull box as close as possible to the edge of pavement. Clean and dry saw cuts according to Subsection 502.06(a).

Install the loop wire in one continuous length at the bottom of the cut. Install without kinks, curls, or other damage to the wire or its insulation. Replace any damaged wires. Hold the loop wire in place with 2-foot long backer rods.

Where the loop wire crosses a crack or joint, use a plastic sleeve that extends 4 inches on each side of the crack or joint. Provide extra loop wire in the sleeve for joint expansion and contraction.

Twist the loop lead-in wires 1 turn per foot from the loop to the pull box. Color code the wires of each loop for identification of separate loops. Coil 3 feet of lead-in pair slack in the pull box for each loop.

Before applying sealant, test the loop and lead-in for continuity and resistance by applying a 1000-volt megger between each end of the loop lead-in and the nearest reliable electrical ground. If no available ground exists, establish a ground for the measurement. Record the location and megger readings and submit readings and test equipment data. Replace the loop if the megger reading is less than 10 megaohms or the inductance is less than 60 microhenries or more than 100 microhenries.

Apply sealant to the saw cuts with the backer rods in place. Apply the sealant in a manner that does not produce air bubbles. Remove excess sealant and finish level with the pavement. Follow the manufacturer's instructions for sufficient time for the sealant to harden before allowing traffic to cross the loops.

Repeat the resistance and continuity test after sealant is applied. Report the second test for comparison with the first report.

636.08 Testing and Demonstration Period. Before energizing any portion of the system, demonstrate that the conductor system is clear and free of all short circuits, open circuits, and unintentional grounds. Repair or replace faulty circuits.

After energizing the system, demonstrate that all electrical components work properly. Repair or replace faulty electrical components.

After completing electrical component tests, conduct a demonstration test for 30 continuous days. Adjust and correct any deficiencies in the system during the 30-day demonstration period. If any part of the system is replaced or repaired, retest that part of the system for an additional 30 days.

636.09 Warranties, Guarantees, and Instruction Sheets. When installations are permanent, deliver manufacturers' warranties, guarantees, instruction sheets, and parts lists at the final inspection.

Upon completion of the work, also submit as-built drawings showing all detail changes from the original plans.

636.10 Relocations. Use material equivalent to existing material, unless present codes require different or improved material. Existing material may be salvaged and reused, provided all material and installation methods used meet the requirements of applicable codes and ordinances.

636.11 Acceptance. Material for signal systems, lighting systems, and electrical systems will be evaluated under Subsections 106.02 and 106.03.

Installation of signal systems, lighting systems, and electrical systems will be evaluated under Subsections 106.02 and 106.04.

Structural excavation and backfill will be evaluated under Section 209.

Concrete will be evaluated under Section 601.

Measurement

636.12 Measure the Section 636 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

For relocations, do not measure additional line or connections necessary to place the fixture at the new location.

Payment

636.13 The accepted quantities will be paid at the contract price per unit of measurement for the Section 636 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment for lump sum items will be prorated based on the total work completed.

Section 637. — FACILITIES AND SERVICES

Description

637.01 This work consists of furnishing, installing, maintaining, and removing facilities (including services) such as field offices and residential housing for the exclusive use of Government personnel.

Construction Requirements

637.02 General. Provide the facilities and services beginning 14 days before project work begins and ending 21 days after final acceptance. Facilities remain the property of the Contractor upon completion of the contract.

Perform all site work to set up and remove facilities. Provide weatherproof buildings or trailers in good condition. Facilities and their location are subject to approval. Suitable commercial or private facilities located near the project may be provided.

637.03 Facilities. Furnish facilities that are ample, safe, sanitary, and include the appropriate electrical service, potable water supply, toilet accommodations and waste disposal services. Pay utility bills (electricity and water) promptly for all facilities. When specified in the contract, provide local and long distance telephone services. The Government will pay the cost of all telephone calls. Conform to all applicable ordinances, safety codes, and regulations.

(a) Field office. Furnish and maintain a field office according to Tables 637-1 and 637-2.

(b) Residential housing. Furnish and maintain residential housing according to Tables 637-1 and 637-2. When the unit is part of a larger building, separate units with partitions and furnish separate outside doors with locks.

Table 637-1
Minimum Requirements for Field Facilities

Property	Field Office	Residential Housing
Floor space — square feet	400	500
Locking outside door — deadbolt with keys	1	1
Steps with slipproof tread and handrails	(1)	(1)
Windows with locks	2	3
Total window area — square feet	30	60
Ceiling height, 7 feet	√	√
Rooms including toilet room	4	5(2)
Room size except toilet room — square feet	100	100
Closet — 45-cubic foot		2
Shelves, 12-inch depth — square feet	12	12
Electrical lighting	√	√
Heat and air conditioning, maintain temperature of 72±7 ºF	√	√
Adequate electrical outlets	√	√
Surge protectors	√	√
Adequate electricity (120 and 240 V, 60 cycle as applicable)	√	√
Adequate potable water supply	√	√
Drinking water cooler with water supply	√	
Sink with faucets for both hot and cold water		√
Adequate hot and cold water supply		√
Shower/bath facilities		√
Parking for 3 vehicles on gravel surface	√	√
6-foot high chain link fence with gate around building and parking area	√	√

(1) As required.
(2) Includes 2 bedrooms.

Table 637-2
Minimum Facility Furnishings and Services

Property	Field Office	Residential Housing
Table — 30-inch wide x 8-foot long x 30-inch high	1	
File cabinet, 2-drawer, fire resistant, metal, with lock	1	
File cabinet, 4-drawer, metal	1	
Desk — 12-square foot	2	
Desk lamp	2	
Office chair	5	
Storage cabinet, 6-inch wide x 36-inch wide x 18-inch high	1	
Fire extinguisher	1	2
Refrigerator, 10-cubic foot		1
Range and oven, standard 36-inch		1
Kitchen table with 2 chairs		1 set
Sofa, 6-foot		1
Coffee table		1
Easy chair		1
End table		1
Table lamp		1
Double bed		2
Night stand		2
Night stand lamp		2
Dresser, 4-drawer, 36-inch		2

637.04 Acceptance. Facilities and services will be evaluated under Subsections 106.02 and 106.04.

Measurement

637.05 Measure the Section 637 items listed in the bid schedule according to Subsection 109.02.

Payment

637.06 The accepted quantity, will be paid at the contract price per unit of measurement for the Section 637 pay items listed in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for each facility will be paid as follows:

(a) 60 percent of the item amount will be paid after the facility is accepted for occupancy.

(b) Payment of the remaining 40 percent of the item amount will be paid after final acceptance or when CO determines the facility is no longer needed.

DIVISION 700

MATERIAL

Section 701. — CEMENT

701.01 Hydraulic Cement. Do not mix cement brands or types. Furnish cement according to the following:

(a) Portland Cement. Conform to AASHTO M 85, type I, II, or V.

(b) Blended Hydraulic Cement. Conform to AASHTO M 240, type IS, IP P, I(PM), or I(SM).

701.02 Masonry and Mortar Cement.

(a) Masonry Cement. Conform to ASTM C 91, type N, S, or M.

(b) Mortar Cement. Conform to ASTM C 1329, type N, S, or M.

Section 702. — ASPHALT MATERIAL

702.01 Asphalt Binder. Conform to AASHTO M 20, M 226, or M320. Conform to Subsection 702.04.

702.02 Cut-Back Asphalt. Conform to Subsection 702.04.

(a) Rapid-curing. Conform to AASHTO M 81.

(b) Medium-curing. Conform to AASHTO M 82.

702.03 Emulsified Asphalt. Conform to Subsection 702.04. When specified for tack coat, an equivalent anionic grade emulsion may be substituted for a cationic grade and vice versa. The sieve test in AASHTO M 140 and M 208 is not required.

(a) Anionic emulsions. Conform to AASHTO M 140. For RS-1h and RS-2h, conform to AASHTO M 140 for RS-1 and RS-2, except conform the following for the penetration on the residue.

Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

(b) Cationic emulsions. Conform to AASHTO M 208. For CRS-1h and CRS-2h, conform to AASHTO M 208 for CRS-1 and CRS-2, except conform to the following for the penetration on the residue.

Ductility, 77 ºF, 2 inches/min, AASHTO T 51 40 mm min.

(c) Quick-setting emulsions. Conform to AASHTO M 208.

(d) Polymer modified emulsions. For micro-surfacing, mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process. Use a polymer quick set emulsified asphalt conforming to AASHTO M 208, ISSA 143, and the following:

(1) Residue by distillation, AASHTO T 59 62 %min.

(2) Softening point, AASHTO T 53 135 °F min.

(3) Penetration at 77 °F, ASTM D 2397 40-90

702.04 Application Temperatures. Apply asphalt within the temperature ranges shown in Table 702-1.

Table 702-1
Application Temperatures - Range ºF

Type and Grade of Asphalt	Temperature Ranges Minimum – Maximum	
	Spraying Temperatures	**Mixing Temperatures (1)**
Cut-back asphalt		
MC-30	85 - (2)	—
RC or MC-70	120 - (2)	—
RC or MC-250	165 - (2)	135 - 175(3)
RC or MC-800	200 - (2)	165 - 210(3)
RC or MC-3000	230 - (2)	180 - 240(3)
Emulsified asphalt		
RS-1	70 - 140	—
RS-2	125 - 185	—
MS-1	70 - 160	70 - 160
MS-2, MS-2h	—	70 - 160
HFMS-1, 2, 2h, 2s	70 - 160	50 - 160
SS-1, 1h, CSS-1, 1h	70 - 160(4)	70 - 160
CRS-1	125 - 185	—
CRS-2	140 - 185	—
CMS-2, CMS-2h	100 - 160	120 - 140
Asphalt binder		
All grades	365 max.	365 max.

(1) Temperature of mix immediately after discharge.
(2) The maximum temperature at which fogging or foaming does not occur.
(3) Temperature may be above flash point. Take precautions to prevent fire or explosion.
(4) For fog seals and tack coats.

702.05 Material for Dampproofing and Waterproofing Concrete and Masonry Surfaces.

(a) Primer. Conform to ASTM D 41.

(b) Asphalt. For mop coat, conform to ASTM D449, type III.

(c) Waterproofing fabric. Furnish asphalt saturated fabric conforming to ASTM D 173.

(d) Mortar. Conform to Subsection 712.05(b).

(e) Asphalt plank. Conform to ASTM D 517 and the following:

(1) Thickness. 1.25 inches.

(2) Width. 9±3 inches. Use only one width of plank for a single structure except for necessary closers.

(3) Length. 3 to 8 feet. Use length that permit the laying of planks to the best advantage on the surface to be covered.

(f) Asphalt roll roofing. Conform to ASTM D 224, type II.

702.06 Recycling Agent. Conform to AASHTO R 14 or use an approved petroleum product additive that restores aged asphalt to the required specifications.

702.07 Asphalt Mastic. Conform to AASHTO M 243.

702.08 Antistrip Additive. Conform to the following:

(a) Type 1. Furnish commercially produced, heat stable liquid products that when added to an asphalt have the chemical and physical properties to prevent separation of the asphalt from aggregates.

(b) Type 2. Furnish cement conforming to Subsection 701.01 or fly ash conforming to Subsection 725.04.

(c) Type 3. Furnish lime conforming to AASHTO M 303.

702.09 Evaluation Procedures for Asphalt. Evaluate under Subsection 106.04 subject to the following:

(a) Shipping container. Before loading, examine the shipping container and remove all remnants of previous cargos that may contaminate the asphalt.

(b) Delivery ticket. Furnish with each shipment 2 copies of the delivery ticket containing the following:

(1) Consignees;

(2) Project number;

(3) Grade;

(4) Net volume;

(5) Net mass;

(6) Type and amount of antistrip additive;

(7) Identification number (truck, car, tank, etc.);

(8) Destination;

(9) Date;

(10) Loading temperature; and

(11) Specific gravity at 59 ºF

(c) Sampling procedures. Obtain samples of asphalt according to AASHTO T 40 at the applicable sampling location as follows:

(1) Asphalt used in direct application on the road. Take samples from each shipping container at the time of discharge into distributors or other conveyances on the project.

(2) Asphalt initially discharged into storage tanks on the project. Take samples from the line between the storage tank and the distributor or the mixing plant after each delivery. Take samples after a sufficient period of circulation to ensure samples are representative of the material in the storage tank.

702.10 Cold Asphalt Mix. Conform to ASTM D 4215.

Do not use an aggregate asphalt mix that strips. For patching mixes, use an asphalt grade and mix that remains pliable and workable at 14 ºF.

Section 703. — AGGREGATE

703.01 Fine Aggregate for Concrete. Furnish sand conforming to AASHTO M 6, class B including the reactive aggregate supplementary requirement, except as amended or supplemented by the following:

(a) Material passing No. 200 sieve, AASHTO T 11	3.0% max.
(b) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method	75 min.

For lightweight fine aggregate, conform to AASHTO M 195.

703.02 Coarse Aggregate for Concrete. Conform to AASHTO M 80, class A, except as amended or supplemented by the following:

(a) Los Angeles abrasion, AASHTO T 96	40% max.
(b) Adherent coating, ASTM D 5711	1.0% max.
(c) Grading, AASHTO M 43	All sizes except numbers 8, 89, 9, or 10

For bridge decks or surface courses, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue as determined by ASTM D 3042.

For lightweight coarse aggregate, conform to AASHTO M 195.

703.03 Granular Backfill. Furnish aggregate for the following installations.

(a) Underdrain pipe with geotextile. Furnish granular backfill conforming to AASHTO M 80, class E and AASHTO M 43, size number 3, 4, 5, 7, 57, or 67.

(b) Underdrain pipe without geotextile. Furnish granular backfill conforming to AASHTO M 6, except the soundness test is not required.

703.04 Permeable Backfill. Furnish either sand conforming to Subsection 703.15 or coarse aggregate consisting of sound, durable particles of gravel, slag, or crushed stone conforming to Table 703-1.

Table 703 - 1
Permeable Backfill Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
3 inch	100
3/4 inch	50 – 90
No. 4	20 – 50
No. 200	0.0 – 2.0

703.05 Subbase, Base, and Surface Course Aggregate.

(a) General. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming the following:

(1) Los Angeles abrasion, AASHTO T 96	50% max.
(2) Sodium sulfate soundness loss (5 cycles), AASHTO T 104	12% max.
(3) Durability index (coarse), AASHTO T 210	35 min.
(4) Durability index (fine), AASHTO T 210	35 min.
(5) Fractured faces, ASTM D 5821	50% min.
(6) Free from organic matter and lumps or balls of clay	

Do not use material that breaks up when alternately frozen and thawed or wetted and dried.

Obtain the aggregate gradation by crushing, screening, and blending processes as necessary. Fine aggregate, material passing the No. 4 sieve, shall consist of natural or crushed sand and fine mineral particles.

(b) Subbase or base aggregate. In addition to (a) above, conform to the following:

(1) Gradation	Table 703-2
(2) Liquid limit, AASHTO T 89	25 max.

Table 703-2
Target Value Ranges for Subbase and Base Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 and T 11)				
	Grading Designation				
	A (Subbase)	B (Subbase)	C (Base)	D (Base)	E (Base)
2½ inch	100(1)				
2 inch	97 – 100(1)	100(1)	100(1)		
1½ inch		97 – 100(1)			
1 inch	65 – 79 (6)		80 – 100 (6)	100(1)	
3/4 inch			64 – 94 (6)	86 – 100 (6)	100(1)
1/2 inch	45 – 59 (7)				
3/8 inch			40 – 69 (6)	51 – 82 (6)	62 – 90 (6)
No. 4	28 – 42 (6)	40 – 60 (8)	31 – 54 (6)	36 – 64 (6)	436 – 74 (6)
No. 40	9 – 17 (4)			12 – 26 (4)	12 – 26 (4)
No. 200	4.0 – 8.0 (3)	4.0 – 12.0 (4)	4.0 –7.0 (3)	4.0 – 7.0 (3)	4.0 – 7.0 (3)

(1) Statistical procedures do not apply.

( ) The value in the parentheses is the allowable deviation (±) from the target values..

(c) Surface course aggregate. In addition to (a) above, conform to the following:

(1) Gradation and plasticity index, AASHTO T 90	Table 703-3
(2) Liquid limit, AASHTO T 89	35 max.

Do not furnish material that contains asbestos fibers.

Table 703-3
Target Value Ranges for
Surface Course Gradation and Plasticity Index

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
1 inch	100(1)
3/4 inch	97 - 100(1)
No. 4	41 - 71 (7)
No. 40	12 - 28 (5)
No. 200	9 - 16 (4)
Plasticity index	8 (4)

(1) Statistical procedures do not apply.
( ) The value in the parentheses is the allowable deviation (±) from the target values.

703.06 Crushed Aggregate. Furnish hard, durable particles or fragments of crushed stone or gravel conforming to the size and quality requirements for crushed aggregate material normally used locally in the construction and maintenance of highways by Federal or State agencies. Furnish crushed aggregate with a maximum size of 1 inch as determined by AASHTO T 27 and T 11. Furnish crushed aggregate uniformly graded from coarse to fine and free of organic matter, lumps or balls of clay, and other deleterious matter.

703.07 Hot Asphalt Concrete Pavement Aggregate.

(a) Coarse aggregate (retained on a No. 4 sieve). Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming to the following:

(1) Los Angeles abrasion, AASHTO T 96	40% max.
(2) Sodium sulfate soundness loss (5 cycles), AASHTO T 104	12% max.
(3) Fractured faces, ASTM D 5821	75% min.

