



Standard Specifications for  
**HIGHWAY**  
**CONSTRUCTION**

**ARKANSAS STATE HIGHWAY AND  
TRANSPORTATION DEPARTMENT**  
————— 2014 Edition —————

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**DEFINITIONS AND TERMS**

**101.01 Abbreviations and Definitions.** Whenever the following abbreviations are used in these specifications or on the plans, they are to be construed the same as the respective expressions represented:

**(a) Industry Abbreviations.**

ACI	American Concrete Institute
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act of 1990
ADEQ	Arkansas Department of Environmental Quality
AGC	Associated General Contractors of America
AHTD	Arkansas State Highway and Transportation Department
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ARA	American Railway Association
AREMA	American Railway Engineering and Maintenance-of-Way Association
ARTBA	American Road and Transportation Builders Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
ATSSA	American Traffic Safety Service Association
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
C of E	U.S. Army Corps of Engineers
CFR	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
DEPT	Arkansas State Highway and Transportation Department
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services Administration
ITE	Institute of Transportation Engineers
LRFD	Load and Resistance Factor Design

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MASH	Manual for Assessing Safety Hardware
MIL	Military Specifications
MUTCD	Manual on Uniform Traffic Control Devices
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
UL	Underwriter's Laboratory
USC	United States Code

**(b) Contract Abbreviations for Construction Work.**

AB	Asphalt Binder	CNTL	Control,
AC	Asphalt Cement		Controller
ACHM	Asphalt Concrete Hot Mix	COMP	Compaction, Compacted
ACTD	Actuated	CONC	Concrete
ADJ	Adjusted	CONST	Construction
AGG	Aggregate(s)	CONT	Continuous,
ALUM	Aluminum		Continuously
APPL	Application	CORR	Corrugated
APPR	Approach	CR	Crushed
ASPH	Asphalt	CRS	Course(s)
ASSY	Assembly	CS	Corrugated Steel
AST	Asphalt Surface Treatment	CTD	Coated
AUTO	Automatic	CU, cu	Cubic
BIND	Binder	DBL	Double
BIT	Bituminous	DI	Drop Inlet(s)
BLDG	Building(s)	DWY(S)	Driveway(s)
BLKT	Blanket	EMUL	Emulsified
BNG(S)	Bearing(s)	EWK	Earthwork
BR	Bridge(s)	EXC	Excavation
BST	Bituminous Surface Treatment	EXP	Expansion
C&G	Curb and Gutter	F&I	Furnish and Install
CA	Corrugated Aluminum	FDN	Foundation
cc	cubic centimeter(s)	FES	Flared End Section(s)
CD	Compacted Depth	FNC	Fence(s)
CEM	Cement	FURN	Furnish, Furnishing
CL	Class	GA	Gage, Gauge
CLVT(S)	Culvert(s)	GALV	Galvanized
CM	Corrugated Metal	GR	Grade, Graded
CMBN	Combination	GRVL	Gravel
		ha	hectare(s)
		HI	High Intensity
		HM	Hot Mix



HMA	Hot Mix Asphalt	PRCST	Precast
HMAS	Hot Mix Asphalt Stabilized	PRFMD	Preformed
INST	Install, Installing, Installation	PROC	Process, Processing
j	joule(s)	PVC	Polyvinylchloride
kg	kilogram(s)	PVMT	Pavement(s)
kL	kiloliter(s)	PVNG	Paving
km	kilometer(s)	QPL	Qualified Products List
km/h	kilometers per hour	QUAD	Quadruple
kPa	kiloPascal(s)	QUINT	Quintuple
L	liter(s)	R&D	Removal and Disposal
LAB	Laboratory	RC	Reinforced Concrete
m	meter(s)	RDWY	Roadway(s)
mm	millimeter(s)	RECOMP	Recompact(ed), Recompaction
MA	Mineral Aggregate	RECON	Reconstruct(ed)
MAINT	Maintenance	REFL	Reflectorized
MATL	Material(s)	REHAB	Rehabilitate, Rehabilitation
MES	Mitered End Section(s)	REINF	Reinforced, Reinforcing
MET	Metal	RELOC	Relocate, Relocation
MG	1000 Gallons	REMV	Removal, Removing, Removed
MIN	Mineral	REPL	Replace, Replacing
MOB	Mobilization	RESTOR	Restoration
MOD	Modified	RESTEEL	Reinforcing Steel
MPa	MegaPascal(s)	RMC	Rigid Metallic Conduit
MRK	Marking(s)	RNMC	Rigid Non-Metallic Conduit
msta	metric station	SCAR	Scarify, Scarifying
mton	1000 kilograms	SGNL(S)	Signal(s)
NO	Number(s)	SHLD(S)	Shoulder(s)
NON MET	Non-Metallic	SPEC	Special
NON REINF	Non-Reinforced	sq	Square
NPDES	National Pollutant Discharge Elimination System	sta	Station (100 feet)
OCT	Octagonal	STAB	Stabilized, Stabilization
OFF	Office		
OH	Overhead		
Pa	Pascal(s)		
PC	Portland Cement		
PIL	Piles, Piling		
PM	Plant Mixed		
ppm	parts per million		

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STAA	Short Term Activity Authorization	TERM	Terminal
		THERMPL	Thermoplastic
STKPL	Stockpile, Stockpiling	TMBR	Timber
		TRAF	Traffic
STL	Steel	TRP	Triple
STN	Stone	TRMT	Treatment
STR(S)	Structure(s)	TRTD	Treated
STRL	Structural	TY	Type
SURF	Surface, Surfacing	UNCL	Unclassified
SWPPP	Storm Water Pollution Prevention Plan	UNTRTD	Untreated
		UT	Uniform Thickness
		VAR	Variable
		VEH	Vehicle(s)
SYS	System, Systems	µm	micrometer (1x10 <sup>-6</sup> m)
TEMP	Temporary		

(c) **Definitions.** Whenever in these specifications or in other contract documents the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

**Advertisement.** The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

**Award.** The acceptance by the Commission of a proposal.

**Bidder.** An individual, partnership, corporation, or joint venture submitting a bid for the advertised work. (The terms "Bidder" and "Contractor" are frequently used synonymously.)

**Bridge.** A single or multiple span structure, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20' (6 m) between undercopings of abutments or spring lines of arches or extreme ends of openings for multiple boxes; may include multiple pipes where the clear distance between openings is less than half the smaller contiguous opening. (All measurements shall include the widths of intermediate piers or division walls.)

**Bridge Length.** The greater dimension of a structure measured along the center of the roadway between backs of abutment backwalls or between ends of bridge floor.

**Bridge Roadway Width.** The clear width of structure measured at right angles to the center of the roadway between the bottom of curbs or, if curbs are not used, between the inner faces of parapet or railing.

**Business Day.** Any calendar day except Saturdays, Sundays, and Department recognized holidays. If a holiday falls on Saturday or Sunday, the observed day shall be the Friday preceding the Saturday or the Monday following the Sunday.

**Calendar Day.** Any day shown on the calendar, beginning and ending at midnight. If a day is not identified by any other modifier, it shall be considered a calendar day.

**Change Order.** A written order issued by the Engineer to the Contractor, covering changes in the plans or quantities or both, within the scope of the Contract and establishing the basis of payment and time adjustments for the work affected by the changes. A contract modification.

**Commission.** The Arkansas State Highway Commission as constituted under the laws of the State of Arkansas for the administration of the Arkansas State Highway and Transportation Department.

**Contract.** The written agreement between the Commission and the Contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the work, the furnishing of labor and materials, and the basis of payment.

(The Contract includes the contract form; the contract schedule of prices; the payment and performance bonds; specifications, supplemental specifications, and special provisions; general and detailed plans; and any change orders and agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, all of which constitute one instrument.)

**Contract Item (Pay Item).** A specifically described unit of work for which a price is provided in the Contract.

**Contract Time.** The number of working days allowed for completion of the Contract.

If a fixed date of completion is shown in the proposal, the Contract shall be completed by that calendar date.

**Contractor.** The individual, partnership, corporation, or any combination thereof, or joint venture contracting with the Commission for performance of the prescribed work. (The terms "Contractor" and "Bidder" are frequently used synonymously.)

**County.** The county in which the work herein specified is to be done.

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

**Department.** The Arkansas State Highway and Transportation Department as constituted under the laws of the State of Arkansas for the administration of highway and transportation work. ("Department" and "State" are sometimes used synonymously.)

**Director.** Director of Highways and Transportation, the chief executive officer of the Department.

**Engineer.** The Chief Engineer of the Department, acting directly or through duly authorized representatives, who is responsible for engineering supervision of the construction.

**Equipment.** All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and tools and apparatus necessary for the proper construction and acceptable completion of the work.

**Extra Work.** An item of work not provided for in the Contract as awarded but found essential to the satisfactory completion of the Contract within its intended scope.

**Holidays.** The Department observes the following legal holidays: New Year's Day, January 1; Dr. Martin Luther King Jr.'s Birthday/Robert E. Lee's Birthday, 3rd Monday in January; President's Day, 3rd Monday in February; Memorial Day, last Monday in May; Independence Day, July 4; Labor Day, 1st Monday in September; Veteran's Day, November 11; Thanksgiving Day, 4th Thursday in November; Christmas Eve, December 24; and Christmas Day, December 25. If a holiday

falls on Saturday or Sunday, the observed day shall be the Friday preceding the Saturday or the Monday following the Sunday.

**Inspector.** The Engineer's authorized representative assigned to make detailed inspections of Contract performance.

**Laboratory.** The testing laboratory of the Department or any other testing laboratory that may be designated by the Engineer.

**Materials.** Any substances specified for use in the construction of the project and its appurtenances.

**Metric Station.** 100 meters.

**Metric Ton.** 1000 kilograms.

**Notice to Contractors.** The advertisement for proposals for all work or materials on which bids are required indicating with reasonable accuracy the quantity and location of the work to be done, or the character and quantity of the materials to be furnished; and the time and place of the opening of proposals.

**Pavement Structure.** The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

**Payment Bond.** The approved form of security, executed by the Contractor and his/her Surety or Sureties, guaranteeing the payment of all legal debts of the Contractor pertaining to the construction of the project.

**Performance Bond.** The approved form of security, executed by the Contractor and his/her Surety or Sureties, guaranteeing complete performance of the Contract and all supplemental agreements thereto.

**Plans.** The approved plans, profiles, typical cross- sections, working drawings, and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the work to be done. (The Title Sheet of the plans is provided for general information only and is not to be taken as an all-inclusive description of the work. Other work and/or locations may be included in the Project as described by the plans, specifications, supplemental specifications, and special provisions.)

**Profile Grade.** Unless otherwise shown on the plans, the trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. (Profile grade means either the elevation or gradient of such trace according to the context.)

**Project.** The specific section of the highway together with all appurtenances and construction to be performed thereon under the Contract.

**Proposal.** The offer of a bidder, on the prescribed form, to perform the work and to furnish the labor and materials at the unit prices quoted.

**Proposal Form.** The approved form on which the Department requires bids to be prepared and submitted for the work.

**Proposal Guaranty.** The security furnished with a bid to guarantee that the bidder will enter into the Contract if the bid is accepted.

**Prospective Bidder.** An individual, partnership, corporation, or joint venture who has requested and been issued a proposal form from the Department.

**Questionnaire.** The specified forms, on which an individual, a partnership, or a corporation shall, as a prerequisite to bidding, periodically furnish required information as to ability to perform and finance the work.

**Professional Engineer.** An Engineer licensed in the State of Arkansas by the Arkansas State Board of Licensure for Professional Engineers and Professional Surveyors. All details, drawings, calculations, and reports submitted by engineers as required by these specifications shall be certified, signed, and stamped with the seal or facsimile thereof as authorized by the Board.

**Professional Surveyor.** A Surveyor licensed in the State of Arkansas by the Arkansas State Board of Licensure for Professional Engineers and Professional Surveyors. All plats submitted by the surveyor as required by these specifications shall be certified, signed, and stamped with the seal or facsimile thereof as authorized by the Board.

**Registered Scale Mechanic.** A person registered with the Arkansas Bureau of Standards, Division of Weights and Measures, as being qualified by training and experience to make adjustments and repairs to commercial scales and performs such work as a skilled trade.

**Resident Engineer.** The direct representative of the Engineer placed in immediate charge of the engineering details and general administration of a project.

**Right-of-Way.** A general term denoting land, property, or interest therein, acquired for or devoted to highway purposes.

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

**Roadbed.** The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders.

**Roadside.** A general term denoting the area adjoining the outer edge of the roadway. (Extensive areas between the roadways of a divided highway may also be considered roadside.)

**Roadway.** The portion of a highway within limits of construction.

**Shoulder.** The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles for emergency use, and for lateral support of base and surface courses.

**Sidewalk.** That portion of the roadway constructed primarily for the use of pedestrians.

**Sieve.** U.S.A Standard Series, as defined in AASHTO M 92. Percent passing or retained is by weight.

**Special Provisions.** Additions and revisions to the standard and supplemental specifications covering conditions peculiar to an individual project.

**Specifications.** A general term applied to all directions, provisions, and requirements pertaining to performance of the work.

**Standard Specifications.** This printed book of Standard Specifications for Highway Construction. Unless otherwise noted, the Edition in effect on the date of advertisement.

**State.** The State of Arkansas acting through its authorized representative. ("State" and "Department" are sometimes used synonymously.)

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

**Structures.** Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other features that may be encountered in the work and not otherwise classed herein.

**Subbase.** The layer or layers of specified or selected material of designated thickness placed on a subgrade to support a base course.

**Subcontractor.** An individual, firm, or corporation to whom the Contractor sublets part of the work.

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

**Substructure.** All of that part of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls, and wing protection railings.

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

**Superstructure.** The entire structure except the substructure.

**Supplemental Agreement.** A written negotiated agreement constituting a modification of the originally executed Contract and covering the performance of work beyond its general scope. (The items of work contained therein will be included in an approved Change Order.)

**Supplemental Specifications.** Revisions to the Standard Specifications that are adopted subsequent to issuance of the printed book of Standard Specifications.



**Surety.** The company, other than the Contractor, executing a bond furnished by the Contractor.

**Titles (Or Headings).** The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

**Ton.** 2000 pounds.

**Town or City.** A subdivision of the county used to designate or identify the location of the proposed work.

**Traveled Way.** The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

**Work.** The furnishing of all materials, labor, equipment, tools, and incidentals necessary or convenient to the successful completion of the project and the carrying out of the duties and obligations imposed by the Contract.

**Working Day.** A calendar day during which normal construction operations could proceed; normally excludes Saturdays, Sundays, and Department recognized holidays. (A working day is further defined in subsection 108.06.)

**Working Drawings.** Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, or any other supplementary plans or similar data that the Contractor is required to submit to the Engineer for informational and record purposes or for approval.

**Work Order.** Written notice from the Engineer directing the Contractor to begin prosecution of the work.

**101.02** To avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, when, or where "contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned," it shall be understood as if the expression were followed by the words "by the Engineer" or "to the Engineer."

## SECTION 102

### BIDDING REQUIREMENTS AND CONDITIONS

**102.01 Prequalification of Bidders.** Prospective bidders, when requested, must present satisfactory evidence that they have been regularly engaged in the kind of work bid upon, giving the length of time so engaged, and that they are fully prepared with the necessary capital, material, machinery, and expert workers to carry out the Contract.

A financial statement and experience record must be furnished on questionnaire forms specified by the Commission. These forms must be prepared by a Certified or Registered Public Accountant and filed by the prospective bidder. A bidder's period of qualification will be for one year, beginning with the effective date of the statement, plus a grace period of four months. Prospective bidders may file a questionnaire at any time; however, no proposal will be released to a bidder unless a rating has been extended based on an acceptable questionnaire. The Department will expect a review period of at least 5 business days before extending a rating. Contractors will be rated in accordance with the maximum amount of work it is deemed they can satisfactorily prosecute through any given period. The maximum amount of work considered will include the unfinished value of all contracts in force.