(4) Durability index (coarse), AASHTO T 210	35 min.

For the surface course, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue when tested according to ASTM D 3042.

(b) Fine aggregate (passing a No. 4 sieve). Furnish natural sand, stone screenings, slag screenings, or a combination thereof conforming to AASHTO M 29 including sulfate soundness and the following:

(1) Durability index (fine), AASHTO T 210	35 min.
(2) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method	45 min.

(c) Composite aggregate blend. Size, grade, and combine the aggregate fractions in mix proportions conforming to the following:

(1) Gradation	Table 703-4
(2) Clay lumps and friable particles, AASHTO T 112	1.0% max.
(3) Reasonably free from organic or other deleterious material	

(d) Lightweight aggregate (slag). Furnish crushed slag conforming to the quality requirements of AASHTO M 195. Do not use any other kind or type of lightweight aggregate as defined in AASHTO M 195.

Table 703-4
Target Value Ranges for
Hot Asphalt Concrete Pavement Aggregate Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)					
	Grading Designation					
	A	B	C	D	E	F
1½ inch	100(1)					
1 inch	97-100(1)	100(1)	100(1)			
3/4 inch	—	97-100(1)	97-100(1)	100(1)	100(1)	
1/2 inch	—	76-88(5)	*(5)	97-100(1)	97-100(1)	
3/8 inch	53-70(6)	—	*(6)	—	*(5)	100(1)
No. 4	40-52(6)	49-59(7)	*(7)	57-69(6)	*(6)	33-47(6)
No. 8	25-39(4)	36-45(5)	*(5)	41-49(6)	*(6)	7-13(4)
No. 30	12-22(4)	20-28(4)	*(4)	22-30(4)	*(4)	—
No. 50	8-16(3)	13-21(3)	*(3)	13-21(3)	*(3)	—
No. 200	3-8(2)	3-7(2)	3-8(2)	3-8(2)	3-8(2)	2-4(2)

(1) Statistical procedures do not apply.
* Contractor specified target value.
( ) The value in the parentheses is the allowable deviation (±) from the target values.

703.08 Open-Graded Asphalt Friction Course Aggregate. Conform to Subsection 703.07 grading F and the following:

(a) 2 or more fractured faces, ASTM D 5821 — 75% min.

(b) 1 or more fractured faces, ASTM D 5821 — 90% min.

(c) Flakiness index, ASTM D 4791 — 30 max.

703.09 and Tables 703-5 and 703-6 Reserved.

703.10 Asphalt Surface Treatment Aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel. Use only one type of aggregate on a project.

Size, grade, and combine the aggregate fractions in mix proportions conforming to the following:

(a) Gradation	Table 703-7
(b) Los Angeles abrasion, AASHTO T 96	40% max.
(c) Sodium sulfate soundness loss, AASHTO T 104	12% max.
(d) Fractured faces, ASTM D 5821	90% min.
(e) Flat and elongated particles, 1:3 ratio & 3/8-inch sieve calculated by mass, weighted average, ASTM D 4791	10% max.
(f) Durability index (coarse), AASHTO T 210	35 min.
(g) Durability index (fine), AASHTO T 210	35 min.
(h) Clay lumps and friable particles, AASHTO T 112	1.0% max.

Do not use lightweight aggregate according to AASHTO M 195.

Table 703-7
Target Value Ranges for
Single and Multiple Course Surface Treatment Aggregate Gradation

Sieve Size	**Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)**					
	Grading Designation					
	A	**B**	**C**	**D**	**E**	**F**
1½ inch	100(1)					
1 inch	90-100(3)	100(1)				
3/4 inch	0-35(5)	90-100(3)	100(1)			
1/2 inch	0-8(3)	0-35(5)	90-100(3)	100(1)		
3/8 inch	—	0-12(3)	0-35(5)	85-100(3)	100(1)	100(1)
No. 4	—	—	0-12(3)	0-35(5)	85-100(3)	85-100(1)
No. 8	—	—	—	0-8(3)	0-23(4)	—
No. 200	0-1(1)	0-1(1)	0-1(1)	0-1(1)	0-1(1)	0-10(1)

(1) Statistical procedures do not apply.
( ) The value in the parentheses is the allowable deviation (±) from the target values.

703.11 Slurry Seal and Micro-Surfacing Aggregate. Furnish natural or manufactured sand, slag, crushed fines, or other mineral aggregate conforming to AASHTO M 29 and the following:

(a) Slurry seal aggregate.

(1) Gradation	Table 703-8
(2) Los Angeles abrasion, AASHTO T 96	35% max.
(3) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method	45 min.
(4) Smooth textured sand with < 1.25% water absorption content by weight of total combined aggregate	50% max.

Table 703-8
Slurry Seal and Micro-Surfacing Aggregate
Gradation(1) and Application Rates(2)

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)		
	Slurry Seal Type		
	I	II	III
3/8 inch	—	100	100
No. 4	100	90-100	70-90
No. 8	90-100	65-90	45-70
No. 16	65-90	45-70	28-50
No. 30	40-65	30-50	19-34
No. 50	25-42	18-30	12-25
No. 100	15-30	10-21	7-18
No. 200	10-20	5-15	5-15
Application rate(2) pounds per square yard	6 - 10	10 - 15	15 or more

(1) Statistical procedures do not apply.
(2) Based on the dry mass of the aggregate.

(b) Micro-surfacing aggregate.

(1) Gradation, type II or III	Table 703-8
(2) Los Angeles abrasion, AASHTO T 96	30% max.
(3) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method	65 min.
(4) Sodium sulfate soundness, AASHTO T 104	
Using NA_2SO_4	15 max.
Using $MgSO_4$	25 max.

703.12 Choker Aggregate. Furnish hard durable particles or fragments of crushed gravel or crushed stone conforming to the following:

(a) Gradation Table 703-9	
(b) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method	75 min.
(c) Free from organic matter and clay balls	

Table 703-9
Choker Aggregate Gradation(1)

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
3/8 inch	100
No. 4	70 – 100
No. 200	0.0 - 5.0

(1) Statistical procedures do not apply.

703.13 Blotter. Furnish sound durable particles of gravel or crushed stone conforming to the following:

(a) Material passing 3/8-mm sieve, AASHTO T 27	100%
(b) Liquid limit, AASHTO T 89	25 max.
(c) Free of organic matter and clay balls	

703.14 Aggregate for Aggregate-Topsoil Course. Conform to the following:

(a) Gradation	AASHTO M 43, size number 57
(b) Quality	AASHTO M 80, class E

703.15 Sand. Furnish clean material conforming to the following:

(a) Gradation	AASHTO M 6
(b) Deleterious substances	AASHTO M 6, class B

703.16 Aggregate for Lean Concrete Backfill. Furnish hard, clean, durable, nonplastic, nonorganic, nonreactive aggregate.

703.17 Superpave Asphalt Concrete Pavement Aggregate. Furnish hard, durable particles or fragments of crushed stone, crushed slag, or crushed gravel conforming to the following:

(a) Los Angeles abrasion, AASHTO T 96	35% max.
(b) Sodium sulfate soundness loss of coarse and fine aggregate (5 cycles), AASHTO T 104	12% max.
(c) Fractured faces, ASTM D 5821	Table 703-10
(d) Fine aggregate angularity, AASHTO T 304, method A	Table 703-11
(e) Flat and elongated particles, 3 to 1 ratio, ASTM D 4791	Table 703-11
(f) Sand equivalent value, AASHTO T 176, alternate method no. 2, reference method	Table 703-11

(g) Gradation. See Table 703-12. Size, grade, and combine the aggregate fractions in mix proportions that result in a composite blend between the control points. Nominal maximum size is one sieve size greater than the first sieve to retain more than 10 percent of the combined aggregate. Test according to AASHTO T 27 and T11.

For the surface course, do not use aggregates known to polish or carbonate aggregates containing less than 25 percent by mass of insoluble residue when tested according to ASTM D 3042.

Table 703-10
Fractured Faces Coarse Aggregate Requirement

Traffic ESALs (million)	Fractured Faces (1face % min. / 2 face % min.)	
	Depth from Surface	
	≤ 4 inch	> 4 inch
< 0.3	55/-	-/-
0.3 to < 3	75/-	50/-
3 to < 10	85/80	60/-
10 to < 30	95/90	80/75
≥ 30	100/100	100/100

Note: "85/80" denotes that a minimum of 85 percent of the coarse aggregate has one fractured face and a minimum of 80 percent has two fractured faces.

Table 703-11
Superpave Aggregate Requirements

Traffic ESALs (million)	Uncompacted Void Content of Fine Aggregate (% minimum)		Sand Equivalent (minimum)	Flat and Elongated (% max.) 3:1 Ratio
	Depth from Surface			
	≤ 4 inch	> 4 inch		
< 3	40	40	40	10
3 to < 10	45	40	45	
10 to < 30	45	40	45	
≥ 30	45	45	50	

Table 703-12
Superpave Aggregate Gradation

Sieve Size	Nominal Maximum Aggregate Size – Percent Passing							
	Grading Designation							
	1 inch		3/4 inch		1/2 inch		3/8 inch	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1½ inch	100							
1 inch	90	100	100					
3/4 inch	*	*	90	100	100			
1/2 inch	*	*	*	*	90	100	100	
3/8 inch	*	*	*	*	*	*	90	100
No. 4	*	*	*	*	*	*	*	*
No. 8	*	*	*	*	*	*	*	*
No. 30	*	*	*	*	*	*	*	*
No. 50	*	*	*	*	*	*	*	*
No. 200	3	8	3	8	3	8	3	8

***** Contractor specified target values. See Table 703-13 for allowable deviations.

Table 703-13
Allowable Deviations for Target Value Gradations

Gradation Range (inches)		Allowable Deviation (percent)
Minimum	**Maximum**	
2.76	3.54	4
2.37	2.75	5
2.17	2.36	6
1.78	2.16	7
1.58	1.77	6
1.19	1.57	5
0.83	1.18	4
0.32	0.82	3
0	0.31	2

Table 703-14
Coarse and Fine Gradation Classification

Nominal Maximum Aggregate Size	Primary Control Sieve (PCS) for Mixture Nominal Maximum Sieve Size			
	1 inch	**3/4 inch**	**1/2 inch**	**3/8 inch**
PCS	No. 4	No. 4	No. 8	No. 8
PCS Control Point (% Passing)	40	47	39	47

703.18 Shotcrete Aggregate. For fine aggregate, furnish rounded particles conforming to Subsection 703.01. For coarse aggregate, conform to AASHTO M 80, class B, except as amended or supplemented by the following:

(a) Los Angeles abrasion, AASHTO T 96 40 % max.

(b) Adherent coating, ASTM D 5711 1.0 % max.

Combine the aggregates to meet the designated gradation in Table 703-15

Table 703 - 15
Shotcrete Gradation Limits for Combined Aggregates

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)		
	Grading Designation		
	A	B	C
3/4 inch	—	—	100
1/2 inch	—	100	80-95
3/8 inch	100	90-100	70-90
No. 4	95-100	70-85	50-70
No. 8	80-100	50-70	35-55
No. 16	50-85	35-55	20-40
No. 30	25-60	20-35	10-30
No. 50	10-30	8-20	5-17
No. 100	2-10	2-10	2-10

703.19 Recycled Asphalt Pavement. Furnish recycled asphalt pavement that is processed in some form (by crushing and screening) to produce a well graded gradation and asphalt content. Process recycled asphalt pavement so that no particle in the mixture made with recycled asphalt pavement will exceed the mixture maximum aggregate size at the time of production. Millings will be considered processed provided they have a uniform gradation and asphalt content. Provide recycled asphalt pavement material with a maximum of 2 percent deleterious materials.

Section 704. — SOIL

704.01 Foundation Fill. Furnish granular material free of excess moisture, frozen lumps, roots, sod, or other deleterious material and conforming to the following:

(a) Maximum particle size	2 inches
(b) Soil classification, AASHTO M 145	A-1-a
(c) Material passing No. 200 sieve, AASHTO T 27 and T 11	6% max.

704.02 Bedding Material. Furnish material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Maximum particle size	1/2 inch or half the corrugation depth, whichever is smaller
(b) Soil classification, AASHTO M 145	A-1, A-2-4, A-2-5, or A-3

704.03 Backfill Material. Furnish a well-graded, compactable material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) For all structures and pipes other than plastic pipe:

(1) Maximum particle size	3 inches
(2) Soil classification, AASHTO M 145	A-1, A-2, or A-3

(b) For plastic pipe:

(1) Maximum particle size	1½ inches
(2) Soil classification, AASHTO M 145	A-1, A-2-4, A-2-5, or A-3

704.04 Structural Backfill. Furnish free draining granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Maximum particle size	3 inches
(b) Material passing No. 200 sieve, AASHTO T 27 and T 11	15% max.
(c) Liquid limit, AASHTO T 89	30% max.

704.05 Topping. Furnish a granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Maximum particle size	4 inches
(b) Soil classification, AASHTO M 145	A-1 or A-2-4

704.06 Unclassified Borrow. Furnish granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Maximum particle size	24 inches
(b) Soil classification, AASHTO M 145	A-1, A-3, or A-2-4

704.07 Select Borrow. Furnish granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Gradation	Table 704-1
(b) Liquid limit, AASHTO T 89	30 max.

Table 704-1
Select Borrow Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
3 inch	100
1 inch	70-100
No. 4	30-70
No. 200	0-5

704.08 Select Topping. Furnish granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Gradation, well graded coarse to fine	Table 704-2
(b) Liquid limit, AASHTO T 89	30 max.

Table 704-2
Select Topping Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
3 inch	100
No. 200	0-15

704.09 Bed Course. Furnish porous, free-draining granular material free of excess moisture, muck, frozen lumps, roots, sod, or other deleterious material conforming to the following:

(a) Gradation, well graded coarse to fine	Table 704-3
(b) Liquid limit, AASHTO T 89	30 max.

Table 704-3
Bed Course Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
1/2 inch	100
No. 200	0 – 10

704.10 Select Granular Backfill. Furnish sound, durable, granular material free from organic matter or other deleterious material. Conform to the following:

(a) Quality requirements.

(1) Gradation	Table 704-4
(2) Angle of internal friction on the portion passing the No. 10 sieve, AASHTO T 236	34° min.

Note: Compact samples for AASHTO T 236 to 95 percent of the maximum density determined according to AASHTO T 99, method C or D and corrected for oversized material according to AASHTO T 99, Note 9.

(3) Sodium sulfate soundness loss (5 cycles), AASHTO T 104	15% max.
(4) Plasticity index, AASHTO T 90	6 max.

(b) Electrochemical requirements for MSE walls with metallic reinforcements.

(1) Resistivity, AASHTO T 288	3000 Ωcm min.
(2) pH, AASHTO T 289	5.0 to 10.0
(3) Sulfate content, AASHTO T 290	200 ppm max.
(4) Chloride content, AASHTO T 291	100 ppm max.

Note: Tests for sulfate and chloride content are not required when resistivity is greater than 5000 ohm centimeters.

(c) Electrochemical requirements for MSE walls with geosynthetic reinforcements.

pH, AASHTO T 289	5.0 to 10.0

Table 704-4
Select Granular Backfill Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
4 inch	100
No. 40	0 – 60
No. 200	0 – 15

704.11 Reserved.

704.12 Crib Wall Backfill. Furnish material according to Subsection 704.10, except conform to the gradation in Table 704-5.

Table 704-5
Crib Wall Backfill Gradation

Sieve Size	Percent by Mass Passing Designated Sieve (AASHTO T 27 & T 11)
3 inch	100
No. 4	25 – 70
No. 50	5 – 20
No. 200	0 – 5

Section 705. — ROCK

705.01 Gabion and Revet Mattress Rock. Furnish hard, durable rock that is resistant to weathering and reasonably free of organic and spoil material. Conform to the following:

(a) Coarse durability index, AASHTO T 210	52 min.
(b) Unit mass of a filled basket	100 pounds per cubic foot min.

(c) Gradation:

(1) Baskets 1 foot or greater in the vertical dimension.

(a) Maximum dimension	8 inches
(b) Minimum dimension	4 inches

(2) Baskets less than 1 foot in the vertical dimension.

(a) Maximum dimension	6 inches
(b) Minimum dimension	3 inches

705.02 Riprap Rock. Furnish hard, durable, angular rock that is resistant to weathering and water action and free of organic or other unsuitable material. Do not use shale, rock with shale seams, or other fissile or fissured rock that may break into smaller pieces in the process of handling and placing. Conform to the following:

(a) Apparent specific gravity, AASHTO T 85	2.50 min.
(b) Absorption, AASHTO T 85	4.2% max.
(c) Coarse durability index, AASHTO T 210	50 min.
(d) Gradation for the class specified	Table 705-1

Table 705-1
Gradation Requirements for Riprap

Class	Percent of Rock by Mass	Mass (pounds)	Approximate Cubic Dimension[2][3] (inches)
1	20	22 to 33	6 to 8
	30	11 to 22	5 to 6
	40	1 to 11	2 to 5
	10 [1]	0 to 1	0 to 2
2	20	55 to 110	8 to 10
	30	22 to 55	6 to 8
	40	2 to 22	3 to 6
	10 [1]	0 to 2	0 to 3
3	20	220 to 330	14 to 16
	30	110 to 220	10 to 14
	40	11 to 110	5 to 10
	10 [1]	0 to 11	0 to 5
4	20	550 to 770	18 to 20
	30	220 to 550	14 to 18
	40	22 to 220	6 to 14
	10 [1]	0 to 22	0 to 6
5	20	1540 to 2200	26 to 28
	30	770 to 1540	20 to 26
	40	55 to 770	8 to 20
	10 [1]	0 to 55	0 to 8
6	20	1870 to 3530	28 to 34
	30	1100 to 1870	22 to 28
	40	110 to 1100	10 to 22
	10 [1]	0 to 110	0 to 10

(1) Furnish spalls and rock fragments graded to provide a stable dense mass.
(2) The volume of a rock with these cubic dimensions has a mass approximately equal to the specified rock mass.
(3) Furnish rock with breadth and thickness at least one-third its length.

705.03 Rock for Masonry Structures. Furnish sound, durable rock that is native to the vicinity of the work or is similar in texture and color to the native rock and has been proven satisfactory for the intended use.

Furnish dimensioned masonry rock free of reeds, rifts, seams, laminations, and minerals that may cause discoloration or deterioration from weathering.

(a) Sizes and shapes. Do not use rock with depressions or projections that might weaken it or prevent it from being properly bedded.

When no dimensions are shown on the plans, furnish the rocks in the sizes and face areas necessary to produce the general characteristics and appearance indicated on the plans.

Unless otherwise specified, furnish rock fragments with the following dimensions:

(1) Minimum thickness	5 inches
(2) Minimum width	12 inches or 1½ times the thickness, whichever is greater
(3) Minimum length	1½ times the width
(4) Rocks with volume ≥ 1 cubic foot	50% min.

When headers are required, furnish headers with lengths no less than the width of bed of the widest adjacent stretcher plus 12 inches.

(b) Dressing. Remove all thin or weak portions. Dress face rock bed and joint lines to a maximum variation from true line as follows:

(1) Rubble masonry	1½ inches
(2) Class B masonry	3/4 inch
(3) Class A masonry	1/4 inch
(4) Dimensioned masonry	Reasonably true

(c) Bed surfaces. Dress face rock bed surfaces normal to the face to a depth of 3 inches. Beyond that point, the departure from normal may not exceed 1 inch in 12 inches for dimensioned masonry or 2 inches in 12 inches for all other classes.

(d) Joint surfaces. For dimensioned masonry, dress face rock joint surfaces normal to the bed surface. For all other classes of masonry, dress face rock joint surfaces to form an angle with the bed surface of not less than 45 degrees.

Dress face rock joint surfaces normal to the face to a depth of 2 inches. Beyond that point, the departure from normal may not exceed 1 inch in 12 inches.

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

(1) Rubble masonry	1½ inches
(2) Class B masonry	1 inch
(3) Class A masonry	No rounding
(4) Dimensioned masonry	No rounding

(e) Arch ring rock joint surfaces. Dress ring rock joint surfaces radial to the arch or normal to the front face to a depth of 3 inches. Beyond that point, the departure from the radial or normal may not exceed 3/4 inch in 12 inches.

Dress the back surface adjacent to the arch barrel concrete parallel to the front face and normal to the intrados to a depth of 6 inches. When concrete is placed after the masonry is constructed, vary adjacent ring stones at least 6 inches in depth.

(f) Finish for exposed faces. Remove all drill or quarry marks from exposed faces. Pitch face stones to the line along all beds and joints. Finish the exposed faces as specified in the contract. The following symbols are used to represent the type of surface or dressing specified:

(1) Fine pointed (F.P.). Make point depressions approximately 3/8 inch apart. Limit surface variations to 1/8 inch or less from the pitch line.

(2) Medium pointed (M.P.). Make point depressions approximately 5/8 inch apart. Limit surface variations to 1/4 inch or less from the pitch line.

(3) Coarse pointed (C.P.). Make point depressions approximately 1⅛ inches apart. Limit surface variations to 3/8 inch or less from the pitch line.

(4) Split or seam face (S.). Provide a smooth appearance, free from tool marks, with no depressions below the pitch line, and no projection exceeding 3/4 inch beyond the pitch line.

(5) Rock faced (R.F.). Provide an irregular projecting surface without tool marks, concave surfaces below the pitch line, and projections beyond the specified pitch line. For example, the specification "1.50 R.F." means no projections 1½ inches beyond the pitch line. Where a "variable rock face" is specified, uniformly distribute stones of the same height of projection.

705.04 Rock for Special Rock Embankment.

(a) Mechanically-placed embankments. Furnish hard, durable rock that is angular in shape, resistant to weathering, and graded in a well-balanced range conforming to Table 705-2.

Table 705-2
Gradation for Mechanically-placed Rock

Percent of Rock Fragments by Mass	Mass (pounds)	Equivalent Cubic Dimension (inches)
50	Greater than 2000	Larger than 28
50	90 to 2000	10 to 28

(b) Hand-placed embankments. Furnish hard, durable rock that is angular in shape, resistant to weathering, and graded in a well-balanced range conforming to Table 705-3.

Table 705-3
Gradation for Hand-placed Rock

Percent of Rock Fragments by Mass	Mass (pounds)	Equivalent Cubic Dimension (inches)
75	Greater than 165	Larger than 12
25	90 to 165	10 to 12

705.05 Rock for Buttresses.

(a) General. Furnish hard, durable, angular rock free of organic and spoil material, resistant to weathering and water action. Furnish rock with breadth and thickness at least one-third its length. Conform to the following:

(1) Apparent specific gravity, AASHTO T 85 2.50 min.

(2) Absorption, AASHTO T 85 4.2% max.

(3) Coarse durability index, AASHTO T 210 52 min.

(b) Mechanically-placed buttresses. In addition to (a) above, furnish rock graded in a well-balanced range conforming to Table 705-2.

(c) Hand-placed buttresses. In addition to (a) above, furnish rock graded in a well-balanced range conforming to Table 705-3.

705.06 Stone Curbing.

(a) Stone curb, type I. Conform to the size and shape specified and the following:

Furnish quarried limestone, sandstone, or granite from an approved source. Use one type of stone throughout the project. Do not use stone with visible drill marks on the exposed faces.

Saw or point the top surface of all vertical stone curb to an approximate true plane with no depression or projection on that surface of over 1/4 inch. Pitch the front and back arris lines straight and true. Limit projections or depressions on the back surface to not exceed a batter of 1 inch horizontal to 3 inches vertical.

Saw, point, or smooth quarry split the front exposed face of the vertical stone curb and form to an approximately true plane. Limit projections or depressions on the remaining face distance to 1 inch or less from the plane of the exposed face.

Square the ends of vertical stone curb with the top back and face and finish so when the sections are placed end to end, no space more than 1/2 inch shall show in the joint for the full width of the top surface and for the entire exposed front face. The remainder of the end may break back no more than 4 inches from the plane of the joint. Cut the joints of circular or curved stone curb on radial lines.

The minimum length of any segment of vertical stone curb is 4 feet. However the length may vary where a depressed or modified section of curb is required for driveways, crossings, closures, etc.

(b) Stone curb, type II. Slope stone curb shall conform to the requirements for type I stone curb except as follows:

The maximum allowable projection or depression on a horizontal top surface is limited to 1/2 inch. On other exposed faces, the maximum allowable projection or depression is limited to 1 inch.

For unexposed surfaces, the maximum allowable projection or depression from a true plane on a 2-foot length shall be 3 inches.

The maximum allowable space showing on exposed faces between adjacent segments of slope stone curb is 3/4 inch. The minimum length of any segment of slope stone curb is 2 feet.

Section 706. — CONCRETE AND PLASTIC PIPE

706.01 Non-Reinforced Concrete Pipe. Conform to AASHTO M 86 for the diameters and strength classes specified.

706.02 Reinforced Concrete Pipe. Conform to AASHTO M 170 for the diameters and strength classes specified. For precast reinforced concrete end sections, conform to cited specifications to the extent they apply.

706.03 Perforated Concrete Pipe. Conform to AASHTO M 175, type 1 or 2 and AASHTO M 86 for the diameters and strength classes specified.

706.04 Reinforced Arch-Shaped Concrete Pipe. Conform to AASHTO M 206 for the diameters and strength classes specified.

706.05 Reinforced Elliptically-Shaped Concrete Pipe. Conform to AASHTO M 207 for the diameters, placement design (horizontal or vertical), and strength classes specified.

706.06 Reinforced D-Load Concrete Pipe. Conform to AASHTO M 242 for the diameters specified.

706.07 Precast Reinforced Concrete Box Sections. Conform to AASHTO M 259 or M 273, as applicable, for dimensions and loading conditions specified.

706.08 Plastic Pipe. Furnish perforated and nonperforated plastic pipe conforming to the following for the sizes and types specified. For watertight joints, conform to ASTM D 3212.

(a) Smooth wall polyethylene pipe. Furnish 12- to 42-inch diameter pipe conforming to ASTM F 714 and minimum cell class, ASTM D 3350, 335434C.

(b) Corrugated polyethylene pipe. Furnish 12- to 36-inch diameter pipe conforming to AASHTO M 294. For sanitary sewer applications, furnish AASHTO M 294, type S pipe with watertight joints.

(c) Profile wall (ribbed) polyethylene pipe. Furnish 18- to 48-inch diameter pipe conforming to ASTM F 894 and minimum cell class, ASTM D 3350, 334433C or 335434C.

(d) Corrugated polyethylene drainage tubing. Furnish 3- to 10-inch diameter tubing conforming to AASHTO M 252.

(e) Smooth wall polyvinyl chloride pipe. Furnish 4- to 15-inch diameter pipe conforming to AASHTO M 278 and minimum cell class, ASTM D 1784, 12454 or 12364. For sanitary sewer applications, conform to ASTM D 3034.

(f) Profile wall (ribbed) polyvinyl chloride pipe. Furnish 4- to 48-inch diameter pipe conforming to AASHTO M 304 and minimum cell class, ASTM D 1784, 12454C or 12364C. For sanitary sewer applications, conform to ASTM F 794 or F 949.

(g) Acrylonitrile-butadiene-styrene (ABS) pipe. Conform to AASHTO M 264. For perforations, conform to AASHTO M 278.

Section 707. — METAL PIPE

Section 708. — PAINT

708.01 General. Furnish a contrasting color for each coat of paint. For the finish coat color, conform to Federal Standard 595 B. If requested, provide color chips from the paint supplier.

(a) Packaging. Furnish paint in strong, substantial containers, plainly marked with the following:

(1) Trade name or trade mark;

(2) Paint type, color, formulation, lot number, and date of manufacture;

(3) Net mass;

(4) Volume including the percent of solids and the percent of volatile organic compound (VOC);

(5) Storage requirements;

(6) Mixing instructions and equipment cleanup instructions; and

(7) Name and address of the manufacturer.

(b) Volatile organic compound (VOC) content. Conform to the following VOC limits for both shop and field painting:

(1) Clear (unpigmented) coatings	3.7 pounds per gallon max.
(2) Other coatings	2.9 pounds per gallon max.

(c) Lead content. max. 0.06% by mass in the dried film

(d) Other properties. Furnish paint that:

(1) Does not show excessive settling in a freshly-opened full can;

(2) Easily redisperses with a paddle to a smooth, homogeneous state free of curdling, livering, caking, color separation, lumps, and skins;

(3) Does not skin within 48 hours in a ¾ filled, closed container;

(4) Brushes on easily;

(5) Possess good leveling properties;

(6) Shows no running or sagging tendencies when applied to smooth steel vertical surfaces;

(7) Dries to a smooth uniform finish, free from roughness, grit, unevenness and other surface imperfections;

(8) Shows no streaking or separation when flowed on clean glass; and

(9) Shows no thickening, curdling, gelling, or hard caking after 6 months of storage in a full, tightly-covered container at a temperature of 70 ºF.

708.02 Paint for Timber Structures.

NOT USED

708.03 Paint for Concrete and Masonry Block Structures. Conform to MPI 10, 11, or 119. Color tint with universal or all purpose concentrates.

708.04 Paint for Steel Structures. Conform to the following:

(a) Inorganic zinc primer.	SSPC no. 20, type I
(b) Vinyl wash primer.	SSPC no. 27
(c) Aluminum vinyl paint.	SSPC no. 8
(d) White or colored vinyl paint.	SSPC no. 9
(e) Aliphatic urethane coating.	SSPC no. 36
(f) Latex primer for steel surfaces.	SSPC no. 23
(g) Acrylic latex coating.	SSPC no. 24
(h) Epoxy coating.	SSPC no. 22
(i) Alkyd primer.	SSPC no. 31
(j) Silicone alkyd coating.	SSPC no. 21

708.05 Penetrating Stain. Conform to the following:

NOT USED

Section 709. — REINFORCING STEEL AND WIRE ROPE

709.01 Reinforcing Steel.

(a) General. Furnish the following information with each shipment of steel to the project:

(1) Name and location of the steel rolling mill;

(2) Manufacturing process;

(3) Heat number(s);

(4) Size(s);

(5) Specifications;

(6) Copies of mill test analyses for chemical and physical tests; and

(7) Consignee and destination of shipment.

(b) Reinforcing bars. Furnish deformed, grade 60 bars conforming to AASHTO M 31, M 42, or M 53.

(c) Epoxy-coated reinforcing bars. Furnish bars conforming to Subsection **709.01** (b). Conform to AASHTO M 284.

Inspect the reinforcing bars after the near white blast cleaning. Reject all bars with steel slivers or scabs. Selective sorting and rejection at the fabricator's shop may avoid unnecessary delays and subsequent rejection of bars during the precoating inspection at the coating applicator's shop.

Coat epoxy coated reinforcing steel in a plant certified by CRSI as a fusion bonded epoxy applicator.

(d) Tie bars. Furnish deformed, grade 60 bars conforming to AASHTO M 31 or M 42, except do not use AASHTO M 42 steel for tie bars bent and restraightened during construction.

(e) Hook bolts. Furnish plain, grade 60 bars conforming to AASHTO M 31 or M 42 with M14 rolled threads or M16 cut threads. Furnish a threaded sleeve nut capable of sustaining a minimum axial load of 15,000 pounds.

(f) Dowel bars. Conform to AASHTO M 254, type A or B. Use plain round bars, free from burring or other deformation restricting free movement in the concrete. Paint half the length of each dowel bar with one coat of tar paint. When the paint dries and immediately before placing the dowels, lubricate the painted end to prevent concrete from bonding to the painted end.

For expansion joints, furnish a dowel cap that snugly covers 2±1/4 inches of the dowel, has a closed end, and has a suitable stop to hold the closed end 1 inch from the end of the dowel bar.

Lubricants for type B dowels may be rapid-curing cut-back asphalt, medium setting emulsified asphalt, or a flaked graphite and vehicle. Lubricants are not required for type A coated dowel bars.

Furnish dowel assemblies that hold dowel bars within 1/4-inch tolerance vertically and horizontally during concrete placement and permit unrestricted movement of the pavement slab.

Use wire conforming to AASHTO M 32 for dowel assemblies. Coat dowel assemblies with the same material as the dowel bar. Recoat or repair damaged coatings equivalent to the manufacturer's original coating.

(g) Deformed steel wire. Conform to AASHTO M 225.

(h) Welded steel wire fabric. Conform to AASHTO M 55.

(i) Cold-drawn steel wire. Conform to AASHTO M 32.

(j) Welded deformed steel wire fabric. Conform to AASHTO M 221.

(k) Fabricated deformed steel bar or rod mats. Conform to AASHTO M 54.

(l) Low alloy steel deformed bars. Conform to ASTM A 706.

709.02 Wire Rope or Wire Cable. Conform to AASHTO M 30 for the size and strength class specified.

709.03 Prestressing Steel.

NOT USED

Section 710. — FENCE AND GUARDRAIL

710.01 Barbed Wire. Furnish galvanized wire conforming to AASHTO M 280 or aluminum coated wire conforming to AASHTO M 305, type I.

710.02 Woven Wire. Furnish galvanized fabric conforming to AASHTO M 279 or aluminum coated fabric conforming to ASTM A 584.

710.03 Chain Link Fence. Furnish fabric, posts, rails, ties, bands, bars, rods, and other fittings and hardware conforming to AASHTO M 181.

Furnish 0.177-inch coiled spring steel tension wire conforming to ASTM A 641 hard temper with a class 3 galvanized coating or an aluminized coating having a minimum coating mass of 0.40 ounces per square foot of aluminum. Use the same coating on the tension wire as used on the rest of the chain link fence.

710.04 Fence Posts and Bollards.

(a) Wood. Conform to AASHTO M 168.

Peel all bark, except for red cedar posts and bracing, which do not require peeling. Trim all knots flush with the surface and season the wood.

For dimension lumber for fences, bollards, or gates, use timber that is sound, straight, and reasonably free from knots, splits, and shakes. Provide S4S finish.

(b) Concrete. Conform to Section 601.

(c) Steel. For line fence posts, conform to AASHTO M 281. For chain link fence, conform to AASHTO M 181.

710.05 Fence Gates. For frame gates used with chain link fences, conform to AASHTO M 181. Use the same chain link fabric in the gate and the fence.

710.06 Metal Beam Rail. Conform to AASHTO-AGC-ARTBA *A Guide to Standardized Highway Barrier Hardware*.

(a) Galvanized steel rail. Furnish W-beam or thrie beam rail elements fabricated from corrugated sheet steel conforming to AASHTO M 180 for the designated shape, class, type, and mass of coating specified.