The attention of prospective bidders is directed to Ark. Code Ann. §17-25-101 et seq., Act 150 of the 1965 Acts of Arkansas, being an "Act Regulating the Practice of Contracting in the State of Arkansas", and acts amendatory thereto. When the work offered is financed in whole with State funds and is estimated to cost \$20,000 or more, the prospective bidder must show evidence of license with the Contractors Licensing Board for the State of Arkansas before being furnished with a proposal form.

When a project is funded in whole or in part with Federal Aid funds, the Commission does not require the bidder to be licensed to bid. Any contractor, otherwise qualified by the State of Arkansas to perform such work, is not required to be licensed nor to submit application for license before submitting a bid or having such bid considered; provided, however, that such exemption does not constitute a waiver of the State's right under its license laws to require a contractor, determined to be a successful bidder, to be

licensed to do business in the State of Arkansas in connection with the execution of an ensuing Contract. (See also subsection 103.02.)

For informational purposes, proposals marked "not for bidding" may be obtained upon request without the prequalification or licensing requirement.

**102.02 Notice to Contractors.** After the date is fixed for the letting of work, the Department will give notice of such letting to contractors. The Notice to Contractors will contain a description of the proposed work, and information to the bidder regarding access to proposal forms, plans, and specifications, and the amount and nature of the proposal guaranty. This notice will be published as required by State law.

**102.03 Contents of Proposal Form.** The proposal form will state the location and description of the contemplated construction and will show the estimate of the various quantities and kinds of work to be performed or materials to be furnished, and will have a schedule of items for which unit bid prices are invited. The proposal form will state the time in which the work must be completed, the amount of the proposal guaranty, and the date and time of the letting of work. The form will also include any special provisions or requirements that vary from or are not contained in the standard specifications.

All papers bound with or attached to the proposal form are considered a part thereof and should not be detached or altered when the proposal is submitted.

The plans, specifications, and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

**102.04 Issuance of Proposals.** Proposals will only be issued to prequalified contractors or their authorized representatives upon request.

If the prospective bidder's prequalification rating is not "unlimited", the bidder shall file a certification with the Department citing all contracts in force and the unfinished value of such work. Proposals will not be issued until a certification for the current bidding period is on file and the amount of work the contractor may be allowed to undertake is determined. The contractor's

prequalification rating, less the unfinished value of all contracts in force, will determine the amount of additional work that the contractor may be allowed to undertake. Proposals covering individual projects for which the estimated cost is more than the amount that the contractor may be allowed to undertake will not be issued, but the contractor may be issued proposals on more than one project, providing that the estimated cost of each project is not more than the amount that the contractor may be allowed to undertake. In the event a contractor submits a low bid on more than one project and the aggregate amount is greater than the amount the contractor may be allowed to undertake, the Commission will exercise its discretion in the award of a particular project or projects.

A charge will be made for proposals and plans issued. Payment shall be made at the time proposals or plans are received or upon receipt of statement therefor. No refund will be allowed for plans or proposals returned.

Plans, proposal forms, and specifications may be examined in the Programs and Contracts Division at the Arkansas State Highway and Transportation Department, 10324 Interstate 30, Little Rock, Arkansas during regular business hours and may be purchased until 4:30 p.m. on the day prior to the scheduled bid opening.

The Department reserves the right to refuse to issue, accept, or consider a proposal for any of the following reasons:

**(a)** Failure to comply with the prequalification requirements of the Department.

**(b)** Lack of competency and adequate machinery, plant, and other equipment, as revealed by the financial statement and experience questionnaires required under subsection 102.01.

**(c)** Uncompleted work that, in the judgment of the Department, might hinder or prevent the prompt completion of additional work if awarded.

**(d)** Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of issuance of proposals.

**(e)** Misconduct which, in the opinion of the Engineer, is of such a serious nature as to adversely affect the ability of the Contractor to perform future work.

(f) Debarment or suspension currently in effect.

(g) Failure to reimburse the Department for moneys owed on any previously awarded contracts including those where the prospective bidder is a party to a joint venture and the joint venture has failed to reimburse the Department for moneys owed.

(h) Previous failure to execute a Contract and/or submit acceptable bonds for any subsequent advertisement of that project.

(i) Unsatisfactory performance on previous work.

(j) If the prospective bidder is the Contractor on a current Contract with the Commission on which Liquidated Damages are being assessed, and there are no pending time extensions warranted to remove the project from Liquidated Damages; or if the prospective bidder has an individual, as an officer/owner/partner of any firm, partnership, or corporation which has a current Contract with the Commission on which Liquidated Damages are being assessed, and there are no pending time extensions warranted to remove the project from Liquidated Damages.

(k) If the prospective bidder has a current Contract in default or has an officer/owner/partner of any firm, partnership, or corporation which has a current Contract in default. (l) Failure to pay any bills owed the Department.

(m) Failure to submit a Certification of Officers/Owners/Partners.

**102.05 Interpretation of Quantities in Proposal Schedule.** The quantities appearing in the schedule are approximate only and are prepared for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the Contract. The scheduled quantities of work to be done and materials to be furnished may each be increased, decreased, or omitted as hereinafter provided.

**102.06 Examination of Plans, Specifications, Special Provisions, and the Site of the Work.** The Department will provide full, complete, and accurate plans and specifications giving such directions as will enable any competent mechanic or contractor to carry them out. The bidder is expected to examine carefully the site of the proposed work, the proposal, plans, specifications, supplemental specifications, special provisions, and contract forms

before submitting a proposal. The submission of a bid shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the plans, specifications, supplemental specifications, special provisions, and contract.

When the plans or special provisions include information pertaining to subsurface exploration, boring logs, soil survey information, or other preliminary investigations, such information was obtained by the Department for design and estimating purposes only. This and other subsurface investigation information may be available and prospective bidders will be permitted to examine such information upon request. It is expressly understood and agreed that said information does not constitute a part of the Contract and represents only the best knowledge of the Department as to the location, character, and depth of the materials encountered. This information is only included and made available so that prospective bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation, and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated.

**102.07 Preparation of Proposal.** The proposal shall be submitted upon the forms furnished to the prospective bidder by the Department. A computer-generated proposal schedule as described below may be used in lieu of the proposal schedule in the proposal. The bidder shall specify a unit price in figures for each pay item for which a quantity is given and should also show the products of the respective unit prices and quantities written in figures in the column provided for that purpose, and the total amount obtained by adding the amounts of the several items. These extensions and totals as calculated by the bidder are for information only; the total proposal amount will be the true sum of the products obtained by multiplying the approximate quantities by their respective unit bid prices. Any notes, comments, or amounts written outside the column headed "Unit Bid Price" will be disregarded when calculating the total proposal amount. A unit price of "zero" (\$0.00) is a valid price and will be considered. A blank unit price is not considered valid except

in the case of a lump sum item for which the price is entered in the column headed "Extension". The unit bid price should not be carried beyond 1/10 cent (\$0.001). Any figures on the unit bid price beyond 1/10 cent will be dropped. All figures shall be in ink and legible.

Should a bidder need to change a unit bid price on the bid proposal schedule of items, the original entry shall be marked out and the new entry shall be initialed by the person signing the proposal or another officer of the firm. Should a bidder need to change an extension, subtotal, or total on the bid proposal schedule of items, the original entry should be marked out and the new entry should be initialed by the person signing the proposal or another officer of the firm. Changes are defined as any physical alterations to the original figures including, but not limited to erasures, cross-outs, line-outs, or other corrections (e.g., liquid paper white-outs, tape corrections, etc.).

If the bidder elects to use a computer-generated Proposal Schedule, the bidder should print the Job Number, Bidder's Company Name (as prequalified with the Department), and Page Number on each Proposal Schedule page and shall list the line numbers, items, and item quantities as shown on the Department Schedule of Items. The final page of the computer-generated Proposal Schedule shall contain the original signature of an authorized representative of the firm. Even though the bidder chooses this option, Page 3 of the Proposal form must still be signed, any applicable certification forms included in the proposal form must be executed, and the entire proposal form submitted.

When plans and specifications permit the use of different types of materials for an item of work and when the proposal provides for these different acceptable materials in an alternate bid system, the bidder should enter a unit price and extension for only one of the two or more alternates listed for that item of work. Should unit prices be entered for more than one alternate of an item of work, the alternate with the lowest extension will be used when computing the contract amount.

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by

one or more officers of a corporation, or by an agent of the Contractor legally qualified and acceptable to the Department.

If the bidder's proposal is made by an individual, the name of the individual must be shown; by a partnership, the name of each partnership member must be shown; as a joint venture, the name of a member or officer of each of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation must be shown. If the proposal is signed by any person who is not listed in the bidder's Prequalification Questionnaire (Questionnaire Form) as the individual, as a partner of a partnership, or as an officer of a corporation, authorization for such signature should be on file with the Department before opening of bids, or should accompany the proposal. This authorization shall be made before the opening of bids and be in the form of a Power of Attorney duly executed and signed by an official with power to constitute such authority.

Various sections of these specifications provide for separate pay items for the major components of Mineral Aggregate/Asphalt Binder mixes, and it is intended that the unit bid prices submitted for these items are balanced according to their proportionate share of the in-place cost of the mix. To prevent gross unbalancing of bids on these components, a minimum unit bid price has been established for some or all of the pay items for Asphalt Binder. Those items of Asphalt Binder that are subject to a minimum bid price will bear the note "(Minimum bid price is \$\_\_\_ per ton)" within the Proposal Schedule.

The Proposal Schedule may contain other various pay items which have a minimum or maximum unit bid price established. Unit bid prices submitted which are equal to or greater than the listed minimum price or which are equal to or less than the listed maximum price, will be computed and tabulated at the unit bid price submitted. However, any unit bid price submitted in an amount less than the specified minimum or greater than the specified maximum, will be automatically adjusted to the specified minimum or maximum and computed accordingly, without any counter-adjustments in prices for other items. For items other than Asphalt Binder which have a minimum or maximum unit bid price established, the minimum or maximum unit bid price will be established within the applicable specification.



The proposal for all federal aid projects will contain a bidders list. The bidder should complete the list by showing the name, address, and DBE designation for all subcontractors, material suppliers, or trucking firms that bid or provided quotes on any item on the project, regardless if the quotes were used or not used in the preparation of the bidder's proposal. The information provided will be used to establish and maintain a master list of subcontractors, materials suppliers, and trucking firms for the development of the Department's overall DBE goals. The information provided will not be used for contract awarding purposes but must be provided before the Contractor will be issued proposals for future lettings.

**102.08 Irregular Proposals.** (a) Proposals will be considered irregular and will be rejected for the following reasons:

(1) If changes are made to the entries for unit bid prices on the bid proposal schedule of items and they are not initialed by the person signing the proposal or an officer of the firm.

(2) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items or lump sum pay items. In the case of a lump sum pay item, a price may be entered as a unit price or an extension.

(3) If the proposal is not prepared and signed with ink.

(4) If the final page of a computer generated Schedule of Items and Page 3 of the Proposal Form do not contain the original signature of an authorized representative of the firm.

(5) If the computer generated Schedule of Items does not contain the items and item quantities shown on the Department's Schedule of Items.

(6) If the proposal is not accompanied by the proper proposal guaranty.

(7) If a proposal is received from an individual, firm, partnership, or corporation with an interest, as principal, in another proposal for the same project.

(8) If any unit price entered on the Schedule of Items or a computer-generated Schedule of Items is illegible.

(9) If the proposal is not submitted by the prospective bidder who purchased the original proposal.

(10) If the Disadvantaged Business Enterprise (DBE) Participation Form or the Certification to Submit DBE Participation is not completed and signed, or documentation to request consideration of a good faith effort is not included with the proposal.

(b) Proposals will be considered irregular and may be rejected for the following reasons:

(1) If the proposal is on a form other than that furnished or authorized by the Department; or if the form is altered except as authorized; or any part thereof is detached.

(2) If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind that may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.

(3) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

(4) If any item entered on the Schedule of Items or a computer-generated Schedule of Items is ambiguous.

(5) If the computer generated Schedule of Items does not contain the Job Number, Bidder's Company Name (as prequalified by the Department), and Page Number on each Proposal Schedule page.

(6) Unbalanced proposals in which the prices for some items are out of proportion to the reasonable costs representative of those items.

**102.09 Proposal Guaranty.** No proposal will be considered by the Commission unless it is accompanied by a guaranty in the form of either a bank draft, certified check, or cashier's check drawn on a solvent bank or trust company, or a bidder's bond executed by an approved surety company. The guaranty shall be made payable to the Arkansas State Highway and Transportation Department and shall be in an amount not less than the amount indicated in the proposal, except that in a joint venture arrangement it will be permissible for each participating bidder to submit a lesser amount that, in aggregate, will meet the required total amount. A separate check or bidder's bond shall be furnished with each proposal submitted.

**102.10 Delivery of Proposals.** Each proposal should be submitted in a special envelope furnished by the Department. The information provided on the submittal envelope shall clearly indicate that it contains a bid proposal for State Job (number) and should list the State job name and the name and address of the Contractor submitting the bid. The submittal envelope should be sealed and addressed to the Chief Engineer, Arkansas State Highway and Transportation Department. When sent by mail, the sealed submittal envelope should be enclosed in a second envelope addressed to the Chief Engineer, Arkansas State Highway and Transportation Department, P.O. Box 2261, Little Rock, Arkansas 72203, and identified as a bid proposal. In the event that the second envelope is not identified as a bid proposal, the Department will not be responsible for consideration of the proposal if it is not recognized as such by the time designated for receipt of proposals. If submitted other than by mail, it shall be delivered to the Division Head, Programs & Contracts Division, or an authorized representative, Arkansas State Highway and Transportation Department, 10324 Interstate 30, Little Rock, Arkansas. Any proposal received after the time stated in the proposal form for receipt of proposals will not be accepted and will be returned unopened to the bidder.

**102.11 Withdrawal/Modification of Proposals.** (a) A bidder may withdraw or modify a proposal after it has been deposited with the Department, provided a request for withdrawal or modification, as described herein, is received by the Department before the time set for opening proposals. A proposal may also be withdrawn if the Commission fails to make an award within 40 calendar days after the date of opening.

(b) A request to withdraw or modify a proposal before bid opening must be legible and in one of the following forms.

**(1) Written Request.** Written requests for release of the bid proposal shall be signed by the bidder and delivered by the person who is to take possession of the proposal. Proposals withdrawn in this manner may be modified and resubmitted, but the modifications must be legible and must satisfy all other criteria for changes listed in this Section. Failure to resubmit a modified proposal before the time set for bid opening will result in no bid on behalf of the company that has withdrawn its bid.

**(2) Facsimiles.**

**a.** The Department will not be responsible for any failure attributable to the transmission or receipt of a facsimile.

**b.** Facsimile requests to withdraw bid proposals shall be on the bidder's letterhead and must clearly and legibly state the job number, job name, and letting date of the proposal being withdrawn. Requests shall be signed by the bidder and addressed to the Division Head, Programs and Contracts Division. The request should be transmitted to the Department at (501)569-2623.

**c.** Facsimile requests to modify a bid must be legible copies of Schedule of Items pages, identical to those originally submitted as part of the bid proposal. The subtotal and total page(s) shall be submitted even if the modifications made do not change the total and subtotal. Original entries must be lined through and only legible revisions initialed by the person who signed the original proposal will be considered. This person must also sign and date the page containing the revised bid total.

**Facsimile requests to modify bid proposals may not be transmitted directly to the Department or any of its agents.** The office or person receiving the facsimiles (e.g., the bidder's bonding agent, a local delivery service, etc.) shall seal them in an envelope clearly marked "BID MODIFICATION" and on which the job number, job name, bidder's name, letting date, and the typed or printed name of the person delivering it have been recorded. This person must also sign and date the envelope. The sealed envelope must then be delivered to the Division Head, Programs & Contracts Division, according to the requirements of this Section. Facsimiles will become part of the bid proposal document. If for any reason a facsimile modifying a bid is not delivered to the Department before the time set for bid opening, the original bid will be opened, read, and considered in the award of the project.