(b) Corrosion resistant steel rail. Furnish W-beam or thrie beam rail elements and associated weathering steel hardware conforming to the following:

(1) Shapes and plates	ASTM A 242
(2) Rail elements	AASHTO M 180
(3) Fasteners	AASHTO M 180

710.07 Box Beam Rail. Furnish steel box beam rail elements conforming to the AASHTO-AGC-ARTBA *A Guide to Standardized Highway Barrier Hardware*.

710.08 Steel-Backed Timber Rail. Furnish timber conforming to AASHTO M 168. Fabricate the timber rail, blockouts, and posts from dry, well seasoned, and dressed rough sawn Douglas fir, southern pine, or other species having a stress grade of at least 1,500 pounds per square inch. Treat the timber rail, blockout elements, and posts according to AASHTO M 133.

Fabricate the steel backing elements from 3/8-inch structural steel conforming to ASTM A 242. For fastener hardware, conform to ASTM A 242.

710.09 Guardrail Posts. Conform to AASHTO-AGC-ARTBA *A Guide to Standardized Highway Barrier Hardware*.

Do not use a wood guardrail post that has a through check, shake, or end slit in the same plane as, or a plane parallel to the bolt hole and extending from the top of the post to within 3 inches or the bolt hole.

For steel-backed timber rail posts, furnish 10- by 12-inch posts conforming to Subsection 710.08.

710.10 Guardrail Hardware. Conform to the AASHTO-AGC-ARTBA *A Guide to Standardized Highway Barrier Hardware.*

For angles, channels, wide flanges, and plates not contained in the above standard, conform to ASTM A 36. For structural tubing for short steel posts, conform to ASTM A 500 or ASTM A 513, grade 1008. Galvanize soil plates and structural tubing according to AASHTO M 111. Do not punch, drill, cut, or weld the metal after galvanizing.

Manufacture reflector tabs from 0.15-inch aluminum or galvanized steel sheets. Use an adhesive that resists peeling with a force of 5 pounds per inch of width. Use mildew-resistant adhesive that has no staining effect on retroreflective sheeting.

710.11 Temporary Plastic Fence. Furnish plastic noncorrosive fence fabricated from polyethylene (HDPE) and UV stabilized for outdoor weathering. Conform to the following:

(a) Height	47 inches min.
(b) Mesh openings	3.15 to 3.35 inches
(c) Color	International orange
(d) Mass	0.16 pound per foot, min.

Section 711. — CONCRETE CURING MATERIAL AND ADMIXTURES

711.01 Curing Material. Conform to the following:

(a) Burlap cloth	AASHTO M 182
(b) Waterproof paper	AASHTO M 171
(c) Polyethylene film	AASHTO M 171
(d) Liquid membrane forming compounds	AASHTO M 148, type 1-D or 2

711.02 Air-Entraining Admixtures. Conform to AASHTO M 154.

711.03 Chemical Admixtures. Furnish water-reducing, retarding, set-accelerating, and hydration stabilizing admixtures, or combinations thereof, conforming to AASHTO M 194. For hydration stabilizing admixtures, conform to AASHTO M 194, type B or D.

711.04 Latex Modifier. Furnish a homogeneous, nontoxic, film forming polymeric emulsion with stabilizers added at the point of manufacture. Conform to the following:

(a) Color	white
(b) Styrene butadiene polymer type	68±4% styrene 32±4% butadiene
(c) Chlorides	0%
(d) Polymer particle size	1,500 to 2,500 Angstroms avg.
(e) Emulsion stabilizers	anionic and non-ionic surfactant
(f) Solids	46.5 to 49.0%
(g) Mass	8.40 to 8.55 pounds per gallon
(h) pH	9 to 13
(i) Shelf life	2 years min.

711.05 Concrete Coloring Agents. Conform to ASTM C 979. Use only coloring agents composed of synthetic or natural inorganic iron oxides.

Section 712. — JOINT MATERIAL

712.01 Sealants, Fillers, Seals, and Sleeves. Conform to the following:

(a) Joint sealants and crack fillers. Furnish a commercial certification identifying the batch and lot number, material, quantity of batch, date and time of manufacture, and the name and address of the manufacturer.

(1) Concrete joint-sealer, hot-poured elastic type	AASHTO M 173
(2) Joint sealants, hot-poured, for rigid and asphalt pavement	ASHTO M 301
(3) Crack filler, hot applied, for asphalt concrete and rigid pavements	ASTM D 5078

(4) For proprietary asphalt-rubber products, furnish the following:

(a) Source and grade of asphalt binder;

(b) Total granulated rubber content and mass, as percent of the asphalt-rubber mixture;

(c) Granulated rubber type(s) and content of each type (if blend);

(1) Mass as a percent of combined rubber; and

(2) Gradation of granulated rubber.

(d) Type of asphalt modifier, if any;

(e) Quantity of asphalt modifier and mass as a percent of asphalt binder;

(f) Other additives;

(g) Heating and application temperatures; and

(h) Manufacturer's recommended application procedures.

(5) Multi-component joint sealant, conforming to TT-S-00227E, type I, class A or ASTM C 920, type M, grade P, class 25, use T. Provide sealant matching the color of the adjacent sidewalk. Conform to the sealant manufacturer’s recommendations for use of primers.

(6) Flexible cellular joint filler ASTM D 1056, type 2, grade 4 or 5

(b) Preformed expansion joint fillers. Furnish in a single piece for the depth and width required for the joint.

(1) Preformed expansion joint filler for concrete (bituminous type)	AASHTO M 33

(2) Preformed sponge rubber expansion joint fillers for concrete paving and structural construction	AASHTO M 153
(3) Preformed cork expansion joint fillers for concrete paving and structural construction(1)	AASHTO M 153
(4) Preformed expansion joint fillers for concrete paving and structural construction (nonextruding and resilient bituminous types)	AASHTO M 213

Note: (1) Do not use in major concrete structures.

(c) Preformed joint seals and sleeves.

(1) Paving applications. Conform to AASHTO M 220. Use a lubricant conforming to ASTM D 2835, which was manufactured within 9 months of use.

(2) Circular concrete sewer and culvert pipes using rubber gaskets. Furnish oil resistant gaskets conforming to AASHTO M 315 and the following:

(a) Minimum thickness	Recommendation of drainage element manufacturer
(b) Tear resistance, ASTM D 624 (die B)	
(1) Ethylene propylene dimonomer (EPDM)	230 pounds per inch min.
(2) Neoprene	115 pounds per inch min.

(3) **Resilient connectors between reinforced concrete manhole structures and pipes.** Conform to ASTM C 923.

(4) **Preformed flexible joint sealants for concrete pipe, manholes, and precast box sections.** Conform to ASTM C 990.

(d) Foam filler. Furnish an expanded polystyrene filler having a compressive strength of not less than 10 pounds per square inch.

(e) Silicone joint sealer. Conform to ASTM D 5893, type NS.

(f) Low-modulus silicone joint sealant. Conform to ASTM D 5893, type SL.

(g) Backer rod. Conform to ASTM D 5249, type 1. Use a compatible sealant as recommended by the rod manufacture. For size of backer rod, conform to Table 712-2.

712.02 Joint Mortar. Conform to Subsection 712.05. Use the mortar within 30 minutes after mixing.

712.03 Watertight Gaskets. For ring gaskets for rigid pipe, conform to AASHTO M 198. For ring gaskets for flexible metal pipe, conform to ASTM C 361. For continuous flat gaskets for flexible metal pipe with flat bands or bands with projections, conform to ASTM D 1056, grade SCE 41 and use a gasket with a thickness 1/2 inch greater than the nominal depth of the pipe corrugations. For continuous flat gaskets for flexible metal pipe with corrugated bands, conform to ASTM D 1056, grade SCE 43 and use a 3/8-inch thick gasket.

Table 712-2
Backer Rod Sizes

Joint Width After Preparation	Rod Diameter
5/16 inch	3/8 inch
3/8 inch	1/2 inch
1/2 inch	5/8 inch
5/8 inch	3/4 inch
3/4 inch	1 inch
1 inch	1¼ inch
1¼ inch	1½ inch
1½ inch	2 inch

712.04 Reserved.

712.05 Mortar for Masonry Beds and Joints.

(a) Type I mortar. Furnish and proportion masonry mortar according to ASTM C 270 proportion specifications. Mortar may be preblended or mixed on site. Use only masonry cement mortar type M or S.

(b) Type II mortar. Furnish mortar and material for use in mortar conforming to the following:

(1) Cement

(a) Portland Cement	Subsection 701.01(a), type I, IA, II, IIA, III, or IIIA
(b) Blended hydraulic cement	Subsection 701.01 (b), type IS, IS-A, IP, IP-A, I(PM) or I(PM)-A
(c) Masonry cement	Subsection 701.02

(2) Fine aggregate	Subsection 703.01or AASHTO M 45
(3) Lime	ASTM C 207, type S or SA. Type N or NA, if tests show it not to be detrimental to mortar soundness.
(4) Water	Subsection 725.01
(5) Air entraining admixture	Subsection 711.02
(6) Composition	Conform to the proportions for one of the mixes in Table 712-3. Uniformly mix with water to a spreading consistency.
(7) Compressive strength	2,000 pounds per square inch, 28-day min., AASHTO T 106

Table 712-3
Mortar Proportions by Volume

Mortar	Portland Cement	Hydraulic Cement	Masonry Cement	Lime	Aggregate	Air (%)*
Cement – Lime	1	—	—	¼ to ½	Not less than 2-1/4 and not more than 3 times total volume of cementous material	8-12
Masonry Cement	—	—	1	—		8-12
Hydraulic Cement	—	1	—	¼ to ½		8-12

***** When air is required, determine air content per ASTM C 91 except use the same material and proportions used in construction.

Section 713. — ROADSIDE IMPROVEMENT MATERIAL

713.01 Topsoil.

(a) Furnished topsoil. Furnish fertile, friable, free draining, sandy loam soil that is free of subsoil, refuse, stumps, roots, brush, weeds, rocks larger than 1 inch, or other substances detrimental to the development of vegetative growth. Demonstrate that the soil can sustain healthy crops of grass, shrubs, or other plant growth. Conform to the following:

(1) Texture

(a) Organic matter, AASHTO T 267	3 to 10%
(b) Sand, AASHTO T 88	20 to 70%
(c) Silt, AASHTO T 88	10 to 60%
(d) Clay, AASHTO T 88	5 to 30%
(2) pH, AASHTO T 289	6 to 8

(b) Conserved topsoil. See Subsection 204.02(c).

713.02 Agricultural Limestone. Furnish calcic or dolomitic ground limestone conforming to the standards of the Association of Official Analytical Chemists International, applicable State and Federal regulations, and the following:

(a) Purity (calcium and magnesium) carbonates	75% min.
(b) Gradation	Table 713-1

Table 713-1
Agricultural Limestone Gradation

Sieve Size	Minimum Percent by Mass Passing Designated Sieve (AASHTO T 27)
No. 10	90
No. 40	50

Granulated slag or other approved natural sources of lime may be used provided the application rate is adjusted to equal the total neutralizing power of the specified ground limestone.

713.03 Fertilizer. Furnish standard commercial grade dry formulated fertilizer conforming to the standards of the Association of Official Analytical Chemists International, applicable State and Federal regulations, and required minimum percentages of available nutrients.

Supply the fertilizer in new, clean, sealed, and properly labeled containers with name, mass, and guaranteed analysis of contents clearly marked.

Liquid fertilizer containing the minimum percentage of available nutrients may be used.

713.04 Seed. Conform to the Federal Seed Act, the Federal Noxious Weed Act, and applicable State and local seed and noxious weed laws. Do not use wet, moldy, or otherwise contaminated or damaged seed. Furnish each seed type in separate sealed container. Clearly label each container with the following:

(a) Name and type of seed;

(b) Lot number;

(c) Net mass;

(d) Percent of purity, germination, and hard seed;

(e) Percent of maximum weed seed content;

(f) Seed Origin;

(g) Noxious weeds present;

(h) Other crop seed;

(i) Inert matter;

(j) Name and address of seed distributor; and

(k) Mixture percent of each component.

Inoculate legume seed with approved cultures according to the manufacturer's instructions.

713.05 Mulch.

(a) Straw. Furnish certified weed free straw from oats, wheat, rye, or other grain crops that is free from mold or other objectionable material. Furnish straw in an air-dry condition suitable for placing with mulch blower equipment.

(b) Wood fiber. Furnish processed wood fiber from wood chips conforming to the following:

(1) Colored with a green dye noninjurious to plant growth;

(2) Readily dispersible in water;

(3) Nontoxic to seed or other plant material;

(4) Free of growth or germination inhibiting substances;

(5) Free of weed seed;

(6) Air dried to an equilibrium moisture content of 12±3 percent;

(7) Packaged in new labeled containers; and

(8) Packaged in a condition appropriate for mixing in a homogeneous slurry suitable for application with power spray equipment

(c) Grass straw cellulose fiber. Furnish processed grass straw fiber conforming to the following:

(1) Colored with a green dye noninjurious to plant growth;

(2) Readily dispersible in water;

(3) Nontoxic to seed or other plant material;

(4) Free of growth or germination inhibiting substances;

(5) Free of weed seed;

(6) Air dried to a moisture content of 10±0.2 percent;

(7) Air dried to a uniform mass of ±5 percent;

(8) Packaged in new containers labeled with the manufacturer's name and air-dry mass; and

(9) Packaged in a condition appropriate for mixing in a homogeneous slurry suitable for application with power spray equipment.

(d) Peat moss. Furnish a granulated sphagnum peat moss conforming to the following:

(1) Sticks, stones, and mineral matter	0%
(2) Partially decomposed stems and leaves of sphagnum	75% min.
(3) Color	brown
(4) Textured from porous fibrous to spongy fibrous	
(5) pH	3.5 to 7.5

(6) Air-dried

(e) Mature compost. Furnish partially decomposed organic material, such as leaves, grass, shrubs, and yard trimmings, cured for 4 to 8 weeks. Maturity is indicated by temperature stability and soil-like odor. Furnish friable, dark brown, weed-free, and pathogen-free mature compost conforming to the following:

(1) Carbon/nitrogen ratio	25/1 to 35/1
(2) Carbon/phosphorus ratio	120/1 to 240/1
(3) pH	6.0 to 7.8
(4) Water content	40% max.
(5) Particle size	
(a) Seeding and sodding	1/2 inch max.
(b) Erosion control	1 inch max.
(6) Organic material	50% min.
(7) Man-made inserts (plastic, glass, metal)	2% max.

(f) Straw for hydroseeding. Furnish clean agricultural straw milled to 1 inch or less in length. Dry the fibers to 10 percent moisture for compaction. Bale in heat-sealed plastic bags.

(g) Bonded fiber matrix hydromulch. Furnish a mixture of long-wood fibers and bonding agent which, when hydraulically applied and dried, produce a matrix conforming to the following:

(1) Does not dissolve or disperse when wetted;

(2) Holds at least 10 ounces of water per ounce of dry matrix;

(3) Has no germination or growth inhibiting factors;

(4) Forms no water insensitive crust;

(5) Contains material that is 100 percent biodegradable; and

(6) Is colored with a green dye noninjurious to plant growth.

(h) Recycled pulp fiber. Furnish cellulose fiber mulch products manufactured from natural material diverted from the waste-stream of manufacturing processes or produced from recycled material. These include newsprint, chipboard, corrugated cardboard, wood chips, and similar material. Process the material to eliminate substances that inhibit seed germination and plant growth. Add a colored dye that is non-injurious to plant growth and fades rapidly with exposure to light. The fiber shall readily blend with water, grass seed, fertilizer, and other additives to for a slurry suitable for application with power spray equipment. Furnish a homogeneous mixture conforming to the following:

(1) Synthetic, plastic, metal, or glass material	0%
(2) Weed Seed	0%
(3) Moisture content	15% max.
(4) Ash content	7% max.
(5) Organic matter	90% min.
(6) Boron	250 ppm max.
(7) Water-holding capacity	800 to 1200% by mass
(8) pH	4.0 to 8.5

713.06 **Plant Material.** Conform to the *American Standard for Nursery Stock.*

(a) Quality of plant material. Furnish plants that are excellent representatives of their normal species or varieties. Furnish nursery grown stock that has been transplanted or root-trimmed two or more times according to the kind and size of plant. Furnish plants with a normally developed branch system. Do not furnish plants with disfiguring knots, sun-scald, injuries, abrasions of the bark, dead or dry wood, broken terminal growth, or other objectionable disfigurements.

Furnish trees with reasonably straight stems and well branched and symmetrical branches according to their natural habits of growth.

(b) Plant names. For scientific and common plant names, conform to *Standardized Plant Names* as adopted by the American Joint Committee on Horticultural Nomenclature. Legibly tag and identify all plants by name and size.

(c) Grading standards. Conform to *American Standard for Nursery Stock* as approved by ANSI.

(d) Nursery inspection and plant quarantine. Furnish plants that are essentially free from plant diseases and insect pests.

Comply with all nursery inspection and plant quarantine regulations of the states of origin and destination including Federal regulations governing interstate movement of nursery stock. Provide a valid copy of the certificate of inspection with each package, box, bale, or carload shipped or otherwise delivered.

(e) Balled and burlapped (B&B) plants. Furnish plants from the original and undisturbed soil in which the plants were grown. Dig B&B plants to retain as many fibrous roots as possible. Wrap, transport, and handle the plants so the soil ball and small and fibrous roots remain intact.