The original, signed modified pages shall immediately be sent to the Department by the bidder. The award of Contract containing a facsimile modification shall be

subject to receipt of the original, signed modified pages by the Department within ten calendar days of the bid opening date. Failure to provide the original pages to the Department within ten calendar days shall be taken as a failure to execute the Contract and handled according to subsection 103.07(a).

**102.12 Public Opening of Proposals.** Proposals will be opened and read publicly at the time and place indicated in the Notice to Contractors. Bidders, their authorized agents, and other interested parties are invited to be present.

**102.13 Disqualification of Bidders.** Only one proposal from an individual, firm, partnership, or corporation, whether under the same or under different names, will be considered. Should it appear to the Commission that any bidder is interested, as principal, in more than one proposal for any one project, all such proposals in which the bidder is interested will be rejected.

A bidder may, however, submit a proposal as principal and also quote as a subcontractor to other principals on the same project provided the quotation as a subcontractor does not exceed 70% of the total bid, and by so doing will not thereby be liable for disqualification. Furthermore, it is not the intent of this specification to disqualify any proposal because of quotations made by any one subcontractor to more than one principal. Should there be reasonable grounds for believing that collusion or a combination exists, all proposals may be rejected and bidders or participants in such combination or collusion will not be considered in future proposals for the same work.

**102.14 Material Guaranty.** The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work together with samples which may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.

**102.15 Project Withdrawal.** The Arkansas Highway Commission reserves the right to withdraw a project previously scheduled for letting. In the event of such withdrawal, potential bidders will be notified by the Department, time permitting. In any case, an announcement will be made before opening bids for such

withdrawn project and the unopened bids will be returned to the bidders.

## **SECTION 103**

### **AWARD AND EXECUTION OF CONTRACT**

**103.01 Consideration of Proposals.** After the proposals are opened and read, they will be compared on the basis of the bid total, which is the summation of the products obtained by multiplying the approximate quantities shown in the Proposal by the unit bid prices. Errors found in the bidder's extensions will be corrected before release of the final summation. The results of such comparisons will be immediately available to the public.

The right is reserved to reject any or all proposals, to waive technicalities, or to advertise for new proposals, if in the judgement of the Commission the best interest of the Department will be promoted thereby.

**103.02 Award of Contract.** Award of the Contract, if awarded, will be made within 40 calendar days after the opening of the proposals or, in the case of contracts having conditional award status, after any conditional award status is lifted, to the lowest responsive and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified by letter of the bid acceptance and of the award of the Contract.

In instances where licensing with the Contractors Licensing Board is not a prerequisite to bidding, an unlicensed successful bidder will be allowed a maximum of 30 calendar days after the written notice of award in which to file for a license. In the event the bidder does not become licensed within 90 calendar days after the written notice of award, the bid may be rejected and the proposal guaranty forfeited.

"Conditional award status", as used herein, means the situation during which, subsequent to bid opening and before execution of Contract, a bidder has been formally advised to comply with one or more bidding requirements, or the Department is obtaining concurrences.

**103.03 Cancellation of Award.** The Commission reserves the right to cancel the award of any contract at any time before the

execution of said contract by all parties without any liability against the Commission.

**103.04 Return of Proposal Guaranty.** All proposal guaranties in the form of checks, except those of the two lowest bidders, will be returned immediately following the opening and verification of the proposals. The retained proposal guaranties of the two lowest bidders will be returned after the Contract has been executed.

All bid bonds will be retained in the files of the Department.

**103.05 Requirement of Performance Bonds, Payment Bonds, and Liability Insurance. (a) Bonds.** At the time of execution of the Contract, the successful bidder shall furnish a surety Performance bond or bonds in a sum equal to the full amount of the Contract and a surety Payment bond or bonds in a sum equal to 80% of the full amount of the Contract. The form of the bonds as well as the surety shall be acceptable to the Department. The Statutory Payment and the Statutory Performance Bonds furnished with the Contract shall be executed by a Resident Agent or Nonresident Agent. The Resident or Nonresident Agent shall be licensed by the Insurance Commissioner of the State of Arkansas to represent the surety company executing the bond. A Power of Attorney supporting the Resident or Nonresident Agent's signature shall be furnished with each bond. The bond number used by the Surety must also be recorded in the space provided on each bond.

The Resident or Nonresident Agent will be responsible for advising the Department, by Certified Mail -- Return Receipt Requested, of any indication that the Surety is experiencing difficulty that may affect its ability to perform. Failure of the Resident or Nonresident Agent to do so may be just cause to reject any or all future bonds from that individual/agency.

Suits concerning the payment or performance bond shall be filed in the State of Arkansas; and the Department and the Commission shall be entitled to the sovereign immunity from suit afforded by the Constitution of Arkansas and laws of the State of Arkansas.

The Department reserves the right to refuse bonds from sureties with a record of unsatisfactory performance under previously accepted bonds.

**(b) Liability Insurance.** The Contractor shall procure and maintain at its own sole cost and expense, until acceptance of the project by the Engineer, General Public Liability Insurance providing bodily injury, including death, personal injury, and property damage coverage with a limit of at least \$1,000,000 per occurrence and a general aggregate limit of at least \$2,000,000. Each such policy shall be endorsed to include broad form general liability, contractual liability, and completed operations coverage.

Before a work order is issued, the Contractor shall furnish to the Division Head, Programs & Contracts Division, evidence of the required insurance. Each policy or its declaration pages shall provide that the policy shall not be materially changed or cancelled until the Engineer has been given at least 30 calendar days advance notice in writing. If any policy is cancelled during the duration of the work, a satisfactory replacement policy must be in force, with notice and evidence of insurance to the Engineer, prior to the effective date of cancellation of the former policy.

Failure to furnish the required proof of Liability Insurance with the submission of the Contract signed by the successful bidder shall be just cause for the cancellation of the award and forfeiture of the proposal guaranty, which shall become the property of the Commission, not as a penalty, but in liquidation of damages sustained. Failure to furnish notice of cancellation or change in the policy will result in the temporary suspension of work as provided in Section 108.05. Temporary suspension shall remain in effect until proof that the required insurance is in effect is received by the Department. If no proof of insurance is received within 20 calendar days of the Suspension Order, the Engineer may proceed with written notice of default according to Section 108.08.

**103.06 Execution and Approval of Contract. (a) General.** The Contract shall be signed by the successful bidder and returned to the Division Head, Programs & Contracts Division, together with the required bonds and proof of liability insurance, within 10 business days after written notice of award has been issued. Execution of the Contract by the Department will take place as soon as practical after it has been signed and returned by the successful bidder.

**(b) Furnishing Disadvantaged Business Enterprise (DBE) Information.** For contracts having DBE goals, and where required



DBE information is not submitted with the bidder's proposal, the successful bidder shall furnish the required DBE information as specified in Subsection 103.08. If the information is furnished and the conditional award status is lifted, the Contract will be handled as stated in (a) above.

**103.07 Failure to Execute Contract. (a) General.** Failure to execute the Contract and file acceptable bonds and proof of liability insurance within 10 business days after the written notice of award has been issued to the bidder shall be just cause for the cancellation of the award and forfeiture of the proposal guaranty, which shall become the property of the Commission, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible bidder, or the work may be re-advertised and constructed under contract or otherwise, as the Commission may decide. The low bidder who fails to execute the Contract and submit acceptable bonds and proof of liability insurance will not be permitted to bid on any subsequent advertisement of that project.

**(b) Failure to Furnish DBE Information.** For contracts having DBE goals, failure to furnish the DBE information required under subsection 103.08 shall be just cause for the cancellation of the conditional award and forfeiture of the proposal guaranty. The proposal guaranty shall become property of the Commission, not as a penalty, but in liquidation of damages sustained to the DBE Program. Conditional award, re-advertisement, etc., will be handled as in (a) above.

**103.08 Disadvantaged Business Enterprise (DBE) in Highway Construction. (a) Contract Requirements.** The provisions of this subsection shall apply to all contracts administered by the Department. If there are no specific participation goals for a contract, the Contractor agrees to ensure that Disadvantaged Business Enterprises (DBEs) are provided reasonable opportunities to compete for and perform on the contract or subcontracts and shall take all necessary and reasonable steps to ensure that the policy set forth in this supplemental specification is maintained. If a Contractor on a project without a specific participation goal elects to utilize a DBE subcontractor, all payments to the DBE subcontractor must be documented in accordance with Subsection 103.08(h). If the Prime Contractor is a DBE, records must be submitted in

accordance with the above referenced section for work accomplished by their own forces.

**(b) Policy.** It is the policy of the Department to ensure nondiscrimination in the award and administration of Department contracts and to create a level playing field on which Disadvantaged Business Enterprises (DBEs) can compete fairly. Consequently, the following apply to the Contract, the DBEs listed in the Contractor's submittal required by Subsection 103.06(b) to achieve a DBE goal (either on a subcontract, purchase order, or other written agreement), the DBEs that may be added to the list later as substitutes, and DBEs performing on a contract, but not used to fulfill a portion of a DBE goal:

(1) The Contractor agrees to ensure that DBEs are provided reasonable opportunities to compete for and to perform on contracts awarded by the Department. In this regard, the Contractor shall take all necessary and reasonable steps to meet the DBE goal established in the Contract.

(2) The Contractor and any subcontractors shall not discriminate on the basis of race, color, national origin, or sex in the performance of the Contract. The Contractor shall carry out applicable requirements of 49 CFR § 26 in the award, administration and performance of contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the Department deems appropriate.

(3) After a conditional award is made and the apparent successful bidder has submitted the required DBE information, the Department will determine if the DBE requirements have been met. If those requirements are met, the conditional status will be removed and the Contract will be forwarded to the bidder for execution. If those requirements are not met, the proposal guaranty will become the property of the Commission, as specified in subsection 103.08(d).

(4) The Contractor should ensure that all DBEs performing on the Contract serve a commercially useful function. To ascertain that all obligations under contracts awarded to DBEs are met, the Department will review the Contractor's DBE involvement efforts during the performance of the Contract. No work shall be

performed by the Contractor or any subcontractor on items originally committed to or included in a subcontract (including purchase orders or other written agreements) with a DBE without prior written approval by the Department. Payments to the Contractor will be withheld or previous payments recovered by the Department in amounts equivalent to that portion of the subcontract with a DBE in which:

- a. The DBE subcontractor is found not performing a commercially useful function as defined in subsection 103.08(f)(3); or
- b. The Contractor or any subcontractor performs any portion of the work to be accomplished by a DBE without prior written approval by the Department.

Amounts that have been withheld as a result of a or b above will be retained by the Department until the Contract DBE goal is satisfied or will be withheld permanently if the Contract DBE goal is not met.

(5) The Contractor shall pay all subcontractors their respective subcontract amounts, including retainage, according to subsection 108.01. The Contractor shall inform the Department of any situation in which regularly scheduled progress payments are not made to DBE subcontractors.

Failure of the Contractor or any subcontractor to carry out the requirements set forth above shall constitute a breach of contract and, after notification by the Department, may result in withholding estimates due the Contractor, termination of the Contract by the Department, or other action as the Department deems appropriate.

**(c) Definitions.**

(1) "Disadvantaged Business Enterprise" means a for profit small business concern:

- a. which is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged, or, in the case of a corporation, at least 51 percent of the stock is owned by one or more such individuals; and
- b. whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

(2) "Small Business Concern" means, with respect to firms seeking to participate as DBEs, a small business as defined pursuant to Section 3 of the Small Business Act and Small Business Administration (SBA) regulations implementing it (13 CFR § 121), that also does not exceed the cap on average annual gross receipts allowed by Federal Regulation.

(3) "Socially and economically disadvantaged individual" means any individual who is a citizen of the United States (or lawfully admitted permanent resident) and who is found to be a socially and economically disadvantaged individual on a case-by-case basis; or any individual in the following groups, members of which are rebuttably presumed to be socially and economically disadvantaged: Black Americans, Hispanic Americans, Native Americans, Asian Pacific Americans, Subcontinent Asian Americans, Women and any additional groups whose members are designated as socially and economically disadvantaged by the SBA, at such time as the SBA designation becomes effective.

a. "Black Americans" includes persons having origins in any of the Black racial groups of Africa;

b. "Hispanic Americans" includes persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;

c. "Native Americans" includes persons who are American Indians, Eskimos, Aleuts, or Native Hawaiians;

d. "Asian Pacific Americans" includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, U.S. Trust Territories of the Pacific Islands (Republic of Palau), the Commonwealth of the Northern Marianas Islands, Macao, Fiji, Tonga, Kirbati, Juvalu, Nauru, Federated States of Micronesia, or Hong Kong;

e. "Subcontinent Asian Americans" includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka; and

f. "Women".

**(d) Bidder's Responsibilities.**

(1) On projects with a DBE goal, each bidder shall furnish, with the proposal, one of the following:

- a. The required DBE participation,
- b. Documentation of good faith efforts, or
- c. An irrevocable certification that the required DBE participation will be submitted within ten (10) business days following conditional award of the project.

If none of the items listed in (d) (1) a, b, or c is submitted, the Department will reject the bid and the proposal guaranty will be handled in accordance with Subsection 103.04.

(2) If an irrevocable certification to achieve the required DBE participation is submitted with the proposal, within ten (10) business days after conditional award of the Contract, the apparent successful bidder shall furnish the required information to the Department on a form provided by the Department. If the information is not furnished as required, the conditional award will be cancelled in accordance with Subsection 103.07(b).

(3) Information required to be submitted to document DBE participation is:

- a. The names and addresses of the AHTD-certified DBE subcontractors to be used to satisfy the percentage goal;
- b. An itemized description of the work each DBE subcontractor is to perform;
- c. The dollar value of each item to be included in the DBE subcontract;
- d. Written documentation of the bidder's commitment to use a DBE subcontractor whose participation it submits to meet a contract goal; and
- e. Written confirmation from the DBE that it is participating in the contract as provided in the Contractor's commitment.

(4) An apparent successful bidder who cannot meet the percentage goals shall document and submit with the proposal the

steps taken to obtain the required DBE participation. Only those efforts made by the bidder to obtain DBE participation prior to the letting will be considered in the evaluation of good faith efforts. Good faith efforts to meet DBE goals would include such items as, but not limited to, the following:

**a.** Soliciting through all reasonable and available means (e.g., attendance at a pre-bid meeting, if any, advertising and/or written notices) the interest of all certified DBEs who have the capability to perform the work of the contract. The bidder must solicit this interest at least two weeks prior to the letting to allow the DBEs to respond to the solicitation. The bidder must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations;

**b.** Selecting portions of the work to be performed by DBEs to increase the likelihood of meeting DBE goals (including, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the prime contractor might otherwise prefer to perform these work items with its own forces). Selections should be made based on the current DBE directory of contractors and their specialty area/areas of work.

**c.** Providing interested DBEs with adequate information about plans, specifications, and requirements of the Contract in a timely manner to assist them in responding to a solicitation;

**d.** Negotiations.

(1) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were contacted; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work;

(2) A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable;

e. Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The Contractor's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the Contractor's efforts to meet the project goal;

f. Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the Department or Contractor;

g. Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services;

h. Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs.

(5) The preceding information shall be submitted directly to the Arkansas State Highway and Transportation Department, Programs and Contracts Division, P. O. Box 2261, Little Rock, Arkansas 72203.

**a.** The information submitted by the apparent low bidder will be reviewed by the Department to determine if the Contractor has successfully met the DBE goal or made a good faith effort to obtain DBE participation sufficient to achieve the DBE goal.

**b.** If it is determined that the goal was not met or a good faith effort was not made, the bidder will be notified and provided an opportunity for administrative reconsideration. As part of the reconsideration, the bidder may provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so. A request for administrative reconsideration must be submitted to the Chief Engineer within two business days of the Department's notification. The Chief Engineer will render a written decision on the reconsideration explaining the basis for the finding.

**(6)** Should the bidder to whom the Contract is conditionally awarded refuse, neglect, or fail to meet the DBE goals or to furnish acceptable documentation of efforts to meet these goals, the bidder will not be provided a contract for execution. If the goal is not met and the good faith efforts are found to be inadequate, the proposal will be rejected and the proposal guaranty filed with the bid will be returned to the contractor. However, if documentation of good faith effort was not submitted with the bid and DBE participation sufficient to achieve the goal is not provided within ten days, as required, the proposal will be rejected and the proposal guaranty shall become the property of the Commission, not as a penalty, but as liquidation of damages to the Department's DBE program.

**(7)** Should the Department accept a good faith effort, this determination will be made on the condition that the Contractor continue efforts throughout the life of the project to attain the DBE participation goal and to document such continued good faith efforts.

**(8)** A Contractor may not terminate a DBE firm's subcontract or purchase order without the written approval of the Department. The Contractor shall make good faith efforts to replace a DBE subcontractor with another DBE subcontractor if the original DBE subcontractor is unable or unwilling to perform



successfully. All substitutions of DBE subcontractors during Contract performance must be approved by the Department in writing, not only because it is routinely required, but also to ensure that DBE firms are provided reasonable opportunities to perform on contracts and substitute firms are eligible DBEs. A substitute DBE or the Contractor will not be allowed to commence work on those items committed or subcontracted to a DBE until satisfactory evidence of the original DBE's inability or unwillingness to perform is submitted to and approved by the Department in writing. For projects with a DBE goal, evidence of good faith efforts exerted by the Contractor must be submitted to and approved by the Department. Good faith efforts to replace a DBE subcontractor shall be directed at finding another DBE to perform at least the same amount of work (not necessarily the same work) under the contract as the DBE that was terminated, to the extent needed to meet the contract goal established for the project. (See also subsection 103.08(b)(4).)

**(9)** Requirements of this Subsection shall also apply to DBE firms bidding as the Prime Contractor on a project. In determining whether a DBE bidder has met a contract goal, the work that the DBE performs with its own forces, as well as the work performed by DBE subcontractors and suppliers will count toward the goal. DBE bidders must list on the DBE Participation Form all work to be performed with its own forces and work to be performed by DBE subcontractors, DBE suppliers, DBE manufacturers, and/or DBE non-construction services that will be utilized in achieving the goal.

**(10)** Agreements between a bidder and a DBE in which the DBE promises not to provide subcontracting quotations to other bidders are prohibited.

**(11)** The successful bidder shall designate a liaison officer who will administer the Contractor's DBE program and maintain in the home office the records and results of the contacts made with DBE subcontractors.

**(12)** Contractors are encouraged to investigate the full extent of services offered by banks owned and controlled by disadvantaged individuals.

**(e) Eligibility of DBEs.**

(1) To ensure that the Department's DBE program benefits only those firms for whom it is intended, the Department will certify or ascertain the eligibility of DBEs, and joint ventures, any of which are proposed to be used by contractors to perform subcontract work.

(2) Certification by the Department will be accomplished through the use of Schedules A, B, and C. Certification will be granted for specific types of work for which the socially and economically disadvantaged owners have the ability to control the firm.

(3) Eligibility of firms certified by the Small Business Administration under Section 8(a) of the Small Business Act or small and disadvantaged business (SDB) programs will be considered on a case-by-case basis by the Department.

(4) Contractors are encouraged to solicit DBE subcontractors wherever they may be located and, if the DBE is not certified by the Department, to encourage the DBE to submit certification forms for approval.

(5) Early submission of certification forms is encouraged, particularly for those complex situations in which a determination of eligibility may require extensive documentation and review.

(6) A Disadvantaged Business Enterprise Directory is published, maintained, and available from the Department. Firms listed in the Directory are certified at the date the Directory is printed. Additions or deletions to the Directory after that date due to certifications, decertifications, etc. are possible. The current status of firms can be ascertained by contacting the Department's DBE Program Specialist.

**(f) Determination of DBE Participation.** DBE participation shall be counted toward meeting the DBE goal according to the following:

(1) When a DBE participates in a contract, only the value of the work actually performed by the DBE for which it is certified is counted toward a DBE goal.

a. The entire amount of that portion of a contract that is performed by the DBE's own forces for which it is certified is

counted toward a goal. The cost of supplies and materials obtained by the DBE for the work of that portion of the contract, including supplies purchased or equipment leased by the DBE (except supplies and equipment the DBE subcontractor purchases or leases from the Contractor or its affiliates), is included. DBEs bidding as prime contractors must indicate all work the firm will be performing with its own forces on the DBE Participation form.

**b.** When a DBE subcontracts part of the work of its contract to another firm, the value of the subcontracted work may be counted toward DBE goals only if the DBE's subcontractor is a DBE and is certified for the types of work. Work that a DBE subcontracts to a non-DBE firm does not count toward DBE goals.

**c.** No credit will be given toward the DBE goal for any subcontracting arrangement that is contrived to artificially inflate or obtain the appearance of DBE participation. Of particular concern is the interjection of DBE middlemen or passive conduits that are inconsistent with standard industry practices or which serve no commercially useful function, and arrangements in which a DBE subcontractor is acting essentially as a broker, (e.g., DBE second-tier subcontracts between DBE subcontractors who are fulfilling project goals, and non-DBE subcontractors with contracts acknowledged by the Department on the same project). Regardless of whether an arrangement between the Contractor and a DBE represents standard industry practice, where such an arrangement erodes the ownership, control, or independence of the DBE or does not meet the commercially useful function requirement, the Contractor shall receive no credit toward the DBE goal.

**d.** The entire amount of fees or commissions charged by a DBE firm for providing a bona fide service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a contract, may be counted toward DBE goals, provided the fee is determined to be reasonable and not excessive as compared with fees customarily allowed for similar services.

(2) When a DBE performs as a participant in a joint venture, the portion of the total dollar value of the contract equal to the clearly defined portion of the work that the DBE performs with its own forces may be counted toward the goal.

(3) The Contractor may count toward the DBE goal only expenditures to DBEs that perform a commercially useful function in the work of a contract. A DBE is considered to perform a commercially useful function when it is responsible for execution of a distinct element of the work of a contract and carrying out its responsibilities by actually performing, managing, and supervising the work involved. To determine whether a DBE is performing a commercially useful function, the Department shall evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and other relevant factors.

A commercially useful function is performed when:

**a.** All employees are under direct supervision of the DBE and on the DBE's payroll. Use by a DBE of personnel from the Contractor or any subcontractor will not be permitted without prior approval by the Department.

**b.** The DBE is responsible for obtaining all equipment necessary to perform Contract work. The DBE shall negotiate and enter into equipment lease or purchase order agreements directly with the equipment source. Such lease or purchase order agreements shall have prior approval by the Department.

**c.** The DBE is responsible, with respect to materials and supplies, for negotiating price, determining quality and quantity, ordering the material, and installing (where applicable) and paying for the material itself.

If the Contractor chooses to assist a DBE firm by assuring payment for materials to be placed in the DBE's work or equipment leased by the DBE and wants to receive credit toward the DBE goal for the cost, the following procedures may be used:

- the material supplier or lessor may invoice the DBE firm and be paid by remittance from the DBE firm or
- the supplier or lessor may invoice the Contractor and DBE firm jointly and be paid by the Contractor and DBE firm utilizing a joint check from the Contractor. Such a joint checking arrangement must be in writing, either in the subcontract or a separate agreement, and approved by the Department prior to the supplies or equipment being utilized and payment being made.

No credit will be given toward the DBE goal for the cost of the DBE's required materials or equipment that the Contractor pays directly to the material supplier or lessor.

**d.** A DBE subcontractor will be deemed to have performed a commercially useful function and the Contractor will be allowed DBE goal credit when a DBE subcontractor performs at least 30 percent of its subcontract. This work shall be performed by the DBE subcontractor's normal work force.

**(4)** The following factors will be used in determining whether a DBE trucking firm or owner/operator is performing a commercially useful function:

**a.** The DBE must be responsible for the management and supervision of the entire trucking operation for the items on its subcontract or purchase order, including scheduling, providing sufficient trucks to accomplish the haul, and coordinating the work with the Contractor. There cannot be a contrived arrangement for the purpose of meeting DBE goals.

**b.** The DBE must own and operate at least one fully licensed, insured, and operational truck used on the contract when work is in progress.

**c.** The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs. The DBE will also receive credit for the total dollar value of the transportation services attributable to no more than twice the number of trucks owned by the DBE and leased from another DBE firm. Long-term lease arrangements are an acceptable form of "ownership."

d. Lease Agreements. There are two types of lease arrangements that can be utilized by DBE firms: long-term leases and short-term leases.

- (1) Long-term lease arrangements. The DBE may lease trucks under a long-term lease arrangement from independent equipment leasing companies. To be an independent equipment leasing company, the company must lease equipment to the public. A long term lease is defined as a twelve month or longer lease period. The drivers, fuel, minor maintenance responsibility, and full control of the leased trucks must rest solely with the DBE owner as stipulated in the lease agreement. Drivers must be employees of the DBE, subject to withholding, worker's compensation requirements, unemployment, etc. Leased trucks must display the name and identification number of the DBE. The DBE will receive full credit for the full value of the transportation services provided by trucks leased and operated in this manner. A DBE supplier (regular dealer) must utilize this type of lease to supplement distribution equipment owned by the firm to receive credit for transportation services.
- (2) Short-term lease arrangements.
  - a). The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.
  - b). The DBE may also lease trucks from a non-DBE firm, or owner-operator. Credit for the total value of the non-DBE firm or owner-operator trucks transportation services will be credited to the DBE so long as the number of non-DBE firm or owner-operator trucks does not exceed the number of trucks owned by the DBE or leased from other DBE firms. For trucks leased by the DBE in excess of the total number of owned or leased DBE trucks, the DBE is entitled to receive credit only for the fee

or commission it receives as a result of the lease arrangements for the excess trucks.

All lease agreements must indicate that the DBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. A copy of each lease agreement must be provided to and approved by the Resident Engineer before the truck begins hauling. The agreement must reflect the name of the lessor, cab card registration numbers of all leased trucks, the description of the truck(s), the amount and terms of the lease and method of payment (hour, ton, cubic yard, or number of loads hauled), and, if owner-operator, his/her Social Security Number.

e. The DBE must certify each estimate period the amounts paid to: (1) other DBE truckers, (2) non-DBE truckers, and (3) for hauls made with trucks owned by the firm. This certification must be made on the form provided by the Department.

(5) When a DBE is found not to be performing a commercially useful function, the DBE may present evidence to rebut the finding. Such evidence will be reviewed by the Department and a determination made. Decisions on commercially useful function matters are subject to review by the Federal Highway Administration for projects receiving federal funds.

(6) The Contractor may count toward the DBE goal 60 percent of expenditures for materials and supplies required under a Contract and obtained from a DBE regular dealer, and 100 percent of such expenditures to a DBE manufacturer.

a. For purposes of this Section, a manufacturer is a firm that operates or maintains a factory or establishment that produces on the premises the materials, supplies, articles or equipment required under the contract for incorporation into the work, and of the general character described by the specifications.

b. For purposes of this Section, a supplier or regular dealer is a firm that owns, operates, or maintains a store, warehouse,

or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract for incorporation into the work are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. To be a supplier, the firm must be an established, regular business that engages in, as its principal business and under its own name, the purchase and sale or lease of the products in question. A trucking firm or owner/operator will not be considered a supplier, nor will a supplier be considered a trucking firm.

A regular dealer in such bulk items as steel, cement, gravel, or stone, must own or lease, and operate, a pit, quarry, concrete plant, or other such facility that sells materials to the public. A person may be a regular dealer in petroleum products or asphalt binder without owning, operating, or maintaining a place of business, where these items are bought, kept in stock, and regularly sold to the public, if the person both owns and operates distribution equipment for the products. Any supplementing of regular dealers' own distribution equipment shall be by a long-term lease agreement and not on an ad hoc or contract-by-contract basis.

**c.** Expenditures for lease of a particular piece or pieces of equipment from DBEs for exclusive use on the project for which DBE participation is to be claimed may be counted 60 percent toward contract goals, provided the DBE dealer actually has ownership or control of the equipment and is considered a regular dealer.

**d.** Capital expenditures for tools, equipment, vehicles, field office furniture, and similar property items, even though such items are used on the project and purchased from DBEs, are not creditable toward contract DBE goals.

**e.** Expenditures for materials and supplies obtained from DBE suppliers and manufacturers for use in the Contractor's general operations which are not incorporated into the work are not creditable in whole or part toward contract goals, even though a portion of such items may be used in the administration and/or execution of a project.



(7) Brokers, manufacturer's representatives, packagers, or other persons who arrange or expedite transactions are not regular dealers within the meaning of this section.

With respect to materials or supplies purchased from a DBE which is neither a manufacturer nor regular dealer, the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site, can be counted toward DBE goals, provided the fees are determined to be reasonable and not excessive as compared with fees customarily allowed for similar services. None of the cost of the materials and supplies themselves will count toward DBE goals.

(8) In order for a firm to qualify as a DBE supplier of metal and/or concrete pipe, the firm must fabricate the pipe.

(9) If material is purchased from a DBE supplier, credit will be allowed at 60% of the total cost of the material obtained from the DBE facility and the cost of delivery if the supplier is transporting the material using equipment it owns or leases on a long-term basis. Credit for 100% of transportation services provided by the DBE truckers will be allowed.

(10) A valid purchase order for the material must be executed by the contractor and DBE and approved by the Department prior to the material being hauled from the facility.

(11) The Contractor may count toward the DBE goal only those payments made to DBEs for work or services performed or material furnished after the DBE has been approved, either on the list in the Contractor's original participation submittal or later as a substitute. The Department must have acknowledged a subcontract or purchase order prior to the beginning of work by the DBE firm. Payments made to a DBE for work, services, or materials performed or furnished prior to approval and acknowledgment will not be counted toward the DBE goal.

**(g) Subcontract Eligibility.** On Federal-Aid projects, the provisions of Arkansas Act 936 of 1989, concerning the listing of unlicensed subcontractors, do not apply. However, the proposed DBE subcontractor shall meet all requirements of applicable

Arkansas law (including licensing) prior to subcontract approval by the Department.

**(h) Certificate of Payment to DBEs/Non-DBEs.** Certification of payments to DBE subcontractors, suppliers, manufacturers, and/or non-construction services must be submitted by the Contractor each estimate period utilizing the forms provided by the Resident Engineer. A payment certification is also required when a non-DBE subcontractor subcontracts a portion of its work to a DBE firm or a DBE subcontractor subcontracts to another firm (DBE or non-DBE). In this case, the subcontractor shall complete the proper form and submit it through the Contractor. In lieu of using these forms, contractors may submit a copy of subcontractor pay estimates provided the required information and certification are included. This information will be submitted to the Resident Engineer for review and compilation. Only those payments reported will be credited toward the DBE goal. Failure to submit the reports within thirty calendar days after the end of the estimate period may result in contract sanctions, including withholding of progress payments.

In addition, a final certificate of payment to DBEs shall be submitted to the Resident Engineer who will attach it to the original copy of the final estimate for payment. This requirement applies regardless of whether a DBE goal had been established for the project.

**(i) Cooperation.** All participants in the Department's DBE program, including, but not limited to, DBE firms and applicants for DBE certification, and Contractors using DBE firms to meet contract goals, are required to cooperate fully and promptly with U. S. Department of Transportation or Department compliance reviews, certification reviews, investigations, and other requests for information. Failure to do so shall be a ground for appropriate action against the party involved (e.g., with respect to DBE firms, denial of certification or removal of eligibility and/or suspension and debarment; with respect to a Contractor using DBE firms to meet goals, withholding of progress estimates, findings of non-responsibility for future contracts and/or suspension and debarment).

**(j) Intimidation and retaliation.** All participants in the DBE program, including but not limited to the Department and contractors, must not intimidate, threaten, coerce, or discriminate

against any individual or firm for the purpose of interfering with any right or privilege secured by 49 CFR § 26 or because the individual or firm has made a complaint, testified, assisted, or participated in any manner in an investigation, proceeding, or hearing.