713.07 Cellular Confinement Systems. Furnish a flexible honeycomb 3-dimensional structure fabricated from light stabilized polyethylene plastic. Conform to the following:

(a) Functional longevity	120 months min.
(b) Cell area	31.0 to 46.5 square inches
(c) Sheet thickness, ASTM D 751	48.8 to 49.6 mils
(d) Density, ASTM D 792	0.549 to 0.555 ounces per cubic inch
(e) Carbon black content, ASTM D 1603	1.5 to 2.5 %
(f) Environmental stress crack resistance, ASTM D 1693	2000 hours min.

(g) Conform to Table 713-2 for the depth specified.

Table 713-2
Cellular Confinement Systems

Property	**Specifications**				
Nominal cell depth	2 inch	3 inch	4 inch	6 inch	8 inch
Cell joint strength	110 pounds min.	160 pounds min.	225 pounds min.	315 pounds min.	450 pounds min.

713.08 Miscellaneous Planting Material.

(a) Stakes for bracing and anchoring. Conform to the *American Lumber Standards*. Fabricate stakes for bracing and anchoring trees from rough cypress, cedar, locust, or other approved wood essentially free from knots, rot, crossgrain, or other defects that would impair the strength of the stake. Furnish stakes with a minimum 2- by 2-inch square cross-section and adequate length.

Furnish anchor stakes of the same size and quality as bracing stakes. The diameter and length of the deadman is specified in the contract.

(b) Hose. Furnish 1-inch diameter garden or steam hose (rubber and fabric) to be used with wire for bracing and anchoring trees.

(c) Wire. Furnish 0.15-inch diameter soft annealed galvanized steel wire for bracing and anchoring trees.

(d) Wrapping material. Furnish 4-inch wide rolls of waterproof paper (triple lamination 30-30-30) or 6-inch wide rolls of burlap for wrapping trees.

(e) Twine. Furnish 2-ply twine for trees 3 inches and less in diameter and 3-ply twine for trees over 3 inches in diameter for tying wrapping material to the trees.

(f) Antidesiccant. If approved, furnish a commercially available antidesiccant emulsion to provide a film over plant surfaces that is permeable enough to permit transpiration.

(g) Tree wound dressing. Furnish a commercially available product with asphalt base and fungicide. Furnish material that is antiseptic, waterproof, adhesive, and elastic. Do not use material that is harmful to living tree tissue such as kerosene, coal tar, or creosote.

713.09 Reserved.

713.10 Sod. Furnish living vigorous sod of the type of grass and thickness specified in the contract. Furnish sod with a dense root system that is reasonably free from noxious weeds and grasses. Before taking up the sod, cut the top growth to less than 3-inch height.

713.11 Pegs for Sod. Furnish square or round pegs of sound wood and conform to the following:

(a) Length	8 inches min.
(b) Approximate cross-sectional area	1 square inch

713.12 Stabilizing Emulsion Tackifiers. Furnish a commercially available product containing no solvents or other diluting agents toxic to plant life. Conform to one of the following:

(a) Emulsified asphalt grades SS-1, SS-1h, CSS-1, or CSS-1h;

(b) Nonasphalt emulsions having a water soluble natural vegetable gum, blended with gelling and hardening agents or a water soluble blend of hydrophilic polymers, viscosifiers, sticking agents, and gums; and

(c) Polyvinyl acetate using emulsion resins and containing 60±1 percent total solids by mass.

713.13 Erosion Control Bales, Wattles, Logs, and Rolls.

(a) Straw bales. Furnish bales tied with either commercial quality baling wire or string. Conform to the following:

(1) Straw	Subsection 713.05(a)
(2) Approximate length	3.5 feet
(3) Shape	rectangular
(4) Approximate mass	70 pounds

(b) Wood excelsior bales. Furnish bales of curled wood excelsior. Tie the bales with either a commercial bailing wire, plastic, or string. Conform to the following:

(1) Approximate dimensions	16 by 18 by 36 inches
(2) Approximate mass	70 pounds

(c) Excelsior fiber wattles, logs or rolls. Furnish wattles, logs, or rolls of curled excelsior fiber rolled into a cylindrical shape and encased in a seamless photodegradable tubular netting. Conform to the following:

(1) Diameter	12 inches min.
(2) Mass	3 pounds per foot min.

(d) Straw wattles, logs or rolls. Furnish straw wattles that are manufactured from weed free straw and wrapped in a tubular photodegradable plastic netting made from 85% high density polyethylene, 14% ethyl vinyl acetate and 1% color for UV inhibition. Conform to the following:

(1) Diameter	9 inches min.
(2) Netting strand thickness	0.030 inches
(3) Netting knot thickness	0.055 inches
(4) Mass of netting	0.315 to 0.385 ounces per foot

713.14 Sandbags. Use clean, silt free material for sand filler. Conform to the following:

(a) Bag material	canvas or burlap
(b) Volume per bag	1/3 cubic foot min.

713.15 Erosion Control Culvert Pipe. Furnish culvert pipe fabricated from corrugated metal, plastic, or concrete for use in diverting live streams through work areas. Provide for AASHTO loading M18 on temporary culvert pipe placed beneath the traveled way.

713.16 Silt Fence. Conform to AASHTO M 288.

713.17 Temporary Rolled Erosion Control Products. Furnish temporary rolled erosion control products conforming to Table 713-3 and the following. See the Erosion Control Technology Council website (ECTC.org) for commercially available products that may conform to these specifications.

(a) Type 1.A, ultra-short term mulch control netting. Furnish a mulch control netting consisting of rapidly degrading photodegradable synthetic mesh or woven biodegradable natural fiber netting with a 3-month typical functional longevity designed for use on geotechnically stable slopes with gradients up to 1V:5H and channels with shear stresses up to 0.25 pounds per square foot.

(b) Type 1.B, ultra-short term netless erosion control blanket. Furnish an erosion control blanket composed of processed rapidly degrading natural or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix with a 3-month typical functional longevity designed for use on geotechnically stable slopes with gradients up to 1V:4H and channels with shear stresses up to 0.50 pounds per square foot.

(c) Type 1.C, ultra-short term single-net erosion control blanket and open weave textile. Furnish one of the following materials: (1) an erosion control blanket composed of processed degradable natural or polymer fibers mechanically-bound together by a single rapidly degrading, synthetic or natural fiber netting to form a continuous matrix or (2) an open weave textile composed of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix. The material must have a 3-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:3H and channels with shear stresses up to 1.50 pounds per square foot.

(d) Type 1.D, ultra-short term double-net erosion control blankets. Furnish an erosion control blanket composed of processed natural or polymer fibers mechanically-bound between two rapidly degrading, synthetic or natural fiber nettings to form a continuous matrix, with a 3-month typical functional longevity designed for use on geotechnically stable slopes with gradients up to 1V:2H and channels with shear stresses up to 1.75 pounds per square foot.

(e) Type 2.A, short-term mulch control netting. Furnish a mulch control netting consisting of photodegradable synthetic mesh or woven biodegradable natural fiber netting with a 12-month typical functional longevity designed for use on geotechnically stable slopes up to 1V:5H and channels with shear stresses up to 0.25 pounds per square foot.

(f) Type 2.B, short-term netless erosion control blanket. Furnish an erosion control blanket composed of processed degradable natural or polymer fibers mechanically-interlocked or chemically-adhered together to form a continuous matrix with a 12-month typical functional longevity designed for use on geotechnically stable slopes

with gradients up to 1V:4H and channels with shear stresses up to 0.50 pounds per square foot.

(g) Type 2.C, short-term single-net erosion control blanket or open weave textile. Furnish one of the following materials: (1) an erosion control blanket composed of processed degradable natural or polymer fibers mechanically-bound together by a single degradable synthetic or natural fiber netting to form a continuous matrix; or (2) an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix. The material must have a 12-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:3H and channels with shear stresses up to 1.50 pounds per square foot.

(h) Type 2.D, short-term double-net erosion control blankets. Furnish an erosion control blanket composed of processed natural or polymer fibers mechanically bound between two natural fiber or synthetic nettings to form a continuous matrix with a 12-month typical functional longevity designed for use on geotechnically stable slopes with gradients up to 1V:2H and channels with shear stresses up to 1.75 pounds per square foot.

(i) Type 3.A, extended term mulch control netting. Furnish a mulch control netting consisting of a slow degrading synthetic mesh or woven natural fiber netting with a 24-month typical functional longevity designed for use on geotechnically stable slopes with gradients up to 1V:5H and channels with shear stresses up to 0.25 pounds per square foot.

(j) Type 3.B, extended term erosion control blanket or open weave textile. Furnish one of the following materials: (1) an erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically-bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix; or (2) an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix. The material must have a 24-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:1½H and channels with shear stresses up to 2.00 pounds per square foot.

(k) Type 4, long-term erosion control blanket or open weave textile. Furnish one of the following materials: (1) an erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically-bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix; or (2) an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix. The material must have a 36-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:1H and channels with shear stresses up to 2.25 pounds per square foot.

Table 713-3
Temporary Rolled Erosion Control Products

Rolled Erosion Control Product Type												
Property	**1.A[1]**	**1.B**	**1.C**	**1.D**	**2.A [1]**	**2.B**	**2.C**	**2.D**	**3.A [1]**	**3.B**	**4**	**Test Method**
Typical functional longevity[2] (months)	3	3	3	3	12	12	12	12	24	24	36	N/A
Minimum tensile strength[3] (pounds per foot)	5	5	50	75	5	50	50	75	25	100	125	ASTM D 4595
Maximum "C" factor[4]	0.10 at 1V:5H	0.10 at 1V:4H	0.15 at 1V:3H	0.20 at 1V:2H	0.10 at 1V:5H	0.10 at 1V:4H	0.15 at 1V:3H	0.20 at 1V:2H	0.10 at 1V:5H	0.25 at 1V:1½H	0.25 at 1V:1H	ASTM D6459 or other qualified independent test[7]
Minimum permissible shear stress[5][6] (pounds per square foot)	0.25	0.50	1.50	1.75	0.25	0.50	1.50	1.75	0.25	2.00	2.25	ASTM D6460 or other qualified independent test[7]

(1) Obtain max "C" factor and allowable shear stress for mulch control nettings with the netting used in conjunction with pre-applied mulch material.

(2) Functional longevities are for guidance only. Actual functional longevities may vary based on site and climatic conditions.

(3) Minimum average roll values, machine direction.

(4) "C" factor calculated as ratio of soil loss from rolled erosion control product protected slope (tested at specified or greater gradient, v:h) to ratio of soil loss from unprotected (control) plot in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC) Test Method #2).

(5) Minimum shear stress the rolled erosion control product (unvegetated) can sustain without physical damage or excess erosion (> 1/2-inch soil loss) during a 30-minute flow event in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using ECTC Test Method #3.

(6) The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.01 to 0.05.

(7) Other large scale test methods determined acceptable by the CO.

713.18 Permanent Rolled Erosion Control Products. Furnish permanent turf reinforcement mats conforming to Table 713-4 and the following. See the Erosion Control Technology Council website (ECTC.org) for commercially available products that may conform to these specifications.

(a) Type 5.A, permanent turf reinforcement mat. Furnish a non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement on geotechnically stable slopes with gradients up to 2V:1H, channels with design shear stresses up to 6.0 pounds per square foot, and other areas where design flow conditions exceed the limits of natural vegetation.

(b) Type 5.B, permanent turf reinforcement mat. Furnish a non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement on geotechnically stable slopes with gradients up to 2V:1H, channels with design shear stresses up to 8.0 pounds per square foot, and other areas where design flow conditions exceed the limits of natural vegetation.

(c) Type 5.C, permanent turf reinforcement mat. Furnish a non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and void space for permanent erosion protection and vegetation reinforcement on geotechnically stable slopes up to 2V:1H, channels with design shear stresses up to 10.0 pounds per square foot, and other areas where design flow conditions exceed the limits of natural vegetation.

Table 713-4
Permanent Turf Reinforcement Mats

Properties[1]	Rolled Erosion Control Product Type			Test Method
	5.A	5.B	5.C	
Minimum tensile strength[2][3] (pounds per foot)	125	150	175	ASTM D4595
UV stability (minimum % tensile retention)	80	80	80	ASTM D 4355 (500-hour exposure)
Minimum thickness[2] (inches)	1/4	1/4	1/4	ASTM D 6525
Minimum permissible shear stress[4] (pounds per square foot)	6.0	8.0	10.0	ASTM D 6460 or other qualified independent test[5]

(1) For turf reinforcement mats containing degradable components, obtain all property values on the non-degradable portion of the matting alone.

(2) Minimum average roll values, machine direction only.

(3) Field conditions with high loading and high survivability requirements may warrant the use of turf reinforcement mats with tensile strengths of 3,000 pounds per foot or greater.

(4) Minimum shear stress the turf reinforcement mat (fully vegetated) can sustain without physical damage or excess erosion (>1/2-inch soil loss) during a 30-minute flow event in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council Test Method #3.

(5) Other large-scale test methods determined acceptable by the CO.

Section 714. — GEOTEXTILE AND GEOCOMPOSITE DRAIN MATERIAL

714.01 Geotextile. Use long-chain, synthetic polymers, composed at least 95 percent by mass of polyolefins or polyesters, to manufacture geotextile or the threads used to sew geotextile. Form the geotextile, including selvedges, into a stable network such that the filaments or yarns retain their dimensional stability relative to each other.

(a) Physical requirements. Conform to the following tables for the type of geotextile specified:

(1) Type I (A - F) Subsurface drainage	Table 714-1
(2) Type II (A - C) Separation	Table 714-2
(3) Type III (A - B) Stabilization geotextile	Table 714-3
(4) Type IV (A - F) Permanent erosion control	Table 714-4
(5) Type V (A - C) Temporary silt fence	Table 714-5
(6) Type VI Paving fabric	Table 714-6

All property values, with the exception of apparent opening size (AOS), in these specifications represent minimum average roll values in the weakest principal direction (i.e., average test results of any roll in a lot sampled for conformance or quality assurance testing shall meet or exceed the specified values). Values for AOS represent maximum average roll values.

Elevate and protect rolls with a waterproof cover if stored outdoors. When using a geotextile for a permanent installation, limit the geotextile exposure to ultraviolet radiation to less than 10 days.

(b) Evaluation procedures. Geotextile will be evaluated under Subsection 106.03. Furnish a commercial certification including the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile.

When samples are required, remove a 3-foot long, full-width sample from beyond the first outer wrap of the roll. Label the sample with the lot and batch number, date of sampling, project number, item number, manufacturer, and product name.

Table 714-1
Physical Requirements for Subsurface Drainage Geotextile

Property	Test Method ASTM	Units	Specifications (1)					
			Type I-A	Type I-B	Type I-C	Type I-D	Type I-E	Type I-F
Grab strength	D 4632	N	1100/700	1100/700	1100/700	800/500	800/500	800/500
Sewn seam strength	D 4362	N	990/630	990/630	990/630	720/450	720/450	720/450
Tear strength	D 4533	N	400(3)/250	400(3)/250	400(3)/250	300/175	300/175	300/175
Puncture strength	D 4833	N	400/250	400/250	400/250	300/175	300/175	300/175
Burst strength	D 3786	kPa	2750/1350	2750/1350	2750/1350	2100/950	2100/950	2100/950
Permittivity	D 4491	s^{-1}	0.5	0.2	0.1	0.5	0.2	0.1
Apparent opening size	D 4751	mm	0.43 (2)	0.25 (2)	0.22 (2)	0.43 (2)	0.25 (2)	0.22 (2)
Ultraviolet stability	D 4355	%	50 % after 500 hours of exposure					

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 elongation (ASTM D 4632).

(2) Maximum average roll value.

(3) The minimum average roll tear strength for woven monofilament geotextile is 245 N.

In addition, when geotextile joints are sewn, submit the seam assembly description and a sample of the sewn material. This description shall include the seam type, seam allowance, stitch type, sewing thread tex ticket number(s) and type(s), stitch density, and stitch gauge. If the production seams are sewn in both the machine and cross-machine directions, provide sample sewn seams that are oriented in both the machine and cross-machine directions. Furnish a sewn sample that has at least 2 meters of sewn seam and is at least 1.5 meters wide. Sew the sample seams with the same equipment and procedures that are used to sew the production seams. For seams sewn on-site, conform to the manufacturer's recommendations. Obtain approval of the seam before installation.

Table 714-2
Physical Requirements For Separation Geotextile

Property	Test Method ASTM	Units	Specifications (1)		
			Type II-A	Type II-B	Type II-C
Grab strength	D 4632	N	1400/900	1100/700	800/500
Sewn seam strength	D 4632	N	1260/810	990/630	720/450
Tear strength	D 4533	N	500/350	400(3)/250	300/180
Puncture strength	D 4833	N	500/350	400/250	300/180
Burst strength	D 3786	kPa	3500/1700	2700/1300	2100/950
Permittivity	D 4491	s^{-1}	0.02	0.02	0.02
Apparent opening size	D 4751	mm	0.60 (2)	0.60 (2)	0.60 (2)
Ultraviolet stability	D 4355	%	50% after 500 hours of exposure		

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 percent elongation (ASTM D 4632).
(2) Maximum average roll value.
(3) The minimum average tear strength for woven monofilament geotextile is 245 N.