## **SECTION 104 SCOPE OF WORK**

**104.01 Intent of Contract.** The intent of the Contract is to provide for the construction and completion in every detail of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work according to the plans, specifications, and terms of the Contract.

**104.02 Alteration of Plans or Character of Work. (a) General.** The Commission shall have the right to increase or decrease the extent of the work or to change the location, gradient, or the dimensions of any part of the work, provided that the length of the improvement is not increased or decreased in excess of 25% of the contract length, or that the quantities of work to be done or the materials to be furnished are not increased or decreased in money value in excess of 25% of the total Contract. Such changes shall not be considered as a waiver of any conditions of the Contract nor invalidate any of the provisions thereof. The Contractor shall perform the work as increased or decreased within the qualifying limits named and no allowance will be made for anticipated profits on increases or decreases so incurred.

**(b) Significant Changes in the Character of Work.** The Engineer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the Contract nor release the Surety, and the Contractor agrees to perform the work as altered.

If the alterations or changes in quantities significantly change the character of the work under the Contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be agreed upon prior to the

performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Engineer may determine to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the work to be performed under the Contract, the altered work will be paid for as provided elsewhere in the Contract.

The term "significant change" shall be construed to apply only to the following circumstances:

- When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or
- When a major item of work is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any adjustment due to an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

A major item of work is defined as any bid item for which the original contract value is more than 10 percent of the total original contract value.

**(c) Differing Site Conditions.** During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the Contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the Contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

Upon written notification, the Engineer will investigate the conditions. If the Engineer determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the Contract, an adjustment, excluding loss of anticipated profits, will be made and the Contract

modified in writing accordingly. The Engineer will notify the Contractor of the determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment that results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

No Contract adjustment will be allowed under this clause for any effects caused on unchanged work.

**104.03 If and Where Directed Items.** The plans and the proposal may specify one or more items to be incorporated into the project "if and where directed" by the Engineer. The Engineer shall have sole discretion in determining whether and to what extent such items will be incorporated into the project. The Engineer may order incorporation of such items at any location within the project and at any time during the work. These items may or may not be located on the plans. The estimated quantities set out in the proposal for such items are presented solely for the purpose of obtaining a representative bid price. The actual quantities employed may be only a fraction of, or many times the estimated quantities. The Contractor shall make no claim for additional compensation because of any increase, decrease, or elimination of such items.

**104.04 Extra Work.** The Contractor, when directed, shall perform unforeseen work for which there is no quantity and price included in the Contract, or where increases or decreases in quantities are made in excess of the amounts set out in subsection 104.02, or whenever it is deemed necessary or desirable to further complete the work as contemplated. Such extra work shall be performed according to the specifications and as directed. However, before payment for any extra work is made, a Supplemental Agreement shall be signed by both contracting parties, or a written order procured from the Engineer directing the Contractor to do the work on a Force Account basis as provided in subsection 109.04.

**104.05 Maintaining Traffic.** Unless otherwise provided, the road, while undergoing improvements, shall be kept open by the Contractor to all traffic. When so provided on the plans, the Contractor may bypass traffic over an approved detour route. The Contractor shall keep the portion of the project being used by public

traffic, whether it is through or local traffic, in such condition that will permit the safe, continuous flow of two-way traffic at all times. When a part of the plans or when approved by the Engineer, areas where the nature of the work restricts or prohibits two-way flow, one-way operation may be maintained by using flaggers or timed signalization. The Contractor shall also provide and maintain in a safe condition temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, residences, garages, farms, etc. The Contractor shall bear all expense of maintaining traffic over the section of road undergoing improvement, and of constructing and maintaining such approaches, crossings, intersections, and other features as may be necessary, without direct compensation, unless a pay item for this work is included in the Contract.

The Contractor is not responsible for general snow and ice removal. Snow and ice removal will be performed by State, County, or City forces, consistent with its snow and ice removal procedures, for the entire length of the route within which the project is located. Work required other than the normal blading of snow and ice, salting, or application of grit, necessary to clear or make passable the main roadway, shall be accomplished by the Contractor.

**104.06 Rights in and Use of Materials Found on the Work.**

The Contractor, with the approval of the Engineer, may use on the project such stone, gravel, sand, or other material, determined suitable by the Engineer, as may be found in the planned excavation and will be paid both for the excavation of such materials at the corresponding contract unit price and for the pay item for which the excavated material is used. However, the Contractor shall replace with other acceptable material at no cost to the Department all of that portion of the excavation material so removed and used that was needed for use in the embankments, backfills, approaches, or otherwise. No charge for the material so used will be made against the Contractor. The Contractor shall not excavate or remove any material from within the highway location that is not within the grading limits, as indicated by the slope and grade lines, without written authorization from the Engineer. When topsoil is stripped from within the project limits, measurement and payment for earthwork and the topsoil will be according to Sections 210 and 628. Planned excavation, for the purposes of this subsection, is defined as

all excavation, including structural excavation-roadway, shown on the plans and/or as changed by the Engineer for any purpose other than obtaining additional material lying within the planned typical sections and slopes. Planned excavation also includes any excavation made beyond the ends of the project for the purpose of blending the new construction into the existing roadway.

When the material found in the planned excavation is used as Borrow, payment will be made for either: 1) the appropriate classification of excavation; or 2) Borrow, whichever results in the lesser cost to the Department. In no case will payment be made for the same material for both excavation and borrow.

Unless otherwise provided, any material from any existing structures designated salvageable that is to remain the property of the owner, may be used temporarily by the Contractor in the erection of the new structure. Such material shall not be cut or otherwise damaged. Material thus used and subsequently cut or damaged by the Contractor's action or inaction shall be replaced in kind with new material of like dimension at no cost to the Department.

**104.07 Final Cleaning Up.** Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the right-of-way, from any temporary plant sites, and from any temporary equipment and material storage sites, all construction equipment, falsework, discarded material, rubbish, debris, temporary structures, footings, and all surplus material. For surplus merchantable aggregates, and upon written request of the property owner, the Engineer may authorize the Contractor to neatly spread or stockpile the aggregates on the temporary plant sites or material storage sites. The Contractor shall restore in an acceptable manner all property, both public and private, that has been damaged during the prosecution of the work and shall leave the waterways unobstructed and the roadway in a neat and presentable condition throughout the length of the work under contract. General mowing of the right-of-way will not be required of the Contractor. However, any isolated areas of excessively high vegetation existing within the project limits, such as at side roads and drives, which restrict or impair vehicular sight distance, shall be cut or mowed by the Contractor any time the situation develops.

Final cleanup of temporary plant sites, equipment and material storage sites, waste areas, and the accompanying access roads shall

be completed according to subsection 110.04 at no cost to the Department.

Material pits and quarries shall be completed according to subsection 106.02 at no cost to the Department.

The materials, labor, equipment, and expense of the final cleaning up of a project will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items in the Contract.

## **SECTION 105 CONTROL OF WORK**

**105.01 Authority of the Engineer.** The Engineer will decide all questions that may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions that may arise as to the interpretation of the plans and specifications; and all questions as to the acceptable fulfillment of the Contract by the Contractor.

The Engineer will have the authority to suspend the work wholly or in part due to the failure of the Contractor to correct conditions unsafe for the workers or the general public; for failure to carry out provisions of the Contract; for failure to carry out orders; for such periods as deemed necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work; or for any other condition or reason deemed to be in the public interest.

Any unresolved disputes arising under the Contract shall be submitted by the Contractor in writing to the Department's Resident Engineer. Disputes claiming additional compensation shall contain the information set forth in Subsection 105.18(a) and (b). The Resident Engineer shall render a written decision within 60 calendar days of receipt of the Contractor's letter and information.

Should a dispute not be resolved by the written decision of the Resident Engineer, subsequent appeal by the Contractor shall be submitted in writing within 60 calendar days of the decision of the Resident Engineer, and shall be addressed directly to the Chief Engineer.



The Chief Engineer shall render a decision on the matter in writing to the Contractor within 60 calendar days after receipt of the Contractor's written request for dispute resolution. The ruling by the Chief Engineer shall be final and conclusive unless, within 180 calendar days from the date of issuance of the Chief Engineer's decision, the Contractor files a claim with the Arkansas State Claims Commission appealing the decision of the Chief Engineer. In connection with any appeal proceeding under this clause, the Contractor shall be afforded an opportunity to be heard and offer evidence in support of an appeal before the Arkansas State Claims Commission, subject to the rules and regulations of the Claims Commission and Ark. Code Ann. § 19-10-302 which require pursuit and exhaustion of all remedies against responsible third parties and insurance coverages. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract and in accordance with the Chief Engineer's decision.

**105.02 Automatically Controlled Equipment.** Whenever a breakdown or malfunction of the automatic controls occurs on scales, scale printers, batch plants, or mixing plants, the equipment may be operated manually or by other methods for a period not to exceed two working days, provided that such alternate methods of operation produce results otherwise meeting the specifications.

**105.03 Plans and Working Drawings.** Plans will show lines, grades, details of all structures, typical cross sections of the roadway, and a summary of items appearing on the proposal.

Work may be provided for on the plans that is not located within the limits of the project as shown on the plan sheets. Work of this nature may include but is not limited to removal of existing items, obliteration, grading, base and surfacing, transitions, etc., and is considered a part of the project.

The plans will be supplemented by such working drawings as are necessary to adequately control the work. Working drawings for structures shall be furnished by the Contractor and shall consist of such detailed plans as may be required to adequately control the work and are not included on the plans furnished by the Department. They shall include stress sheets, shop drawings, erection plans, falsework plans, cofferdam plans, or any other supplementary plans or similar data required of the Contractor. All working drawings

shall be submitted to the Engineer for informational and record purposes or for approval as specified for the item of work involved. The Contractor should anticipate a review period of 15 - 30 calendar days from receipt by the Engineer of working drawings. Approval shall not relieve the Contractor of any responsibility under the Contract for the successful completion of the work.

The Contract price shall include the cost of furnishing all working drawings.

**105.04 Conformity with Plans and Specifications.** All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown on the plans or indicated in the specifications.

Unless otherwise specified, in the event the materials or the finished product in which the materials are used is not within reasonably close conformity with the plans and specifications but reasonably acceptable work has been produced, the Engineer shall then determine if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by change order that will provide for an appropriate adjustment in the contract cost for such work or materials as deemed necessary to conform to the determination based on engineering judgement.

In the event the materials or the finished product in which the materials are used or the work performed is found not to be in reasonably close conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected at no cost to the Department.

**105.05 Coordination of Plans, Specifications, Supplemental Specifications, and Special Provisions.** These specifications, the supplemental specifications, the plans, special provisions, and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy:

- Shown or computed dimensions will govern over scaled dimensions;

- Special provisions will govern over plans, supplemental specifications, and standard specifications;
- Plans will govern over supplemental specifications and standard specifications;
- Supplemental specifications will govern over standard specifications.

Neither the Contractor nor the Department shall take advantage of any apparent error or omission on the plans or in the proposal, Contract, or specifications. The party discovering such error or omission shall notify the other party when the discovery is made. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

**105.06 Cooperation by Contractor.** The Contractor will be supplied with a minimum of two sets of approved plans and Contracts, one set of which shall be kept available on the project at all times.

The Contractor shall give the work the attention necessary to facilitate the progress thereof and shall cooperate fully with the Engineer, inspectors, and other Contractors. Failure to cooperate may result in default according to Subsection 108.08.

The Contractor shall furnish an agent who is a competent superintendent or supervisor who is on the project while work is being performed and accessible to the Engineer during all hours of each workday. The agent shall be capable of reading and fully understanding the plans and specifications and thoroughly experienced in the type of work being performed. The superintendent shall receive instructions from the Engineer and shall have full authority to execute orders or directions of the Engineer without delay and to promptly supply such materials, labor, equipment, tools, and incidentals as may be required. Such superintendent shall be furnished regardless of the amount of work sublet.

**105.07 Cooperation with Utilities.** In general, the Contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner, and others that are to be relocated or adjusted by the Contractor. The Department will notify all known utility companies, all known pipe line owners, or other known parties affected, and endeavor to have all necessary adjustments of

the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction made as soon as practicable.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals, and all other utility appurtenances within the limits of the proposed construction that are to be relocated or adjusted are to be moved by the owners, except as otherwise provided for in the Special Provisions or as noted on the plans.

The Contractor shall consider in the bid all of the permanent and temporary utility facilities and appurtenances in their present, relocated, or proposed positions. No additional monetary compensation will be allowed for any delays, inconveniences, or damages sustained due to any interference from the utilities or appurtenances or from the operations of relocating them. Assessment of time charges shall be in accordance with Subsection 108.06.

**105.08 Coordination and Cooperation Between Contractors.**

The Department reserves the right at any time to contract for and perform other or additional work on or near the work covered by the Contract.

When separate contracts are let adjacent to or within the limits of any one project, the work of each Contractor shall be conducted so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other.

It is understood and agreed that the Contractor considered, in the bid, the status of the existing Contract or Contracts at the time of bidding and will arrange to coordinate and schedule the work jointly with the other affected Contractors in order to complete the work within the time allowed in the Contract.

Contractors involved shall assume all liability, financial or otherwise, in connection with their own Contracts and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

Contractors shall arrange their work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project, and shall join their work with that of the others in an acceptable manner, and shall perform it in proper sequence with that of the others.

**105.09 Construction Stakes, Lines, and Grades.** When Section 635, Roadway Construction Control, and/or Section 636, Bridge Construction Control is not included in the Contract, the Engineer will set construction stakes establishing lines, slopes, and profile grade in road work, and line and grade for bridge work, culvert work, protective and accessory structures and appurtenances as may be deemed necessary, and will furnish the Contractor with all necessary information relating to lines, slopes, and grades. The Department will be responsible for the accuracy of all stakes or marks set by the Department to establish the planned lines, slopes, and grades. These stakes and marks shall constitute the field control with which the Contractor shall be responsible for accurately establishing other necessary controls and performing the work.

The Contractor will be held responsible for the preservation of all stakes and marks. If any of the construction stakes or marks are carelessly or willfully destroyed or disturbed by the Contractor, the cost of replacing them will be deducted from the payment for the work.

Before beginning work, the Contractor must be satisfied as to the correctness and meaning of all stakes, measurements, and marks. No claim will be entertained as a result of alleged inaccuracies unless the Contractor notifies the Engineer thereof in writing in time for the Engineer to verify or check such stakes or marks before the work is begun.

All construction control markings made for layout work, placement of traffic control devices, spotting for placement of pavement markings, or for any other purposes on structures, curb and gutters, pavements, or any surfaces that will not either be removed or covered by succeeding pavement layers or other construction shall be made with non-permanent materials (chalk, keel, non-permanent paint, etc.). Failure to comply with this requirement will result in removal of the markings by the Contractor at no expense to the Department.

**105.10 Authority and Duties of Resident Engineer.** As the direct representative of the Engineer, the Resident Engineer has immediate charge of the engineering details of each construction project; is responsible for the general administration of the project; and has the authority to reject unacceptable material or work and to suspend any work that is being improperly performed.

**105.11 Duties of the Resident Engineer's Personnel.** Inspection personnel will be authorized to inspect all work performed and all materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. The inspection personnel will not be authorized to alter or waive the provisions of the Contract and will not be authorized to issue instructions contrary to the plans and specifications, or to act as supervisor for the Contractor. The inspection personnel shall, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

**105.12 Inspection of Work.** The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is necessary to make a complete and detailed inspection.

When requested by the Engineer at any time before acceptance of the work, the Contractor shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering or removing and the replacing of the covering or making good of the parts removed will be paid for as extra work. Should the work so exposed or examined prove unacceptable, the uncovering or removing and the replacing of the covering or making good of the parts removed will be at no cost to the Department.

Any work performed or materials used without inspection by an authorized Department representative may be ordered removed and replaced at no cost to the Department.

When any unit of government, political subdivision, railroad corporation, or other agency is to pay a portion of the cost of the work covered by the Contract, its respective representatives shall

have the right to inspect the work. Such inspection shall in no sense make any unit of government, political subdivision, railroad corporation, or other agency a party to the Contract, and shall in no way interfere with the rights of either party thereunder.