Table 714-3
Physical Requirements For Stabilization Geotextile

Property	Test Method ASTM	Units	Specifications (1)	
			Type III-A	Type III-B
Grab strength	D 4632	N	1400/900	1100/700
Sewn seam strength	D 4632	N	1260/810	990/630
Tear strength	D 4533	N	500/350	400(3)/250
Puncture strength	D 4833	N	500/350	400/250
Burst strength	D 3786	kPa	3500/1700	2700/1300
Permittivity	D 4491	s^{-1}	0.05	0.05
Apparent opening size	D 4751	mm	0.43 (2)	0.43 (2)
Ultraviolet stability	D 4355	%	50% after 500 hours of exposure	

(1) The first values in a column apply to geotextiles that break at < 50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 percent elongation (ASTM D 4632).
(2) Maximum average roll value.
(3) The minimum average tear strength for woven monofilament geotextile is 245 N.

Table 714-4
Physical Requirements for Permanent Erosion Control Geotextile

Property	Test Method ASTM	Units	Specifications (1)					
			Type IV-A	Type IV-B	Type IV-C	Type IV-D	Type IV-E	Type IV-F
Grab strength	D 4632	N	1400/900	1400/900	1400/900	1100/700	1100/700	1100/700
Sewn seam strength	D 4632	N	1260/810	1260/810	1260/810	990/630	990/630	990/630
Tear strength	D 4533	N	500/350	500/350	500/350	400(3)/250	400(3)/250	400(3)/250
Puncture strength	D 4833	N	500/350	500/350	500/350	400/250	400/250	400/250
Burst strength	D 3786	kPa	3500/1750	3500/1750	3500/1750	2750/1350	2750/1350	2750/1350
Permittivity	D 4491	s^{-1}	0.7	0.2	0.1	0.7	0.2	0.1
Apparent opening size	D 4751	mm	0.43 (2)	0.25 (2)	0.22 (2)	0.43 (2)	0.25 (2)	0.22 (2)
Ultraviolet stability	D 4355	%	50 % after 500 hours of exposure					

(1) The first values in a column apply to geotextiles that break at <50 percent elongation (ASTM D 4632). The second values in a column apply to geotextiles that break at ≥ 50 elongation (ASTM D 4632).

(2) Maximum average roll value.

(3) The minimum average roll tear strength for woven monofilament geotextile is 245 N.

Table 714-5
Physical Requirements For Temporary Silt Fence

Property	Test Method ASTM	Units	Specifications		
			Type V-A	Type V-B (2)	Type V-C (3)
Grab strength	D 4632	N			
Machine direction			400	550	550
Cross direction			400	450	450
Permittivity	D 4491	s^{-1}	0.05	0.05	0.05
Apparent opening size	D 4751	mm	0.60 (1)	0.60 (1)	0.60 (1)
Ultraviolet stability	D 4355	%	70% after 500 hours of exposure		

(1) Maximum average roll value.
(2) Elongation at break ≥ 50 percent elongation (ASTM D 4632).
(3) Elongation at break < 50 percent elongation (ASTM D 4632).

Table 714-6
Physical Requirements For Paving Fabric

Property	Test Method	Units	Specifications Type VI
Grab strength	ASTM D 4632	N	500
Ultimate elongation	ASTM D 4632	%	50% at break
Asphalt retention	ASTM D 6140	L/m^2	0.90
Mass per unit area	ASTM D 5261	g/m^2	140
Melting point	ASTM D 276	ºC	150

714.02 Geocomposite Drains. Furnish a drainage core with a subsurface drainage geotextile attached to or encapsulating the core. Include all necessary fittings and material to splice one sheet, panel, or roll to the next and to connect the geocomposite drain to the collector and outlet piping.

For the drainage core, use long chain synthetic polymers composed at least 85 percent by mass of polypropylene, polyester, polyamide, polyvinyl chloride, polyolefin, or polystyrene. Fabricate the core in sheets, panels, or rolls of adequate strength to resist installation stresses and long-term loading conditions. Build the core up in thickness by means of columns, cones, nubs, cusps, meshes, stiff filaments, or other configurations.

Furnish geocomposite drains with a minimum compressive strength of 40 pounds per square inch when tested according to ASTM D 1621, procedure A. Furnish splices, fittings, and connections with sufficient strength to maintain the integrity of the system during construction handling and permanent loading without impeding flow or damaging the core.

Elevate and protect sheets, panels, or rolls with a waterproof and ultraviolet resistant cover if stored outdoors.

When using a geocomposite drain for a permanent installation, limit the geocomposite exposure to ultraviolet radiation to less than 10 days.

Geocomposites will be evaluated under Subsection 106.03. When samples are required, provide a 3-foot square sample from products supplied as sheets or panels or a 3-foot length full-roll width sample from products supplied in rolls. Label the sample with the lot and batch number, date of sampling, project number, item number, manufacturer, and product name.

(a) Geocomposite underdrains. The horizontal and vertical flow of water within the core shall interconnect at all times for the full height of the core. The drainage core with the geotextile fully encapsulating the core shall provide a minimum flow rate of 5 gallons per minute per foot of width when tested according to ASTM D 4716 under the following test conditions:

(1) 14-inch long specimen;

(2) Applied load of 7.25 pounds per square inch;

(3) Gradient of 1.0;

(4) 100-hour seating period; and

(5) Rubber membrane between platens and geocomposite.

Firmly attach the geotextile to the core so folding, wrinkling, or other movement cannot occur either during handling or after placement. Achieve bonding using nonwater-soluble adhesive, heat sealing, or other methods recommended by the manufacturer. Do not use adhesive on areas of the geotextile fabric where flow is intended to occur.

If heat sealing is used, do not weaken the geotextile below the required strength values. Extend the geotextile below the bottom of the core a length sufficient to completely encapsulate the collector pipe.

(b) Geocomposite sheet drains. The horizontal and vertical flow of water within the sheet drain shall interconnect at all times for the full height of the core. The drainage core with the geotextile laminated to one side of the core shall provide a minimum

flow rate of 5 gallons per minute per foot of width when tested according to ASTM D 4716 under test conditions (1) through (5) in (a) above.

If core construction separates the flow channel into two or more sections, only the flow rate on the in-flow face is considered in determining the core's acceptability.

Firmly attach the geotextile to the core so folding, wrinkling, or other movement cannot occur either during handling or after placement. Achieve bonding using nonwater-soluble adhesive, heat sealing, or other method recommended by the manufacturer. Do not use adhesive on areas of the geotextile fabric where flow is intended to occur.

If heat sealing is used, do not weaken the geotextile below the required strength values. Extend the geotextile below the bottom of the core length sufficient to completely encapsulate the collector pipe.

(c) Geocomposite pavement edge drains. The geotextile shall tightly encapsulate the geocomposite edge drain. The edge drains shall permit in-flow from both sides. The drain core with the geotextile in place shall provide a minimum flow rate of 15 gallons per minute per foot of width when tested according to ASTM D 4716 under test conditions (1) through (5) in (a) above, except the gradient shall be 0.1.

If the geocomposite polymer core separates the flow channel into two or more parts, consider only the tested flow rate of the channel facing the pavement.

All pipe and pipe fittings used for an outlet to the edge drain shall be non-perforated plastic pipe conforming to Subsection 706.08.

The solvent cement for the outlet pipe and fittings shall be according to ASTM D 2564. The material composition of the outlet fittings shall be compatible for direct solvent welding to PVC.

Section 715. — PILING

NOT USED

Section 716. — MATERIAL FOR TIMBER STRUCTURES

716.01 Untreated Structural Timber and Lumber. Conform to AASHTO M 168. Furnish an inspection certification from an agency accredited by the American Lumber Standards Committee for the species and grade. Mark all pieces with the inspection service, grade designation, species, and inspector identity.

Season and dry all structural timber and lumber before fabrication. Do not use material that is twisted, curved, or otherwise distorted.

Do not use boxed-heart pieces of Douglas fir or redwood in outside stringers, floor beams, caps, posts, sills, or rail posts. Boxed-heart pieces are defined as timber so sawed that, at any point in the length of a sawed piece, the pith lies entirely inside the four faces.

716.02 Hardware. Machine bolts, drift bolts and dowels may be medium steel. Fabricate washers from gray iron or malleable iron castings unless structural washers are specified.

Use square-headed bolts and nuts. Use a standard commercial type of cut or round nail. Use cut, round, or boat spikes as specified.

Galvanize all hardware according to AASHTO M 232 or cadmium plate all hardware according to ASTM B 766, class 12, type III.

Use ring or shear-plate timber connectors conforming to AASHTO *Standard Specifications for Highway Bridges* Division II, article 16.2.6, Timber Connectors.

716.03 Treated Structural Timber and Lumber. Furnish wood according to Subsection 716.01. Incise all wood and make all dimensional cuts and holes in the wood before pressure treatment. Treat the wood and mark each piece of treated timber according to AASHTO M 133. Treat glued laminated timber members according to AWPA Standards C14 and C28. Use the type of treatment and minimum net retention of preservative shown in the plans.

Treat timber members according to *Best Management Practices for the Use of Treated Wood in Aquatic Environments* as published by the Western Wood Preservers Association.

All treated timber members must have a quality mark approved by the American Lumber Standards Committee for individual pieces or sealed pallets assuring that treatment conforms to the appropriate AWPA standards.

Provide a production certification for each lot of treated wood according to Subsection 106.03. Indicate the preservative used, penetration in inches, retention in pounds per cubic foot (assay method), and the "Best Management Practices" used in treating timber members.

716.04 Structural Glued Laminated Timber. Furnish structural glued laminated timber according to AITC 117. Fabricate according to the combination and grade as indicated in the contract. Fabricate structural glued laminated members according to ANSI/AITC A190.1, Structural Glued Laminated Timber.

Manufacture members as industrial appearance grade for wet use conditions, using a phenol-resorcinol resin type of adhesive throughout. Use only single- or multiple-piece laminations with bonded edge joints.

Section 717. — STRUCTURAL METAL

NOT USED

Section 718. — TRAFFIC SIGNING AND MARKING MATERIAL

718.01 Retroreflective Sheeting. Conform to ASTM D 4956.

Conform to ASTM D 4956 Supplemental Requirement S1, Fungus Resistance, if specified. For reboundable retroreflective sheeting, conform to ASTM D 4956 including Supplemental Requirement S2, Reboundable Sheeting Requirements.

When an adhesive is used, use ASTM D 4956, backing class 1, 2, or 3.

718.02 Reserved.

718.03 Plywood Panels. Furnish exterior type B-B high-density overlay plywood or better conforming to NIST specification PS-1 for construction and industrial plywood. Use 1/2-inch thick plywood for sign panels with a facial area 4 square feet or less and the horizontal dimension no greater than the vertical dimension. Use 3/4-inch thick plywood for larger panels.

Abrade, clean, and degrease the face of the plywood panel according to methods recommended by the manufacturer of the retroreflective sheeting. Treat the edges of the plywood panel with an approved edge sealant.

718.04 Steel Panels. Furnish 0.079-inch continuous coat galvanized sheet steel blanks conforming to ASTM A 653. Mill phosphatize the zinc coating (designation G 90) to a thickness of 0.0035±0.00175 ounces per square foot of surface area.

Furnish panels with a substantially plane surface. Do not use twisted or buckled panels. Clean, degrease, or otherwise prepare the panels according to methods recommended by the sheeting manufacturer.

718.05 Aluminum Panels. Conform to ASTM B 209, alloy 6061-T6 or 5052-H38.

Fabricate all temporary panels and those permanent panels that are 30 by 30 inches or smaller from 0.080-inch thick aluminum sheets. Fabricate larger permanent panels from 0.125-inch thick aluminum sheets.

The blanks shall be free from laminations, blisters, open seams, pits, holes, or other defects that may affect their appearance or use. The thickness shall be uniform and the blank commercially flat. Perform shearing, cutting, and punching before preparing the blanks for application of reflective material.

Clean, degrease, and chromate the blanks or otherwise properly prepare the panels according to methods recommended by the sheeting manufacturer.

718.06 Plastic Panels.

(a) Plastic. Furnish light, flexible, high-impact, and ultraviolet chemical resistant polycarbonate material, or approved equal that will accept adhesives, coatings, and retroreflective sheeting material as recommended for such material.

Fabricate panels that are 24 by 24 inches or smaller from 0.08-inch thick plastic blanks. Fabricate larger panels from 0.125-inch thick plastic blanks.

The panels shall be flat and free of buckles, warps, and other defects. Where multiple panels adjoin, the gap between adjacent panels shall not be greater than 5/8 inches. Signs larger than 24 by 24 inches shall have reinforcement stiffeners attached on the back for rigidity and for mounting on the supports.

(b) Fiberglass reinforced plastic. Furnish fiberglass reinforced thermoset polyester acrylic modified laminate sheets. Furnish sign panel UV stabilized for outdoor weathering ability. The sign panel shall accept adhesives, coatings, and retroreflective sheeting material as recommended.

Furnish sign panel free of visible cracks, pinholes, foreign inclusions, or surface wrinkles that would affect implied performance, alter the specific dimensions of the panel, or otherwise affect the sign panels serviceability.

Wipe sign panel surface clean with a slightly dampened cloth before applying reflective sheeting.

Make fiberglass reinforced panels conform to the following mechanical and physical properties:

(1) Average tensile strength, ASTM D 638	10,000 psi min.
(2) Average tensile modulus, ASTM D 638	1,200,000 psi min.
(3) Average flexural strength, ASTM D 790	20,000 psi min.
(4) Average flexural modulus, ASTM D 790	1,200,000 psi min.
(5) Average compression strength, ASTM D 695	32,000 psi min.
(6) Average compression modulus, ASTM D 695	1,400,000 psi min.
(7) Punch shear, ASTM D 732	13,000 psi min.
(8) Thickness	0.13±0.004 inches
(9) Size, dimension < 12 feet, ASTM D 3841	±0.12 inches
(10) Squareness in 12-foot length, ASTM D 3841	±0.12 inches

(11) Surfaces, top and bottom	Smooth
(12) Color, visually uniform gray, Munsel^{R} range	N.7.5/ - N.8.5/
(13) Coefficient of lineal thermal expansion, ASTM D 696	0.000004 inches/inch/ºF max.
(14) Impact resistance, -65 to 212 ºF, ASTM D 3841	1.2 pounds from 60 feet
(15) Flame resistance, ASTM D 635	1 inch max.
(16) Weather resistance, 3000±100 h, ASTM D 3841	grade II min.

718.07 Extruded Aluminum Panels. Furnish panels conforming to ASTM B 221, aluminum alloy 6063-T6. For panel thickness and fabrication, conform to Subsection 718.05. The maximum allowable deviation from flat on the face is 0.05 inches per foot.

718.08 Signposts. Furnish wood, steel, or aluminum signposts as specified.

(a) Wood posts. Furnish posts from dry no. 1 grade Douglas fir, southern or Ponderosa pine, hemlock, spruce, or western larch conforming to AASHTO M 168. Treat the posts with water-borne preservative ACA, ACZA, or CCA according to AWPA Standard C14 except the minimum preservative retention is 0.40 pounds per cubic foot.

(b) Galvanized steel posts. Furnish posts that are straight, smooth, and free from defects affecting strength, durability, or appearance. Conform to the following:

(1) U-channel steel posts. Furnish flanged, channel, galvanized steel posts conforming to ASTM A 499, grade 60, and the following:

(a) Dimensions of U cross-section

(1) Width of opened end of U including flanges	3.0 – 3.5 inches
(2) Width of closed end of U	1.0 – 1.6 inches
(3) Depth of U	1.0 – 2.0 inches
(4) Thickness of steel	0.12 – 0.20 inches

(b) Punching. Starting 1 inch from the top and extending the full length of the post, drill or punch 3/8-inch holes on 1-inch centers along the centerline of the bottom of the U. Remove all burrs and sharp edges.

(c) Galvanizing after punching	AASHTO M 111

(2) Square tubular steel posts. Furnish square tubular galvanized steel posts conforming to ASTM A 1011, grade 55, or ASTM A 715, grade 60, and the following:

(a) Dimensions

(1) Outside dimensions	1¾ by 1¾ inches or 2 by 2 inches
(2) Wall thickness	0.083 inches
(3) Mass	1.7 – 2.0 pounds per foot

(b) Punching. Starting 1 inch from the top and extending the full length of the post, drill or punch 7/16-inch holes on 1-inch centers along the centerline of all four sides, in true alignment and opposite each other directly and diagonally. Remove all burrs and sharp edges.

(c) Galvanizing after punching (inside and outside of post)	ASTM A 635, coating Z275 designation

(c) Aluminum posts. Furnish approved standard shapes and thicknesses conforming to ASTM B 221, alloy 6061-T6, 6351-T5, 6063-T6, or 6005-T5.

(d) Corrosion resistant steel posts. Furnish posts conforming to ASTM A 588 or ASTM A 242.

718.09 Object Marker and Delineator Posts. Furnish wood, steel, or aluminum object marker and delineator posts. Delineator posts may also be fabricated from plastic.

(a) Wood posts. Furnish 4- by 4-inch wooden posts conforming to Subsection 718.08.

(b) Steel posts. Furnish flanged U-channel steel posts weighing not less than 2 pounds per foot and conforming to ASTM A 36. Galvanize the posts according to AASHTO M 111.

(c) Aluminum posts. Furnish standard shaped 1/8-inch thick aluminum posts conforming to ASTM B 221, alloy 356.0-T6.

(d) Plastic posts. Furnish flexible delineator posts made with high impact resistant polymer material.

718.10 Hardware. For lag screws, washers, clip angles, wood screws, shear plates, U-bolts, clamps, bolts, nuts, and other fasteners, use galvanized steel or aluminum alloy.

For high-strength steel bolts, nuts, and washers, conform to Subsection 717.01. Galvanize steel hardware according to AASHTO M 232.

For aluminum alloy bolts, nuts, and washers, conform to Subsections 717.13 and 717.14 as applicable.

Furnish oversize bolt heads and oversize neoprene or nylon washers for plastic sign panels.

718.11 Letters, Numerals, Arrows, Symbols, and Borders. Colors will be specified in the contract and shall conform to Subsection 718.01.

Form letters, numerals, and other units to provide a continuous stroke width with smooth edges. Make the surface flat and free of warp, blisters, wrinkles, burrs, and splinters. Conform to one of the following:

(a) Type L-1 (screen process). Apply letters, numerals, arrows, symbols, and borders on the retroreflective sheeting or opaque background of the sign by direct or reverse screen process. Apply messages and borders of a color darker than the background to the paint or the retroreflective sheeting by direct process. Produce messages and borders of a color lighter than sign background by the reverse screen process.

Use opaque or transparent colors, inks, and paints in the screen process of the type and quality recommended by the retroreflective sheeting manufacturer.

Perform the screening in a manner that results in a uniform color and tone, with sharply-defined edges of legends and borders, and without blemishes on the sign background that will affect intended use.

Air dry or bake the signs after screening according to manufacturer's recommendations to provide a smooth hard finish. Any signs with blisters or other blemishes will be rejected.

(b) Type L-3 (direct applied characters). Cut letters, numerals, symbols, borders, and other features of the sign message from the type and color of the retroreflective sheeting specified, and apply to the sign background's retroreflective sheeting according to the retroreflective sheeting manufacturer's instructions. For the retroreflective sheeting minimum coefficient of retroreflection (R_A), conform to AASHTO M 268.

718.12 Delineator and Object Marker Retroreflectors. Furnish type 1 or type 2 retroreflectors that are ready for mounting. Furnish antitheft hardware for mounting as required.

(a) Type 1 (acrylic plastic lens). Furnish a 7-square inch minimum acrylic plastic lens with prismatic optical elements and a smooth, clear, transparent face. Fabricate the back from similar material and fuse it to the lens around the entire perimeter to form a homogenous unit. Permanently seal the units against the intrusion of dust, water, or air. Conform to Table 718-1 regardless of the orientation angle.

Table 718-1
Minimum Coefficient of (Retroreflective) Luminous Intensity (R_I) [(1)]
Candelas per Footcandle

Observation Angle º	Entrance Angle º	White[(2)]	Yellow	Red
0.1	0	115	70	30
0.1	20	45	25	12

(1) See AASHTO T 257.
(2) Crystal, clear, or colorless are acceptable color designations.

Mount the retroreflector unit in a housing fabricated from 0.063-inch aluminum alloy 3003-H-14 or similar, or from cold rolled, hot dip, galvanized steel, having a thickness of 0.064 inches. Provide antitheft attachment hardware.

(b) Type 2 (retroreflective sheeting). Furnish a fungus resistant type III, V, VII, VIII, or IX retroreflective sheeting with a class 1 or 2 adhesive backing conforming to ASTM D 4956. Attach the sheeting to an aluminum or plastic support panel (target plate) of the size and dimension specified.

718.13 Conventional Traffic Paint. Conform to AASHTO M 248.

718.14 Waterborne Traffic Paint. Furnish an acrylic water-based, ready-mixed paint for use on asphalt and rigid pavements conforming to the following:

(a) Composition. Furnish a paint composed of resin solids of 100 percent acrylic polymer with the exact formulation determined by the manufacturer. Conform to the following:

(1) Pigment, % by mass, ASTM D 3723	45% to 55%
(2) Lead, chromium, cadmium, or barium ASTM D 3335 & D3718	0%
(3) Volatile organic compounds, ASTM D 2369	20.0 ounces per gallon max.
(4) Mass of paint, ASTM D 1475	12.0 pounds per gallon min.

(b) Viscosity. ASTM D 562 — 75-90 Krebs units

(c) Drying time.

(1) Dry to no pickup, ASTM D 711	10 minutes max.
(2) Drying to no track, 6 pounds per gallon, type 1 waterproofed glass beads, 15±1 mil wet film thickness at 130 ºF	90 seconds max.

(d) Flexibility. ASTM D 522, using the 1/4-inch cylindrical mandrel	No cracking or flaking
(e) Dry opacity. ASTM D 2805, contrast ratio at 319 square feet per gallon spreading rate	0.96 min.
(f) Color.	
(1) White, ASTM D 1729	Match FHWA standard highway white
(2) Yellow, ASTM D 1729	Match FHWA standard highway yellow
(g) Daylight reflectance. (Without glass beads)	
(1) White, FTMS 141 method 6121 ASTM E 1347	84% relative to magnesium oxide standard
(2) Yellow, FTMS 141 method 6121 ASTM E 1347	55% relative to magnesium oxide standard
(h) Bleeding ratio. ASTM 969. Determine reflectance according to ASTM D 1347 immediately after drying. Divide the average of 3 reflectance readings of the paint over the bleeding surface by the average of 3 readings over the non-bleeding surface to determine the bleeding ratio.	0.96 min.
(i) Scrub resistance. ASTM D 2486	300 cycles min.
(j) Freeze-thaw stability. ASTM D 2243	
(1) Change in viscosity	±5 Krebs units max.
(2) Decrease in scrub resistance	-10% max.

(k) Storage stability. During a 12-month storage period, conform to the following:

(1) No excessive setting, caking, or increase in viscosity; and

(2) Readily stirred to a consistency for use in the striping equipment.

718.15 Epoxy Markings. Furnish a 2-component, 100 percent solids type system for hot-spray application conforming to the following:

(a) Pigments. Component A. Percent by mass.

(1) White.

(a) Titanium dioxide (TiO_2), ASTM D 476, type II and type III	18% min.
(b) Epoxy resin	75 to 82%

(2) Yellow:

(a) Chrome yellow ($PbCrO_4$), ASTM D 126, type III.	23% min.
(b) Epoxy resin	70 to 77%

(3) Non-Lead Yellow:

(a) Titanium dioxide (TiO_2) ASTM D 476, type II and type III.	14% min.
(b) Organic yellow	7 to 8%
(c) Epoxy resin	75 to 79%

(b) Epoxy content. Component A. Mass per epoxy equivalent, ASTM D 1652	Manufacturer's target value ±50
(c) Amine value. Component B, ASTM D 2074	Manufacturer's target value ±50
(d) Toxicity. Toxic or injurious fumes at application temperature	none

(e) Color. 15 mil film thickness specimen(cured).

(1) White, ASTM D 1729	Match FHWA standard highway white
(2) Yellow, ASTM D 1729	Match FHWA standard highway yellow

(f) Directional reflectance. (Without glass beads)

(1) White, ASTM E 1347	84% relative to magnesium oxide standard
(2) Yellow, ASTM E 1347	55% relative to magnesium oxide standard

(g) Drying time. 15 mil film thickness with beads.

(1) Laboratory at 72 ºF, ASTM D 711	30 minutes maximum to no-pick-up condition
(2) Field at 77 ºF, viewed from 50 feet	10 minutes maximum to no-tracking condition

(h) Abrasion resistance. Wear index with a CS-17 wheel under a 35.3 ounce load for 1000 cycles, ASTM D 4060	82 max.
(i) Hardness. Shore D hardness with 72- to 96-hour cure at 72 ºF, ASTM D 2240	75 to 100

(j) Storage. When stored for up to 12 months, individual epoxy components shall not require mixing before use.

718.16 Polyester Markings. Furnish a 2-component system conforming to the following:

(a) Directional reflectance. (Without glass beads)

(1) White, ASTM E 1347	80% relative to magnesium oxide standard
(2) Yellow, ASTM E 1347	55% relative to magnesium oxide standard

(b) Color.

(1) White, ASTM D 1729	Match FHWA standard highway white
(2) Yellow, ASTM D 1729	Match FHWA standard highway yellow

(c) Viscosity. Uncatalyzed polyester at 25 ºF, ASTM D 562	70 to 90 Krebs units

(d) Bleeding. ASTM D 969 — 6 minimum

(e) Drying time in field. Viewed from 50 feet — 45 minutes maximum to no-tracking condition

718.17 Thermoplastic Markings. Conform to AASHTO M 249.

718.18 Preformed Plastic Markings. Conform to ASTM D 4505, type I, V, VI, or VII, grade A, B, C, D, or E.

718.19 Glass Beads. Conform to AASHTO M 247 for the type specified. Table 1, Gradation of Glass Beads in AASHTO M 247 is supplemented by Table 718-2. Treat glass beads with an adherence coating as recommended by manufacturer.

Table 718-2
Gradation of Glass Beads

Sieve Size	Percent by Mass Passing Designated Sieve (ASTM D 1214)		
	Grading Designation		
	Type 3	Type 4	Type 5
No. 8			100
No. 10		100	95 - 100
No. 12	100	95 - 100	80 - 95
No. 14	95 - 100	80 - 95	10 - 40
No. 16	80 - 95	10 - 40	0 - 5
No. 18	10 - 40	0 - 5	0 - 2
No. 20	0 - 5	0 - 2	
No. 25	0 - 2		

For type 3, 4, and 5 glass beads, also conform to the following:

(a) Treat beads with a reactive adherence coating as recommended by the manufacturer.

(b) Roundness, FLH T 520 — 70% min. per sieve size

(c) Refractive index, AASHTO M 247 — 1.50 - 1.55

718.20 Raised Pavement Markers.

(a) Non-plowable, extended life, retroreflective, pavement markers. Conform to ASTM D 4280.

(b) Plowable, retroreflective, pavement markers. Conform to ASTM D 4383.

718.21 Temporary Pavement Markings.

(a) Preformed retroreflective tape. Furnish 4-inch wide tape conforming to ASTM D 4592, type I (removable).

(b) Raised pavement markers. Furnish an L-shaped polyurethane marker body with retroreflective tape on both faces of the vertical section, capable of retroreflecting light from opposite directions, and with an adhesive on the base.

Provide a minimum coefficient of retroreflection of 1200 candela per lux per square meter at 0.1-degree observation angle and -4 degrees entrance angle.

Fabricate the marker body from 60-mil minimum thickness polyurethane. Fabricate the vertical leg about 2 inches high by about 4 inches wide. Fabricate the base for the marker body about 1⅛ inches wide.

Factory apply a 125-mil minimum thickness and 750-mil wide pressure sensitive adhesive to the marker base and protect it with release paper.

If approved, variations in design and dimensions will be permitted to meet manufacturer's standards.

718.22 Temporary Traffic Control Devices. Use suitable commercial grade material for the fabrication of the temporary traffic control devices. Construct the devices from material capable of withstanding anticipated weather, traffic conditions, and suitable for the intended use. Do not use units used on other projects without approval.

718.23 Epoxy Resin Adhesives. Epoxy resin adhesives for bonding traffic markers to rigid and asphalt concrete pavements shall conform to AASHTO M 237.

Section 719. — Reserved

Section 720. — STRUCTURAL WALL AND STABILIZED EMBANKMENT MATERIAL

720.01 Mechanically-Stabilized Earth Wall Material.

(a) Concrete face panels. Conform to Section 552 and the following:

(1) Use concrete class A(AE) with a minimum 4,000-pound per square inch 28-day compressive strength.

(2) Conform to Section 562 and fully support the units until the concrete reaches a minimum compressive strength of 1,000 pounds per square inch. The units may be shipped and installed after the concrete reaches a minimum compressive strength of 3,400 pounds per square inch.

(3) Finish the front face of the panel with a class 1 finish according to Subsection 552.16. Screed the rear face of the panel to eliminate open pockets of aggregate and surface distortions in excess of 1/4 inch. Cast the panels on a flat area. Do not attach galvanized connecting devices or fasteners to the face panel reinforcement steel.

(4) Clearly scribe on an unexposed face of each panel the date of manufacture, the production lot number, and the piece mark.

(5) Handle, store, and ship all units in such a manner as to eliminate the dangers of chipping, discoloration, cracks, fractures, and excessive bending stresses. Support panels in storage on firm blocking to protect the panel connection devices and the exposed exterior finish.

(6) Manufacture all units within the following tolerances:

(a) Panel dimensions. Position of panel connection devices within 1 inch. All other dimensions within 3/16 inch.

(b) Panel squareness. Squareness, as determined by the difference between the 2 diagonals, shall not exceed 1/2 inch.

(c) Panel surface finish. Surface defects on smooth formed surfaces 5 feet or more in length shall not exceed 1/8 inch. Surface defects on textured-finished surfaces 5 feet or more in length shall not exceed 5/16 inch.

Concrete face panels having any or all of the following defects will be rejected.

- Defects that indicate imperfect molding;
- Defects indicating honeycombed or open texture concrete;
- Cracked or severely chipped panels; or
- Color variation on front face of panel due to excess form oil or other reasons.

(b) Wire facing. Fabricate from welded wire fabric conforming to AASHTO M 55, except that section 7.4. applies for all longitudinal and transverse wire sizes. After fabrication, galvanize according to AASHTO M 111.

(c) Backing mat. Fabricate from welded wire fabric conforming to AASHTO M 55 except that section 7.4 applies for all longitudinal and transverse wire sizes. After fabrication, galvanize according to AASHTO M 111.

(d) Clevis connector. Fabricate from cold-drawn steel wire conforming to AASHTO M 32, and weld according to AASHTO M 55. After fabrication, galvanize according to AASHTO M 111.

(e) Connector bars. Fabricate from cold-drawn steel wire conforming to AASHTO M 32. Galvanize according to AASHTO M 111.

(f) Fasteners. Furnish 1/2-inch diameter, heavy hexhead bolts, nuts, and washers conforming to AASHTO M 164. Galvanize according to AASHTO M 232.

(g) Hardware cloth. Fabricate with maximum 1/4-inch square mesh openings from woven or welded galvanized steel wire fabric conforming to ASTM A 740.

(h) Reinforcing mesh. Fabricate from cold-drawn steel wire conforming to AASHTO M 32. Weld the wire into the finished mesh fabric according to AASHTO M 55. After fabrication, galvanize according to AASHTO M 111. Repair all damage to the galvanized coating before installation.

(i) Reinforcing strips. Fabricate from high-strength, low-alloy structural steel conforming to ASTM A 572, grade 65, type 3. After fabrication, galvanize according to AASHTO M 111.

(j) Tie strip. Fabricate from hot-rolled steel conforming to ASTM A 570, grade 50. Galvanize according to AASHTO M 111.

720.02 Gabion and Revet Mattress Material.

(a) Basket mesh. Twist or weld the mesh from galvanized steel wire conforming to ASTM A 641, class 3 or aluminized steel wire conforming to ASTM A 809. Use wire with a minimum tensile strength of 60,000 pounds per square inch when tested according to AASHTO T 244. The galvanized or aluminized coating may be applied after mesh fabrication. Make the mesh openings with a maximum dimension less than 4½ inches, an area less than 10 square inches, and a size less than the gabion or revet mattress rock to be used with the mesh.

(1) Gabion baskets (1 foot or greater in the vertical dimension). Fabricate the mesh for galvanized or aluminized coated baskets from nominal-sized 0.12-inch or greater diameter wire and fabricate the mesh for polyvinyl chloride coated baskets from nominal-sized 0.11-inch or greater diameter wire.

(a) Twisted wire mesh. Form the mesh in a uniform hexagonal pattern with nonraveling double twists. For galvanized or aluminized coated baskets, tie the perimeter edges of the mesh for each panel to a 0.15-inch or greater diameter selvedge wire. For polyvinyl chloride coated baskets, tie the perimeter edges of the mesh for each panel to a 0.13-inch or greater diameter selvedge wire. Make the selvedge at least the same strength as the body of the mesh. Furnish selvedge wire from the same type of material used for the wire mesh.

(b) Welded wire mesh. For galvanized or aluminized coated baskets, weld each connection to obtain a minimum average weld shear strength of 585 pounds with no value less than 450 pounds. For polyvinyl chloride coated baskets, weld each connection to obtain a minimum average weld shear strength of 472 pounds with no value less than 360 pounds.

Fabricate gabion baskets in the dimensions required with a dimension tolerance of ±5 percent. Where the length of the basket exceeds 1.5 times its width, equally divide the basket into cells less than or equal to the basket width using diaphragms of the same type and size mesh as the basket panels. Prefabricate each basket with the necessary panels and diaphragms secured so they rotate into place.

(2) Revet mattresses (less than 1 foot in the vertical dimension). Fabricate the mesh from nominal-sized 0.086-inch or greater diameter wire.

(a) Twisted wire mesh. Form the mesh in a uniform hexagonal pattern with nonraveling double twists. Tie the perimeter edges of the mesh for each panel to a 0.11-inch or greater diameter selvedge wire. Make the selvedge at least the same strength as the body of the mesh. Furnish selvedge wire from the same type of material used for the wire mesh.

(b) Welded wire mesh. Weld each connection to obtain a minimum average weld shear strength of 292 pounds with no value less than 225 pounds.