**105.13 Removal of Unacceptable or Unauthorized Work.** All work that does not comply with the requirements of the Contract will be considered unacceptable, unless otherwise determined acceptable under the provisions of Subsection 105.04.

Unacceptable work, whether the result of poor workmanship, use of unacceptable materials, damage through carelessness, negligence, or any other cause, found to exist before the final acceptance of the work, shall be removed and replaced in an acceptable manner at no cost to the Department.

Unless otherwise provided, no work shall be done without lines and grades having been established. Work performed contrary to any instructions of the Engineer; work performed beyond the lines shown on the plans or as established, except as herein specified; or any extra work performed without authority will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so performed may be ordered removed or replaced at no cost to the Department.

Should the Contractor fail to comply with any order of the Engineer, the Engineer will have the authority to cause unauthorized work to be removed and unacceptable work to be corrected or removed and replaced and to deduct the costs from any moneys due or to become due the Contractor.

**105.14 Load Restrictions.** The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads being maintained for the traveling public. A special permit will not relieve the Contractor of liability for damage that may result from construction equipment operations. The operation of equipment of such weight or so loaded as to cause damage to structures or the roadway or to any other type of construction will not be permitted.

The Contractor shall submit to the Engineer, for information and record purposes, an engineering analysis evaluating the structural adequacy of a bridge for any of the following to cross the structure or be placed on the structure:

(a) For bridges to be constructed as part of the Contract:

(1) Vehicle(s) or equipment that exceeds the legal load.

(2) Off-road equipment or off-road vehicles that exceed 20,000 pounds.

(3) Stockpiled material exceeding 75 pounds/square foot based on a uniform distribution of load. Loads that are non-uniform in nature shall be uniformly distributed to the bridge deck by the use of timbers or other means approved by the Engineer. The total area of stockpiled material within a span shall not exceed 600 square feet.

(b) For existing bridges that will be used by the traveling public during or after the Contract or if the plans include salvage requirements by the Owner:

(1) Vehicle(s) or equipment that exceeds the legal load or posted weight restrictions.

(2) Off-road equipment or off-road vehicles that exceed the lesser of 20,000 pounds or 75% of the least posted weight restrictions.

(3) Stockpiled material.

The engineering analysis shall be consistent with the design specifications, if known, that were used to design the bridge and shall be prepared by an Arkansas Professional Engineer who shall certify the adequacy of all components of the bridge for the anticipated loads. The certification shall include a detailed list of any restrictions of the vehicles, equipment, and loads. Sufficient supporting calculations and documentation shall be included in the engineering analysis. Unequal distribution of weight due to the vehicle or equipment's use shall be considered, such as a crane being used to lift material. Considerations shall also be given to loads placed on partially completed bridge decks and the possible detrimental effects to the beam's profile within the deck area that has not yet been constructed.

Equipment and vehicle literature detailing the axle loads and configuration, spacing and length of tracks, operating weights, and other relevant data along with a summary of assumptions, restrictions, and limitations shall be included with the engineering



analysis. A diagram detailing the location, extent of span area, and weight shall also be included for stockpiled material exceeding the weight limitations shown above. The engineering analysis shall consider independent and simultaneous arrangement of the vehicles in single or repeated crossings and any temporary barriers, material, and equipment utilized in construction operations.

For use in the engineering analysis of existing bridges, inspection records and design drawings, if available, may be requested from the Programs and Contracts Division during the advertisement period or from the Engineer after award of the Contract. The inspection records shall be used to determine the loss of load carrying capacity of a bridge element due to any deterioration or additional loads that are subsequent to the bridge's original construction.

Bridge decks constructed as part of the Contract or the deck of an existing bridge that is used or will be used by the traveling public shall be temporarily protected as approved by the Engineer from any vehicles, equipment, or material that would damage the bridge deck. When hauling materials over the base or surface courses under construction, the Contractor shall limit the hauling as necessary to prevent damage. No loads will be permitted on bases, pavements, or structures before the expiration of the specified curing period controlling such operations.

The Contractor shall be responsible for all damage resulting from construction operations.

The City, County, or Department may restrict the load limit on any route under their jurisdiction at any time.

Compliance with this specification will not be paid for separately, but full compensation thereof will be considered included in the Contract unit prices.

**105.15 Maintenance During Construction.** The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces, to the end that the roadway or structures are kept in satisfactory condition at all times.

In the case of a Contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

The Contractor shall be responsible for the maintenance of existing drainage ditches and channels within the right-of-way limits, including construction easements if any, from the date any work is begun on the project to the date of its final acceptance. This is not a requirement that the Contractor improve existing drainage ditches and channels, except as shown on the plans or as directed by the Engineer. The Contractor shall maintain the waterways in such condition that damage to the work or to abutting property will not result from the Contractor's operation. Obstruction of natural flow in waterways by stockpiling or storing materials, or by placement of equipment or supplies without provision for adequate by-passing of such natural flow, will not be permitted. Collections of sediment or debris that prohibits or inhibits normal function of drainage facilities shall be removed promptly.

All costs of maintenance work during construction and before the project is accepted will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items in the Contract.

**105.16 Failure to Maintain Roadway or Structure.** If the Contractor, at any time, fails to comply with the provisions of subsection 105.15, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project and the entire cost of this maintenance will be deducted from moneys due or to become due the Contractor on the Contract.

**105.17 Acceptance. (a) Partial Acceptance.** The Engineer may accept units or substantially completed portions of a project when it is in the best interest of the Department. Partial acceptance will generally be made on stage construction projects where the partial acceptance of a portion of the project will allow an early issuance of a work order on a contract located within the limits of the first contract. Such partial acceptance shall in no way void or alter any of the terms of the Contract.

Devices intended to be used for traffic safety and control, which are permanently installed in their final position and being used by the traveling public, will be accepted when installed according to the plans and specifications before completion of the remaining work on the project. Permanently installed items accepted on this basis are limited to guardrail, impact attenuation barriers, traffic signal items, signs, delineators, lighting, raised pavement markers, concrete barrier wall, concrete bridge parapet, bridge railings, guard cable, crash cushions, permanent pavement markings, and fence. Any required performance tests and/or guarantees shall remain applicable.

The Contractor shall erect these items in a logical sequence and time frame within the life of the project and any of these items constructed prematurely will not be accepted until such time in the life of the project that the device becomes effective for its intended use.

Damage, theft, or vandalism to these items after acceptance will be repaired and/or replaced by the Department, or by the Contractor at the applicable contract unit price. When the damage to an item is such that only partial repair or replacement is required and the work is to be done by the Contractor, payment shall be made as provided in Subsection 109.04. Items damaged due to negligence of the Contractor shall be repaired and/or replaced at no cost to the Department.

The Department reserves the sole right to seek any and all recovery of repair or replacement costs from those parties responsible for damage to permanently installed items accepted according to this subsection.

**(b) Final Acceptance.** As soon as practical after completion of the entire project, including receipt of all required documentation, the Engineer will make an inspection. If all construction provided for and contemplated by the Contract is found to have been satisfactorily completed, that inspection shall constitute the final inspection and the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will advise the Contractor

of the work requiring correction. The Contractor shall immediately make the required corrections. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

**105.18 Claims for Adjustment and Disputes. (a) General.** If, in any case, the Contractor deems that additional compensation is due for work or material not clearly covered in the Contract or not ordered by the Engineer as extra work, as defined in Subsection 104.04, the Contractor shall notify the Engineer in writing of intention to make claim for such additional compensation before beginning the work on which the claim is based. If such notification is not given and the Engineer is not afforded proper time and facilities by the Contractor for keeping accurate account of the actual costs of the work, the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the Engineer has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. If the claim, after consideration by the Engineer, is found to be just and adequately supported, an adjustment will be made to the Contract. If the Contract does not contain a pay item for which the adjustment can be made, the adjustment will be made according to Subsection 109.04.

Nothing in this subsection shall be construed as establishing any claim contrary to the terms of Subsection 104.02.

All claims shall be in sufficient detail to enable the Engineer to determine the basis for entitlement and the costs incurred, excluding loss of anticipated profits, organization or overhead expenses not related directly to the project, or interest. The following information must accompany each claim:

- (1) A detailed factual statement of the claim providing all necessary dates, locations, and items of work affected by the claim.
- (2) The date actions resulting in the claim occurred or conditions resulting in the claim became evident.

(3) A copy of the "Notice of Potential Claim" filed for the specific claim.

(4) The name, title, and activity of each Department employee knowledgeable about facts that gave rise to such claim.

(5) The name, title, and activity of each Contractor or employee knowledgeable about facts that gave rise to such claim.

(6) The specific provisions of the Contract that support the claim, and a statement why such provisions support the claim.

(7) The identification of any pertinent documents, and the substance of any material oral communications relating to the claim.

(8) A statement whether the additional compensation or extension of time is based on the provisions of the Contract or an alleged breach of Contract.

(9) If an extension of time is also sought, the specific days for which it is sought and the basis for such claim.

(10) The amount of additional compensation sought and a breakdown which clearly differentiates the additional cost from the Contractor's normally anticipated costs for an item or project.

(11) Any other information or documents that may be relevant to the claim.

All claims must be submitted to the Resident Engineer within 180 calendar days after receipt of the Final Estimate. Failure to do so shall constitute a waiver of said claims.

**(b) Required Certification of Claims.** When submitting a claim, the Contractor must certify in writing, under oath according to the formalities required, as to the following:

(1) The claim is made in good faith.

(2) Supportive data are accurate and complete to the Contractor's best knowledge and belief.

(3) The amount of the claim accurately reflects the actual cost incurred by the Contractor.

**(c) Auditing of Claims.** All claims filed against the Department shall be subject to audit by the Department at any time following the

claim filing, whether the claim is part of a suit pending in the courts of this State or an action before the State Claims Commission. The audit may begin upon ten business days notice to the Contractor, subcontractor, or supplier. The Contractor, subcontractor, or supplier shall make a good faith effort to cooperate with the auditors and shall provide access to the following documents upon the request of the Chief Engineer:

- (1) Daily time sheets and foreman's daily reports.
- (2) Union agreements, if any.
- (3) Insurance, welfare, and benefits records.
- (4) Payroll register.
- (5) Earnings records.
- (6) Payroll tax returns.
- (7) Material invoices, purchase orders, and all material and supply acquisition contracts.
- (8) Material cost distribution worksheets.
- (9) Equipment records (list of company equipment, rates, etc.)
- (10) Vendor rental agreements and subcontractor invoices.
- (11) Subcontractor payment certificates.
- (12) Cancelled checks (payroll and vendors).
- (13) Project cost report.
- (14) Project payroll ledger.
- (15) General ledger, general journal (if used), and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals.
- (16) Cash disbursements journal.
- (17) Financial statements for all years reflecting the operations on this project.
- (18) Depreciation records on all company equipment.

(19) All other documents used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment.

(20) All bid preparation documents and all documents necessary to determine compensation due according to Subsection 109.04.

(21) Any other information or documents that may be relevant to the claim.

**105.19 Claims Limitations.** The Contractor acknowledges and agrees that in no event shall a claim be submitted to the Resident Engineer more than 180 calendar days after the receipt of the Final Estimate for the project and the Contractor acknowledges and agrees that any claim submitted to the Department or before the Arkansas State Claims Commission later than 180 calendar days from receipt of the Final Estimate shall be deemed waived by the Contractor.

## **SECTION 106 CONTROL OF MATERIAL**

### **106.01 Sources of Supply and Quality Requirements.**

**(a) General.** The materials used in the work shall meet all quality requirements of the Contract. To expedite the inspection and testing of materials, the Contractor shall notify the Engineer of proposed sources of materials before delivery. At the option of the Engineer, certain materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources. Materials shall be approved before being incorporated in the work.

The Contractor shall assume full responsibility for ordering materials of the quality and quantity required and for the delivered costs of such materials. Materials needed in the work shall be furnished by the Contractor unless otherwise stated in the Contract.

### **(b) Steel and Iron Items.**

**(1) General.** Steel and iron items are subject to the "Buy America" provisions of 23 CFR § 635.410, and the requirements and restrictions of this section:

Except as provided hereinafter, steel and iron materials shall not be permanently incorporated into the work unless all manufacturing processes (e.g., smelting, remelting, and any subsequent process that alters the material's physical form or changes its chemical composition) occur within the United States. This includes, but is not limited to, such processes as rolling, extruding, machining, bending, grinding, drilling, fabrication, and coating. Coating includes all processes that protect or enhance the value of the material to which the coating is applied. The use of pig iron or processed, pelletized, and reduced iron ore manufactured outside of the United States is permitted in the domestic manufacturing process for steel and/or iron materials. All steel and iron mill test reports must include a certified statement that all manufacturing processes for the iron or steel product occurred in the United States. Each manufacturer/fabricator shall provide the same certification. Each supplier shall provide certification of the transfer of intermediate products, thereby generating a chain of custody documentation. Exceptions are as follows:

**a.** These requirements do not prevent a minimal use of foreign iron or steel material if the cost of such materials used does not exceed 0.1% of the total Contract cost or \$2,500, whichever is greater. For comparison with either of these given limitations, the cost is that shown to be the value of steel products as they are delivered to the project.

**b.** These requirements do not apply when the Engineer establishes:

- That their application would be inconsistent with the public interest, or
- That such materials are not produced in the United States in sufficient and reasonably available quantities that are of a satisfactory quality.

The determination of foreign or domestic character is based on place of manufacture. The burden of proof for the place of manufacture shall rest with the Contractor. The cost of any foreign materials permanently incorporated into the work shall be documented by the Contractor and the documentation submitted to the Engineer.



**(2) Foreign Steel Option.** If the Proposal for the project contains an alternate bid system for submitting a bid for furnishing domestic structural steel for which all manufacturing processes occur in the United States and a bid for furnishing foreign structural steel, bidders are hereby advised that the Contract will be awarded to the bidder who submits the lowest total bid based on furnishing domestic structural steel unless such total bid exceeds the lowest total bid based on furnishing foreign structural steel by more than 25%.

If the bidder proposes to furnish foreign structural steel, it shall be mandatory that a bid for domestic structural steel also be submitted. If the bidder proposes to furnish domestic structural steel, it will not be necessary to submit a bid for foreign structural steel.

Structural steel is hereby defined as steel sheet piling (Section 811-Sheet Piles); H-piling and shell or pipe piling (Section 805-Piling); and W, M, S, or Z shapes, plates, channels, angles, and/or T-sections (Section 807-Steel Structures).

**(3) Quality Control for Foreign Steel.** When the Contractor elects to purchase items of structural steel manufactured outside the United States, such materials shall be furnished only from those foreign manufacturers who have previously established, to the satisfaction of the Engineer, the sufficiency of ability to furnish material uniformly and consistently in conformance with the Specifications.

Proof of sufficiency must be provided to the Engineer by the Contractor and the Engineer's approval obtained before manufacture of the material is authorized. Proof may be established by 1) the Contractor providing the Engineer with a detailed written certification by an established and approved independent testing and inspection laboratory or agency showing evidence that the foreign manufacturer has previously established in-plant quality control to give assurance of their ability to furnish material uniformly and consistently in conformance with the specifications, or 2) a thorough in-plant inspection of the foreign manufacturer's facilities by the Engineer or an appointed representative. The cost of determining such sufficiency shall be borne by the Contractor.

When the Contractor elects to have items of structural steel fabricated outside the United States, the Contractor shall reimburse the Department for all costs connected with the inspection of such fabrication, including necessary expenses for the Engineer or a representative to make an in-plant inspection or to arrange for an inspection agency to handle the shop inspection.

Reimbursement for costs of determining sufficiency and inspection of fabrication shall be made by the Contractor upon receipt of detailed billing prepared by the Department.

Steel material manufactured outside the United States shall be delivered to the fabrication site where it shall be retained a sufficient period of time to permit inspection, sampling, and testing, as deemed necessary by the Engineer, before fabrication.