Fabricate revet baskets in the dimensions required with a dimension tolerance of ±5 percent in length and width and ±10 percent in height. Where the length of the basket exceeds 0.5 times its width, equally divide the basket into cells less than or equal to 0.5 times the basket width using diaphragms of the same type and size mesh as the mattress panels. Prefabricate each basket with the necessary panels and diaphragms secured so they rotate into place.

(3) Polyvinyl chloride coated baskets. Use either a fusion bonded or extruded coating to coat the galvanized or aluminized mesh. Conform to the following:

(a) Color	Black or gray
(b) Thickness	0.125 inch min.
(c) Specific gravity, ASTM D 792	1.20 to 1.40
(d) Tensile strength, ASTM D 638	2,300 pounds per square inch min.
(e) Modulus of elasticity, ASTM D 638	2,000 pounds per square inch min. at 100 strain
(f) Hardness — shore "A", ASTM D 2240	75 min.
(g) Brittleness temperature, ASTM D 746	16 ºF max.
(h) Abrasion resistance, ASTM D 1242, method B at 200 cycles, CSI-A abrader tape, 80 grit	12% max. mass loss
(i) Salt spray (ASTM B 117) and ultraviolet light exposure (ASTM D 1499 and G 23 using apparatus type E and 145 ºF) for 3000 hours	No visual effect *(c)* Δ< 6% *(d)* Δ< 25% *(e)* Δ< 25% *(h)* Δ< 10%
(j) Mandrel bend, 360º bend at 0 ºF around a mandrel 10 times the wire diameter	No breaks or cracks in coating

(b) Permanent fasteners.

(1) Lacing wire. Furnish nominal-sized 0.086-inch diameter wire of the same type, strength, and coating as the basket mesh.

(2) Spiral binders. Form with wire having at least the same diameter, type, strength, and coating as the basket mesh.

(3) Alternate fasteners. Furnish fasteners according to the basket manufacturer's specification that remain closed when subjected to a 585-pound tensile force while confining the maximum number of wires to be confined in the gabion structure or revet mattress. Submit installation procedures and fastener test results.

(c) Internal connecting wire. Furnish lacing wire as described in (b)(1) above or alternate stiffeners according to the basket manufacturer's specification.

720.03 Metal Bin Type Crib Walls.

NOT USED

Section 721. — ELECTRICAL AND ILLUMINATION MATERIAL

NOT USED

Section 722. — ANCHOR MATERIAL

722.01 Anchorage Devices. For post-tensioning, furnish anchorage devices capable of holding the prestressing steel at a load producing a stress of not less than 95 percent of the guaranteed minimum tensile strength of the prestressing steel.

Use a steel distribution plate or assembly to effectively distribute the compressive stresses from the anchoring device to the concrete. If the anchorage device is sufficiently large and is used with a steel grillage embedded in the concrete, the distribution plate or assembly may be omitted. Conform to the following:

(a) The final unit compressive stress on the concrete directly beneath the plate or assembly shall not exceed 3,000 pounds per square inch.

(b) Bending stresses in the plates or assemblies induced by the pull of the prestressing shall not exceed the yield point of the material or cause visible distortion in the anchorage plate when 100 percent of the ultimate load is applied.

Furnish 2 anchorage devices (complete with distribution plates or assemblies) for each size and type to be used.

722.02 Ground Anchors. Conform to the following:

(a) Tendons. For either single or multiple elements, conform to one of the following:

(1) Steel strand uncoated seven-wire stress relieved for prestressed concrete	AASHTO M 203
(2) Uncoated high-strength steel bar for prestressed concrete	AASHTO M 275
(3) Steel strand uncoated seven-wire compacted stress relieved for prestressing concrete	ASTM A 779 and AASHTO M 203

(b) Couplers. Furnish couplers for tendon sections that are capable of developing 95 percent of the minimum specified ultimate tensile strength of the tendon.

(c) Sheathing. Conform to one of the following:

(1) Unbonded length.

(a) Polyethylene tube. Conform to ASTM D 1248, type II, III, or IV with a minimum wall thickness of 60 mils.

(b) Hot-melt extruded polypropylene tube. Conform to ASTM D 4101, cell classification PP 210 B5554211 with a minimum wall thickness of 60 mils.

(c) Hot-melt extruded polyethylene tube. Conform to ASTM D 3350 and D 1248 high-density type III with a minimum wall thickness of 60 mils.

(d) Steel tubing. Conform to ASTM A 500 with a minimum wall thickness of 0.20 inches.

(e) Steel pipe. Conform to ASTM A 53, schedule 40 minimum.

(f) Plastic pipe. Conform to ASTM D 1785, schedule 40 minimum.

(2) Bonded length.

(a) High-density corrugated polyethylene tubing. Conform to AASHTO M 252 with a minimum wall thickness of 30 mils.

(b) Corrugated, polyvinyl chloride tubes. Conform to ASTM D 1784, class 13464-B.

(c) Fusion-bonded epoxy. Conform to AASHTO M 284 with a minimum film thickness of 15 mils.

(d) **Grease.** Conform to Table 3.2.1 of the PTI *Post Tensioning Manual*. Formulate to provide corrosion inhibiting and lubricating properties.

(e) **Grout.** Furnish a pumpable mixture of portland cement, sand, water, and admixtures. Use type I, II or III portland cement conforming to AASHTO M 85.

Chemical additives that control bleed or retard set may be used provided the additives conform to Subsection 711.03 and are mixed according to the manufacturer's recommendations.

For permanent ground anchors, furnish grout capable of reaching a cube strength (AASHTO T 106) of 3,500 pounds per square inch in 7 days. For soil nails, furnish grout capable of reaching a cube strength of 1,500 pounds per square inch in 3 days and 3,000 pounds per square inch in 28 days.

Make grout cubes for testing from random batches of grout as directed. Normally, strength testing for permanent ground anchors will not be required as system performance will be measured by proof-testing each anchor. Grout cube testing will be required if admixtures are used or irregularities occur in anchor testing.

(f) **Centralizers.** Fabricate centralizers and spacers from any type of material, except wood, that is not deleterious to the prestressing steel.

(g) **Anchorage devices.** Conform to Section 3.2.3 of the PTI *Post Tensioning Manual*. For strand tendons, design anchorage devices to permit lift-off testing without the jack engaging the strand. For anchorage device bearing plates, furnish steel plates conforming to ASTM A 36 or A 588.

Extend a pipe or trumpet from the anchor plate a sufficient distance to encapsulate the protective sheath. Furnish anchorage devices capable of developing 95 percent of the minimum specified ultimate tensile strength of the anchor tendon.

722.03 Rock Bolts. Conform to ASTM F 432.

722.04 Soil Nails.

(a) Tendon. Furnish deformed bars conforming to one of the following:

(1) Deformed bars, grade 60 or 75	ASTM A 615
(2) Deformed bars, grade 150	ASTM A 722

Provide new, straight, continuous, undamaged, bare, epoxy coated, or encapsulated bars.

(b) Coupler. Furnish couplers that are capable of developing the full, ultimate tensile strength of the tendon as certified by the manufacturer.

(c) Fusion bonded epoxy coating. Apply epoxy coating conforming to ASTM A 775, with the exception of the bend test requirements. Electrostatically apply the coating to a minimum thickness of 12 mils. The coating at the wall anchorage end of epoxy-coated bars may be omitted over the length provided for threading the nut against the bearing plate.

(d) Encapsulation. Furnish corrugated polyethylene pipe conforming to AASHTO M 252 or corrugated polyvinyl chloride pipe conforming to ASTM D 1784, class 13464-B.

Section 723. — Reserved

Section 724. — Reserved

Section 725. — MISCELLANEOUS MATERIAL

725.01 Water. Conform to the following:

(a) Water for mixing or curing cement concrete, mortar, or grout. Conform to AASHTO M 157. Potable water of known quality may be used without testing according to AASHTO T 26. Potable water is safe for human consumption as defined by the public health authority having jurisdiction.

(b) Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalies, or salts.

(c) Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

725.02 Calcium Chloride, Calcium Chloride Flakes and Magnesium Chloride.

(a) Calcium chloride liquid. Conform to AASHTO M 144, type L for the specified concentration.

(b) Calcium chloride flakes. Conform to AASHTO M 144, type S, grade 1, 2, or 3, class A.

(c) Magnesium chloride. Furnish a brine solution conforming to the following:

(1) Magnesium chloride by mass	28% minimum
(2) Water by mass	72% maximum
(3) Specific gravity, AASHTO T 227	1.290 to 1.330

725.03 Lime.

(a) Lime for masonry. Furnish hydrated lime conforming to ASTM C 207, type N.

(b) Lime for soil stabilization and paving. Conform to AASHTO M 216.

725.04 Pozzolans. Conform to the following:

(a) Fly ash	AASHTO M 295, class C or F
(b) Ground iron blast-furnace slag	AASHTO M 302, grade 100 or 120
(c) Silica fume (microsilica)	AASHTO M 307

725.05 Mineral Filler. Conform to AASHTO M 17.

725.06 Precast Concrete Curbing and Wheelstops. Furnish units conforming to the following:

(a) Concrete	Section 601
(b) Reinforcing steel	Subsection 709.01

725.07 Clay or Shale Brick. Conform to one of the following:

(a) Sewer brick	AASHTO M 91, grade SM
(b) Building brick	AASHTO M 114, grade SW

725.08 Concrete Brick. Conform to ASTM C 55, grade N-I.

725.09 Concrete Masonry Units. Conform to one of the following:

(a) Load-bearing concrete masonry units	ASTM C 90
(b) Concrete masonry units for constructing catch basins and manholes	ASTM C 139
(c) Nonload-bearing concrete masonry units	ASTM C 129

725.10 Cellular Concrete Blocks. Conform to ASTM C 936 or C 1319.

725.11 Precast Concrete Units and Accessories.

(a) Reinforced concrete manholes sections. Conform to AASHTO M 199

(b) Precast concrete barrier. Conform to ASTM C 825.

(c) Reinforced concrete crib wall members. Conform to ASTM C 915.

(d) Underground concrete utility structures. Conform to ASTM C 858.

(e) Concrete water and waste water structures. Conform to ASTM C 913.

(f) Solid concrete interlocking paving units. Conform to ASTM C 936.

(g) Other precast concrete units not covered by the preceding requirements. Cast the units in substantial permanent steel forms. When reinforcing steel is required, conform to Section 709. Provide additional reinforcement as necessary for handling the units. Use concrete conforming to the following.

(1) Minimum design strength (f'_c) at 28-day strength, AASHTO T 22	3,600 pounds per square inch min.

(2) Air entrained concrete for precast units exposed to freezing and thawing environment. For air-entrained concrete, conform to the following:

(a) 3/8 inch max. size aggregate	5% min.
(b) > 3/8 inch max. size aggregate	4% min.

Cure the units according to AASHTO M 170.

Sample for verification of required average compressive strength (f'_{cr}). Cast a sufficient number of concrete cylinders from each unit or randomly selected from a production run of units to permit compressive strength testing at 7, 14, and 28 days. Fabricate at least 2 cylinders for each test age. Each compressive strength test consists of two or more cylinders tested according to AASHTO T 22 at the same age. If the minimum required average (f'_{cr}) strength requirement is met at 7 or 14 days, the units may be used 14 days from date of casting.

Do not use precast concrete units when:

- Compressive strength as determined by AASHTO T 22 from each unit or production run does not meet the minimum required average (f'_{cr}) strength requirement by the age of 28 days.
- Cracks, honeycombed, or patched areas are larger than 30 square inches.

725.12 Frames, Grates, Covers, and Ladder Rungs. Fabricate metal grates and covers to evenly bear on the frames. Correct bearing inaccuracies by machining. Assemble all units before shipment. Mark all pieces to facilitate reassembly at the installation site. Uniformly coat all castings with a commercial preservative according to the manufacturer's standard practice. Conform to the following:

(a) Gray iron castings	AASHTO M 105
(b) Carbon steel castings	AASHTO M 103
(c) Structural steel	ASTM A 36
(d) Galvanizing	AASHTO M 111
(e) Malleable iron castings	ASTM A 47
(f) Aluminum alloy ladder rung material	ASTM B 221, alloy 6061-T6
(g) Aluminum castings	ASTM B 26, alloy 356.0-T6

725.13 Corrugated Metal Units. For steel corrugated units, conform to AASHTO M 36. For aluminum corrugated units, conform to AASHTO M 196. For coatings, conform to the following:

(a) Asphalt-coated corrugated units	AASHTO M 190, type A
(b) Polymer precoated corrugated units	AASHTO M 245, grade 250/250
(c) Fiber-bonded units	Subsection 707.09

725.14 Protective Coatings for Concrete. Furnish protective coatings for bridge decks, curbs, sidewalks, and concrete portions of bridge railings conforming to one of the following:

(a) Boiled linseed oil	ASTM D 260, type I or II
(b) Petroleum spirits (mineral spirits)	ASTM D 235

725.15 Polyvinyl Chloride (PVC) Pipe for Water Distribution Systems. Conform to the following for the designated sizes and strength schedules:

(a) PVC pipe	ASTM D 1785
(b) Solvent cement for pipe and fittings	ASTM D 2564

725.16 Polyethylene (PE) Pipe for Water Distribution Systems. Conform to ASTM D 2447 for the designated sizes and strength schedules.

725.17 Cast Iron Soil Pipe and Fittings. Conform to ASTM A 74, class SV for the designated sizes.

725.18 Seamless Copper Water Tube and Fittings. Conform to ASTM B 88, type L for the designated sizes.

725.19 Plastic Lining. Furnish a film or fabric that is serviceable for the duration of the installation.

725.20 Lignosulfonate. Furnish a water solution with a base cation of ammonia, calcium, or sodium. Conform to the following:

(a) Solids(1)	50%
(b) Specific gravity	1.25
(c) pH, AASHTO T 289	4.5 min.

Note: (1) Determine the percentage of solids according to the modified Technical Association of the Pulp and Paper Industry Standard T 650-TM-84 or by a specific gravity/percent solids versus temperature graph that correlates with the standard.

725.21 Epoxy Resin Adhesives. Conform to AASHTO M 235.

725.22 Grout. Furnish grout mixtures conforming to the following for the type or types specified in the contract.

(a) Expansive hydraulic sanded cement grout. Furnish a mixture of hydraulic cement, fine aggregate, water, expansive admixture, and/or pozzolan, or additional admixtures, conforming to the following:

(1) 7-day compressive strength, AASHTO T 106	600 pounds per square inch min.
(2) Flow (time of efflux), ASTM C 939	16 to 26 seconds

Note: A more fluid mix, having a flow cone time of efflux of 9 to 15 seconds, may be used during the initial injection.

Submit the following with the production certification:

- Current material certifications for the hydraulic cement, fine aggregate, expansive admixture, and other grout additives; and
- Independent laboratory test results for 1-day, 3-day, and 7-day strengths, flow cone times, shrinkage and expansion observed, and time of initial set.

(b) Polymer grout. Furnish a polymer binder and fine aggregate in the proportions recommended by the polymer manufacturer with a minimum compressive strength of 3,500 pounds per square inch in 4 hours.

(c) Nonshrink grout. Conform to ASTM C 1107.

(d) **Grout for Post-Tensioned Structures.** Conform to the requirements of the *PTI Guide Specification for Grouting of Post-Tensioned Structures.*

(e) Sanded Hydraulic Cement Grout for Miscellaneous Applications. Furnish 1 part hydraulic cement and 3 parts sand. Thoroughly mix with water to produce a thick, creamy consistency.

(f) Neat hydraulic cement grout. Furnish a grout consisting of a mixture of hydraulic cement, water, and admixtures. Do not exceed a water/cement ratio of 0.44. Fly ash, if used, shall not exceed 20% of the cement by weight. Admixtures to reduce water content, improve the flowability, control bleeding, or control shrinkage may be added according to the manufacturer's recommendations. Admixtures shall be free of chlorides, fluorides, sulphites, and nitrates.

725.23 Reserved.

725.24 Color Coating. Furnish a semiopaque colored toner containing methyl methacrylate-ethyl acrylate copolymer resins or equivalent resins, solvents, and color-toning pigments suspended in solution by a chemical suspension agent. The color- toning pigments shall consist of laminar silicates, titanium dioxide, and inorganic oxides. Conform to the following:

(a) Mass per liter, ASTM D 1475	8.3 pounds min.
(b) Solids by mass, ASTM D 2369	30% min.
(c) Solids by volume	21% min.
(d) Drying time, ASTM D 1640	30 minutes at 70 ºF and 50% max. humidity
(e) Color change, ASTM D 822, 1000 h	No appreciable change
(f) Resistance to acids, alkalies, gasoline, and mineral spirits, ASTM D 543	Excellent
(g) Water vapor transmission from interior concrete, ASTM D 1653	Transmittable
(h) Exterior moisture absorption into the concrete surface pores, FSS TT-C-555	Reduces rate
(i) Oxidation over time	None

725.25 Explosives and Blasting Accessories.

NOT USED

725.26 Mineral Slurry (Drillers Mud).

NOT USED

725.27 Form Liner. Furnish a high quality product that attaches easily to the forming system. Install the form liner so it does not compress more than 1/4 inch at a concrete pour rate of 750 pounds per square foot.

725.28 Aluminum-Impregnated Caulking Compound. Conform to FSS TT-C-598, grade 1.

725.29 Reinforcing Fibers. Use deformed steel or fibrillated polypropylene fibers conforming to ASTM C 1116.

Publication No. FHWA-FLH-03-002