Before fabrication or shipment of any foreign produced structural steel items, the Contractor shall obtain all the Certified Mill Test Reports clearly identifiable to the lot of material to be shipped. These reports shall be identifiable by heat numbers and color-coding, and shall be submitted to the Engineer for complete review, analysis, and approval.

The Contractor or a designated representative shall serve as the Communication Contact for any structural steel fabricator outside the United States. All correspondence, telephone calls, and other forms of communication from the Department or its representative will be made with the Communication Contact and not with the foreign industry.

Costs involved in materials testing, shop inspection, communication, consultation, and coordination that are incurred because of the use of materials produced or fabricated outside the continental limits of the United States, shall be borne by the Contractor.

**106.02 Furnishing Materials from Borrow Areas, Pits, or Quarries.** The required materials shall be obtained from local or commercial sources.

When obtained from local sources, applicable severance taxes shall be paid by the Contractor.

Borrow areas, material pits, and quarry sites shall comply with the following requirements:

- 1) All Areas, Pits, or Quarries. In general, the nearest edge of an area, pit, or quarry shall be no closer than 300' (100 m) from the nearest right-of-way line of a State Highway, except as provided in 3) or 4) below. All slopes shall be 2:1 or flatter, except that faces of rock quarries shall be cut to a neat appearance with the overburden sloped to 2:1 or flatter.
- 2) Water Retaining Pits or Quarries. Water retaining pits or quarries will not be permitted within 300' (100 m) of the nearest right-of-way line of a State Highway.
- 3) Drained Areas, Pits, or Quarries. Areas, pits, or quarries shall comply with 1) above but with the following exceptions: a) if the material is being obtained from a site that is being excavated and contoured to conform to the terrain of the adjacent surroundings, or b) if the site is to be used as a commercial or residential building location as defined in the agreement with the property owner.
- 4) In the event that an area, pit, or quarry is closer than 300' (100 m) from the right-of-way line of a County Road or City Street, the written approval of the governing authority shall be furnished the Engineer prior to any excavation.
- 5) When sites are closer than 300' (100 m) from the right-of-way line, the slope in the area, pit, or quarry adjacent to the right-of-way shall not be steeper than that of the backslope or foreslope of the existing or planned roadway in the area of the site. All other slopes in the site shall not be steeper than 2:1, except that faces of rock quarries shall be cut to a neat appearance with the overburden sloped to 2:1 or flatter. In addition, if the floor of the site is sloped away from the right-of-way line, the slope shall not be steeper than 6:1 for a distance of 100' (30 m) from the right-of-way line.

The final quantity of material removed from each pit will be verified by the Engineer and furnished the Contractor as soon as possible after the final measurements have been made, except that no measurement will be made by the Department when Compacted Embankment is a pay item or when Borrow is specified to be paid as Plan Quantity. In such cases, the determination of the quantity of material removed from each pit shall be the responsibility of the Contractor.

The Contractor shall be responsible for resolving disputes or claims arising from the pit operations.

Natural tree screens shall be preserved during the course of construction. Haul roads will not be allowed to pass through tree screens except where absolutely necessary for access to the construction site. A temporary haul road through a tree screen shall be normal to the roadway and the cleared width shall be no more than is necessary to accomplish the work. In general, temporary haul roads will not be approved through natural tree screens at intervals closer than 500' (120 m).

All applicable work involved in furnishing borrow, pit, or quarried materials, including:

- Clearing, grubbing, stripping, and disposal of overburdens or other unsatisfactory material;
- Stockpiling and replacing topsoil;
- Loosening, excavating, and hauling;
- Screening, furnishing right-of-way, and constructing and maintaining haul roads;
- Fence moving and reconstructing;
- Confining livestock;
- Seeding and restoration, as required; and
- Complying with Section 110 and Subsection 107.10

will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items of work.

**106.03 Samples, Tests, and Cited Specifications.** All materials will be inspected, tested, and accepted as required by these specifications before incorporation in the work.

Whenever a reference is made in the specifications to the Department's *Manual of Field Sampling and Testing Procedures*, it shall mean the revision in effect on the day the advertisement for bids is dated. Copies of this manual are available from the Engineer of Materials.

Whenever a reference is made in the specifications to a Federal Specification, or to a specification or test designation of the American Association of State Highway and Transportation Officials, the American Society for Testing and Materials, or any

other recognized national organization, it shall mean the year of adoption or latest revision of the specification or test designation in effect on the day the advertisement for bids is dated. When a specific reference is made to a dated specification or test designation, the revision in effect on that date shall apply.

When requested, the Contractor shall furnish a complete certified statement of the origin, composition, and/or manufacture of materials that are to be used in the work.

**106.04 Acceptance of Materials.** All materials used in the work shall conform to the specified requirements. For the purposes of determining conformance with specifications, all limits are to be considered absolute limits, according to ASTM E-29, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications. Limits are maximums, minimums, or tolerances and shall be considered absolute limits. Observed or calculated values shall not be rounded but shall be compared directly with the limit. Any deviation, however small, outside the limit shall be considered non-complying. Reported values that are an average of two or more test values are to be rounded-off to the same number of significant digits as the individual test value even though the specification requirements are considered absolute. Test values and reported values are to be the same and are to show the same number of significant figures allowed by the accuracy of the test procedure and the equipment being used.

In the case of materials for which quality may be subject to change during handling and storage, samples may be taken at the source for informational purposes only. Sampling will be performed at the latest practicable time the Engineer deems it necessary to check compliance with specification requirements either prior to, during, or after incorporation in the work. Regardless of any compliance at that time, if there is subsequent indication of change in any material it will again be tested for compliance.

All materials used are subject to inspection and testing during preparation, placement, manipulation, and use. The Contractor will be held responsible for damage, contamination, segregation, and/or degradation caused by poor methods of stockpiling, manufacture, handling, placement, and/or by poor workmanship or negligence prior to completion and acceptance of the work.

Further, the Contractor shall be responsible for defects in accordance with Subsections 107.20 and 109.02.

All Contractor Acceptance Tests must be signed by the certified technician performing the test and submitted to the Engineer on the next business day after the test is performed. All test reports shall contain the following information, as a minimum:

- Job Number
- Date of Test
- Type of Material (i.e. ACHM Surface Course, Aggregate Base Course Cl. 5, etc.)
- Test Method
- Property being Tested (i.e. gradation, compressive strength, etc.)
- Sample Location
- Quantity Represented (Lot or Sublot size)
- Quality Control or Acceptance Test indicator
- Sequential sample number for each project
- Name, Signature, Title, and Certification number of Technician performing the test.
- Name and address of testing laboratory (if applicable)
- Pass or Fail indicator (in addition to actual numerical test results)

Examples of acceptance test report forms are found in the Department's *Manual of Field Sampling and Testing Procedures*.

**106.05 Plant Inspection.** The Engineer may undertake the inspection of materials at the source.

In the event plant inspection is undertaken the following conditions shall be met:

(a) The Engineer shall have the cooperation and assistance of the Contractor and of the producers of materials for the work.

(b) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

(c) Adequate safety measures shall be provided and maintained.

**106.06 Storage of Materials.** Materials shall be so stored as to assure the preservation of their quality and fitness for the work.

Stored materials, even though approved before storage, may again be inspected before their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right-of-way may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefor must be provided by the Contractor, and at no cost to the Department. Private property shall not be used for storage purposes without written permission of the owner or lessee, and if requested by the Engineer, copies of such written permission shall be furnished.

**106.07 Handling Materials.** All materials shall be handled in such manner as to preserve their quality and fitness for the work. Aggregates shall be transported from the storage site to the work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring so that there may be no inconsistencies in the quantities of materials intended for incorporation in the work as loaded and the quantities as actually received at the place of operations.

**106.08 Unacceptable Materials.** All materials not conforming to the requirements of the specifications at the time they are used shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work unless otherwise instructed by the Engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

**106.09 Department-Furnished Material.** The Contractor shall furnish all materials required to complete the work, except those specified to be furnished by the Department.

Material furnished by the Department will be delivered or made available to the Contractor at the points specified in the Special Provisions.

The cost of handling and placing all materials after they are delivered to the Contractor will not be paid for separately, but full compensation therefor will be considered included in the contract unit price(s) bid for the item(s) with which they are used.

The Contractor will be held responsible for all material delivered by the Department through this arrangement. Deductions will be made from any moneys due the Contractor to make good any

shortages and deficiencies, from any cause whatsoever; for any damage that may occur after such delivery; and for any demurrage charges.

**106.10 Qualified Products List.** The Department maintains a Qualified Products List (QPL). Various materials are listed on the QPL by manufacturer, supplier, and/or brand name. Specific brands, manufacturers, and/or suppliers may be added to the QPL upon request and compliance with the requirements specified for the type of material involved. Materials listed on the QPL will be accepted under the procedures specified therein. Information concerning the QPL may be obtained from the Engineer of Materials.

Products listed on the QPL must meet all the appropriate requirements of the specifications. The quality of materials listed on the QPL will be monitored by the Department through random sampling and testing.

The listing of a material on the QPL will in no way relieve the Contractor of furnishing material meeting the specification requirements. Material may be rejected if the Engineer determines that the material is contaminated and/or damaged or if products normally shipped as packaged units have been opened and partially used before delivery to the project.

The QPL does not constitute an endorsement by the Department of any product, manufacturer, or supplier, but is a listing of products that have been prequalified for use. If the Specifications designate that a material shall be one listed on the QPL or from a source listed on the QPL, the Contractor has the option of furnishing a material or using a source that is not listed provided that the material or source is shown by appropriate certifications and/or test reports to meet the requirements necessary for listing on the QPL.

For materials not listed on the QPL, if deemed appropriate, the Engineer may require and accept the manufacturer's certified analysis in lieu of sampling and testing of commercial or manufactured products.

**106.11 Contractor Acceptance Test Evaluation.** The Contractor's acceptance test results will be evaluated by the Department and will be correlated with other test results available for the same material. The Department will use all tests and witness the Contractor's sampling and testing methods as part of this



verification process in accordance with the *Manual of Field Sampling and Testing Procedures*.

If the results fail to correlate within the limits shown in the *Manual of Field Sampling and Testing Procedures* or if the witness of the sampling and testing indicates the utilization of improper procedures, the Engineer will notify the Contractor and document the finding. In such case, the Engineer reserves the right to instruct the Contractor to cease materials placement to prevent non-complying materials from being utilized. Operations may resume when, in the Engineer's judgment, sampling and testing procedures are acceptable. The Contractor will continue to be responsible for providing material meeting the applicable Specification.

The Contractor shall investigate the cause of the failure of the test results to correlate and document and report the findings to the Engineer. If the cause cannot be determined, or if the Contractor's investigation is considered unacceptable to the Engineer, the Engineer may require the material to be resampled and retested by the Contractor and the Department using the same test methods and frequencies as required by the *Manual of Field Sampling and Testing Procedures*. Acceptance of the lot will then be based on the new test results. The original test results shall not be used for acceptance.

If the test results of the resampled material fails to correlate, and the cause remains undetermined, the Engineer may elect to accept the material based upon the uncorrelated results or proceed with dispute resolution as provided in Subsection 106.12.

**106.12 Materials Dispute Resolution.** When either the Contractor or the Engineer disputes the other's acceptance test results and cannot resolve the dispute, the party disputing the results shall notify the other party in writing that the acceptance test results are in dispute. Both parties shall then review the sampling and testing procedures with a representative of the Department's Materials Division.

In the event that the test procedures are revealed as the cause of the dispute, the technicians who performed the original test for each party will split and test one sample from the disputed subplot. The Materials Division representative will observe the testing procedures of both technicians. In addition, each party will observe the other's

testing procedure. The Materials Division will prepare a report of the review findings and distribute the report to both parties for their information and action. The Contractor and the Department will respectively provide training and instruction to the technician who has performed improper testing, as identified in the Materials Division's report.

If the dispute is not resolved, the Materials Division will sample and test the material in dispute. The test results obtained by the Materials Division will govern over all previous test results. As appropriate, the Contractor or the Engineer will take corrective action.

## **SECTION 107 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC**

**107.01 Laws and Regulations to be Observed.** (a) The Contractor shall keep fully informed of all Federal and State laws, all local laws, ordinances, and regulations, and all orders and decrees of bodies or tribunals having any jurisdiction or authority which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. Further, the Contractor shall at all times observe and comply with all such laws, ordinances, regulations, quarantines, orders, and decrees; and shall protect and indemnify the State and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees.

All work pertaining to Electrical, Plumbing, and/or Building Crafts shall be performed in strict accordance with governing Federal, State, City, and Local Codes and Ordinances, with particular attention to the current editions of the Arkansas State Plumbing Code and the National Electrical Code as adopted by the National Fire Protection Association.

(b) The Contractor shall comply with applicable Federal, State, and local laws governing safety, health, and sanitation. The Contractor shall provide safeguards, safety devices, and protective

equipment and take any other action necessary to protect the life and health of employees on the project and the safety of the public and to protect property in connection with the performance of the work covered by the Contract.

**Attention is directed to Federal, State, and local laws, rules, and regulations concerning construction safety and health standards. The Contractor shall not require workers to work in surroundings or under conditions that are unsanitary or dangerous to their health or safety.**

All workers within the right-of-way who are exposed either to traffic (vehicles using the highway for travel purposes) or to construction equipment within the work area shall wear high-visibility safety apparel meeting the Performance Class 2 or 3 requirements of the current ANSI/ISEA publication entitled *American National Standard for High – Visibility Safety Apparel and Headwear*.

(c) Restrictions placed on the employment of labor or on the scale of pay for the work on a contract will be the requirements of the Fair Labor Standards Act (Federal Wage-Hour Law) of 1938, 28 USC §201 et seq., other applicable labor laws, and, when included as a part of the Special Provisions, the Department of Labor's schedule of minimum wages for the Contract. For further information regarding overtime or opinions on specific cases, contact the Office of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Little Rock, Arkansas.

The Contractor will be expected to employ Arkansas labor insofar as possible unless such preferential practice is prohibited by regulations such as for Federal Aid Contracts.

(d) If designated on the bridge layout or where the working height above the ground or water surface exceeds 25' (7.7 m) or where other conditions exist that require protection to workers against injury from falling, the Contractor shall install safety nets or life lines with safety belts. All materials and construction methods shall comply with the Occupational Safety and Health Act of 1970, 29 USC § 651 et seq., and the Safety and Health Regulations for Construction promulgated thereunder.

(e) The Contractor shall comply with Ark. Code Ann. § 2-16-101, et seq., and Title VII of USC and regulations promulgated

thereunder. These laws and regulations have been established to prevent the spread of certain plant pest species, control of pesticides, and control and eradication of Johnson grass. Pursuant to such regulations, the U.S. Department of Agriculture and the Arkansas State Plant Board have established certain domestic quarantine areas within the State of Arkansas for the purpose of preventing further infestation within and beyond these boundaries.

Soil moving equipment operating within or from regulated areas will be subject to plant quarantine regulations. In general, these regulations provide for cleaning soil from equipment before it is moved from regulated areas.

It is the Contractor's responsibility to determine from Federal or State plant pest control authorities the exact areas under control. Any list of regulated areas appearing in the proposal is furnished for information purposes only and represents the most recent information available to the Department as of the date indicated. Prospective bidders should be aware that the list of regulated areas is subject to change and they should therefore verify the exact areas under control by contacting the Plant Industry Division of the Arkansas Plant Board or the Plant Protection Program offices of the Arkansas District of the U.S. Department of Agriculture.

(f) If the release of a suspect hazardous substance has occurred, the Contractor shall notify the Engineer. This will not relieve the Contractor or responsible parties of the obligation to notify other appropriate agencies and will not relieve responsible parties of any liability.

Commonly used materials which could be potentially hazardous substances if they are spilled or enter waterbodies are: asphalt materials, concrete, cement, paint, solvents, petroleum products, fertilizers, concrete curing compound, lime, linseed oil, asphalt additives, and concrete additives. This list is not all inclusive.

Notification should be made if, at any time, there is an indication of a spill. Indicators could be:

- Leaking or empty containers, surface staining, chemical odors, vegetation damage, etc.
- Oil, grease or petrochemical substances which produce residue, coat the banks and/or bottoms of a waterbody, or produce a visible, colored film on the surface.

- Distinctly visible solids, scum, or foam of a persistent nature, or slime, bottom deposits, or sludge banks in a waterbody.

The work involved or the delay or cost incident to compliance with these regulations will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items of the Contract.

**107.02 Permits, Licenses, and Taxes.** The Contractor shall procure all permits and licenses, pay all charges, fees and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work. These costs will not be paid for directly, but will be considered included in the contract unit prices bid for the various items of the Contract.

**107.03 Patented Devices, Materials, and Processes.** Contractors employing any design, device, material, or process covered by letters of patent or copyright shall provide for such use by suitable legal agreement with the patentee or owner. Contractors and their Sureties shall indemnify and save harmless the State, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright, and shall indemnify the State for any costs, expenses, and damages that it may be obliged to pay by reason of any infringement, at any time during the prosecution of or after the completion of the work.

**107.04 Restoration of Surfaces Opened by Permit.** The right to construct or reconstruct any utility service in the highway or street, or to grant permits for such work, at any time, is hereby expressly reserved by the Department for the proper authorities of the political entity in whose jurisdiction the work is done and the Contractor shall not be entitled to any damages either for the digging up of the street or for any delay occasioned thereby.

Any individual, firm, or corporation wishing to make an opening in the highway must secure a permit from the Department and deposit security in a suitable amount to cover the cost of making the necessary repairs. The Contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. When ordered by the Engineer, the Contractor shall make in an acceptable manner all necessary repairs due to such openings and such necessary work will be paid for as extra work, or as provided in

these specifications, and will be subject to the same conditions as original work performed.

**107.05 Required Contract Provisions. (a) Federal Aid.** When the United States Government pays all or any portion of the cost of a project, the Federal laws and rules and regulations made pursuant to such laws must be observed by the Contractor, and the work shall be subject to the inspection of the appropriate Federal Agency.

Such inspection shall in no sense make the Federal Government a party to the Contract and will in no way interfere with the rights of either party thereunder.

**(b) Non-Federal Aid.**

**(1) Employment Practices.**

**a.** The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, disability, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, age, disability, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment advertising; layoffs or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

**b.** The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, disability, or national origin.

**c.** In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract, this contract may be canceled, terminated, or suspended in whole or in part.

**(2) Selection of Subcontractors, Procurement of Materials, Leasing of Equipment.**

**a.** The Contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, religion, sex, age, disability, or national origin in the

selection and retention of subcontractors, including procurement of materials and leases for equipment.

**b.** In all solicitations, either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurement of materials or leases for equipment, each potential subcontractor or supplier shall be notified by the Contractor of the Contractor's obligations under this contract relative to nondiscrimination on the grounds of race, color, religion, sex, age, disability, or national origin.

**c.** The Contractor shall provide all information and reports required by the Department and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Department to be pertinent to ascertain compliance with such directives. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to the Department and shall set forth what efforts have been made by the Contractor to obtain the information.

**d.** In the event of the Contractor's noncompliance with the nondiscrimination provisions described herein, the Department shall impose such contract sanctions as it may determine to be appropriate, including, but not limited to:

1. Withholding of payments to the Contractor under the contract until the Contractor complies, and/or
2. Cancellation, termination, or suspension of the contract, in whole or in part.

**e.** The Contractor shall include nondiscrimination provisions in every subcontract, including procurements of materials and leases of equipment. The Contractor shall take such action with respect to any subcontractor or procurement as the Department may direct as a means of enforcing such provisions, including sanctions for non-compliance.

**(3) Nonsegregated Facilities.** Upon execution of the Contract, the Contractor certifies that segregated facilities are not maintained or provided for employees at any of its establishments, and that employees are not permitted to perform services at any location,

where segregated facilities are maintained. As used in this certification, the term “segregated facilities” means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, age, disability, or national origin, because of habit, local custom, or otherwise. The bidder/subcontractor agrees that, except where identical certifications have been obtained from proposed subcontractors and material suppliers for specific time periods; identical certification will be obtained from subcontractors prior to the award of subcontracts.

(4) Waiver of Certificate of Payments. The requirements for certification of payments to DBEs/Non-DBEs, as specified in Subsection 103.08(h), are hereby waived and are not required for Non-Federal Aid Projects.

**107.06 Sanitary Provisions.** The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of the employees as may be necessary to comply with the requirements of the State and local Boards of Health, or of other bodies or tribunals having jurisdiction.

**107.07 Public Safety and Convenience.** The Contractor's work shall at all times be conducted so as to assure the least possible obstruction to traffic. The safety and convenience of the general public and the residents along the highway and the protection of persons and property shall be provided for by the Contractor as specified under Subsection 104.05 and Sections 603 and 604, as applicable.

The Contractor will be responsible for maintaining U.S. mailboxes within the project limits in such a manner that the public may receive continuous mail service according to U.S. Postal Service regulations. Unless otherwise provided, upon completion of the project, mailboxes will be replaced as near as practicable to their original location.

The Contractor shall be responsible for providing a fence to control livestock in areas where pastures are severed or existing



fencing is altered under the Contract. Wire fence may be constructed initially, or in lieu thereof, the Contractor, at Contractor expense, may elect to provide temporary fencing suitable to contain livestock.

**107.08 Railway-Highway Provisions.** All work on railroad property shall be accomplished in strict compliance with the plans, these specifications, and such Special Provisions as are appropriate to the Contract.

All work to be performed by the Contractor in construction on the railroad right-of-way shall be performed at such times and in such manner as not to unnecessarily interfere with the movement of trains or traffic upon the track of the Railway Company. The Contractor shall use all care and precaution to avoid accidents, damage, or unnecessary delay or interference with the Railway Company's trains or other property.

Plans for all sheeting or cofferdams for foundation work adjacent to operated track, and plans of falsework, staging, protective sheeting, or other temporary construction near the operated track shall be approved by the Railway Company. The Contractor shall construct the work according to the approved plans.

**107.09 Work over Navigable Waters or within Regulated Floodways. (a) Navigable Waters.** All work on navigable water shall be so conducted that free navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by the U.S. Coast Guard and/or the U.S. Army Corps of Engineers (C of E), as applicable, and with Section 110.

**(b) Regulated Floodways.** All work within regulated floodways shall be accomplished within the requirements of all permits issued by the Federal Emergency Management Agency (FEMA), C of E, or other applicable agencies, and with Section 110.

**(1) Responsibility for FEMA Permit.** Within regulatory floodways all permanent and temporary fills/structures must be in accordance with FEMA and local governmental requirements. The Department obtains all required permits and/or variances for essential work in the regulated floodway before the Contract is awarded. The Department will apply for Contractor requested variances which it determines are necessary. The Contractor

should be aware that requested temporary fills/structures may not be approved or may require mitigation.

**(2) Corps of Engineers Section 404 Permit Requirements.**

Placement of temporary fills/structures within a regulatory floodway may also require alteration of the existing C of E 404 Permit described in Section 110. The Contractor should refer to Section 110 and the Contract Documents for further details, restrictions, and requirements of Section 404 Permits.

**(3) Compensation and Extension of Contract Time.**

The Contractor will not be granted additional compensation or contract time due to requested floodway variances that are considered by the Engineer to be for the convenience of the Contractor. If, however, due to no fault of the Contractor, a floodway variance is deemed by the Engineer to be necessary, additional contract time and/or compensation may be considered according to the provisions of Section 104.

**(c) Contractor's Permit Conditions.** All permits issued to the Contractor by the U.S. Coast Guard, C of E, or other applicable agencies, for the convenience of the Contractor in accomplishing the work, shall be complied with in full and the project will not be accepted until the permittor has accepted the work covered by permit. The Contractor will be responsible for obtaining a release from the permittor before acceptance.

**107.10 Restraining Conditions. (a) General.** A "restraining condition" is defined as a condition and/or material that is, or can reasonably be suspected of being:

- Archeologically or historically significant.
- Environmentally sensitive.
- Hazardous substances or waste.

(1) Archeologically or historically significant sites may contain artifacts or the remains of prehistoric/historic people's dwelling sites. The determination of archeological or historical significance will be made by the Department in coordination with the appropriate authorities.

(2) Environmentally sensitive conditions include, but are not limited to, wetlands, caves, underground streams, and habitats of threatened or endangered species.

(3) Hazardous substances or waste are defined as: any chemical or biological element, compound, mixture, solution, or substance that, when released to the environment, may present substantial danger to public health or welfare or to the environment.

Potentially hazardous substance or waste sites may include, but are not limited to: tanks, drums, containers, and packages (with or without hazardous materials labels), plus any liquids or solids not typical in color, odor, or texture to the native soils or strata of the site. Any indication that the area was a dump site or landfill shall constitute a reason to stop work in that area until a determination can be made as to whether hazardous materials exist.

**(b) Restraining Conditions Within the Right-of-Way.** Known restraining conditions within the right-of-way will be shown on the plans and any special work requirements in the vicinity of such conditions shall be shown on the plans or included in the Contract.

When any restraining condition not shown on the plans is encountered, work in that area will stop and the Engineer shall be notified immediately. Work in that area shall not resume until the condition has been investigated, a determination made as to the disposition of the condition, and clearance to continue has been obtained.

**(c) Restraining Conditions Outside of the Right-of-Way.**

**(1) Commercially Operated Site.** The term "commercially operated site" is defined as a pit or quarry from which material is obtained that has served the general public for purposes other than Department projects for more than one year and has furnished materials to the general public for purposes other than Department projects during the twelve month period immediately preceding the execution of the Contract.

The Contractor is advised that the owner/operator of the site has the responsibility to obtain clearances and ensure compliance with all Federal and State laws regarding the above restraining conditions.

**(2) Non-commercially Operated Site.** The Contractor shall notify the Engineer of the location of all proposed off-site locations, including borrow pits, waste areas, haul roads,

equipment and materials storage areas, field offices, etc., prior to starting any site preparation in these areas. This notification shall include detailed information which will enable Department personnel to locate the site on the ground, and include a 7.5 minute topographic quadrangle or equivalent map showing the location and limits of the proposed off-site location. The limits of the off-site location shall be clearly and visibly flagged for easy recognition. Within 10 business days after notification by the Contractor, the Department will:

- Investigate for the presence of archeologically or historically significant sites. If no evidence is found of archeological/historical materials during the initial visual survey, the site will be conditionally approved, and
- Investigate for the presence of environmentally sensitive conditions. If no evidence is found the site will be conditionally approved.
- After Restraining Condition conditional approval has been given to the Contractor, the Department will provide the Contractor with an Endangered Species Clearance. This clearance may be used by the Contractor to obtain his NPDES Permit for the off right-of-way site.

The Contractor is responsible to carefully investigate off right-of-way sites to ensure the absence of hazardous materials or wastes.

If the site is determined to involve a restraining condition, no work in that area will be permitted. Any site preparation prior to conditional approval will cause the site to be rejected. The Contractor will not be reimbursed for work done prior to conditional approval.

If a restraining condition is discovered the Contractor may, at no cost to the Department, acquire approval for use of the site from the appropriate authorities. All sites that have been rejected because of prior site preparation are ineligible for clearance. All clearances or permits obtained by the Contractor regarding the dismissal of the restraining conditions shall be submitted to the Engineer for approval before site preparation begins.

If a restraining condition is discovered after operations have begun, work in the area of the restraining condition shall stop and

the Engineer shall be notified immediately. Work in that area shall not resume until the condition has been investigated, a determination made as to the disposition of the condition, and clearance to continue has been obtained. If no further work is permitted at the site due to the restraining condition, the site shall be closed and the area dressed and restored under Sections 106 and 110 to the extent practicable without interfering with the disposition of the condition.

**(d) Contract Adjustments.**

**(1) Within the Right-of-Way.** Contract adjustments due to the discovery on the right-of-way of restraining conditions not shown on the plans will be made according to subsection 104.02(c).

**(2) Outside of the Right-of-Way.** No additional compensation or extension of time will be given for delays or extra work required resulting from the discovery of restraining conditions at commercially operated sites.

In the event the Contractor has begun using a conditionally approved non-commercially operated site and is prevented from fully utilizing this site due to the discovery of a restraining condition, such conditions will be deemed a differing site condition and Contract adjustments will be made according to subsection 104.02(c).

**(e) Protection of Sensitive Areas.** Any area identified by the Department as containing a restraining condition which is adjacent to or within an approved site must be clearly marked and protected by the Contractor from any vehicle or equipment encroachment. Department personnel will establish the limits of the restraining condition area. The Contractor, at Contractor expense, will mark and maintain the limits of the restraining condition area using flagging, stakes, or other appropriate devices to clearly indicate that the area is to be protected. The Contractor will be responsible for any damages to the area containing the restraining condition as provided in Subsection 107.12.

**107.11 Use of Explosives.** When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall comply with all laws and

ordinances regarding the use of explosives; further, the Contractor shall be responsible for all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and in accordance with the Occupational Safety and Health Act of 1970, 29 USC § 651 et seq., and the Safety and Health Regulations for Construction promulgated thereunder, but not closer than 1,000' (300 m) from the road or from any building or camping area or place of human occupancy.

The Contractor shall notify each public utility company having structures in proximity to the site of the work of any intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury.

**107.12 Protection and Restoration of Property and Landscape.** The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location, and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character: 1) during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in the manner or method of executing the work, or 2) at any time, due to defective work or materials, and said responsibility will not be released until the project has been completed and accepted.

Property shall include but not be limited to street and roadway signs, right-of-way monuments, roadway lighting, traffic signal equipment, and any conduits and wiring. Should it become evident that any item, such as listed above, is in conflict with the proposed work, the Contractor will notify the Engineer so that proper steps can be taken to adjust, remove, or otherwise eliminate the conflict.

On projects where the Department has monumented the right-of-way before the start of construction operations, it shall be the responsibility of the Contractor to protect such right-of-way or land

monuments from disturbance during the construction period. The term "right-of-way or land monument" shall include the actual monument; stakes, pins, nails, or other devices marking the location of the monument; and witness markers associated with the monument. Any and all such monuments disturbed by the Contractor's operations will be reestablished by the Department. An immediate deduction of \$300 for each monument disturbed by the Contractor's operations will be made on the next progress estimate after the discovery of the damage.

If the Department has completed installation of all monuments and filed the appropriate plat before the disturbance of any monument, the Contractor may, at Contractor option and in lieu of restoration by the Department, have the monuments restored by a Professional Surveyor at the Contractor's expense. The monument will be reset using current AHTD property and right of way monumenting procedures and shall include the Professional Surveyor's number on the monument cap. A plat shall be prepared by the Professional Surveyor for documentation of such replacement or restoration. The plat shall comply with the current requirements of the *Arkansas Minimum Standards for Property Boundary Surveys and Plats* and approved by the Surveys Division of AHTD. The plat shall be filed with the State Land Surveyor's Office and a copy of the filed plat, including the State Land Surveys Office document number, shall be furnished to the Department. The deduction of \$300 per monument will be made as specified above and re-paid after completion of the requirements of this paragraph.

The Contractor shall not create a public nuisance while performing the various operations of the work. Excessive noise between the hours of 10 p.m. and 6 a.m., and dust from haul roads, County roads, or State roads may be considered by the Engineer to be a public nuisance.

When or where any direct or indirect damage or injury is done to public or private property by or as a result of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof, the Contractor shall restore, or bear the expense of restoring, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or shall make good such damage or injury in an acceptable

manner. Failure to do so within a reasonable period of time will constitute noncompliance, and the Engineer may cause the entire cost of the restoration to be deducted from moneys due or to become due the Contractor on the Contract.

**107.13 Forest Protection.** When working within or adjacent to a State or National Forest, the Contractor shall comply with all regulations concerning the protection of forests. The Contractor and all subcontractors shall take all reasonable precautions to prevent forest fires and shall provide reasonable aid in the suppression of forest fires. The size and location of all fires seen or otherwise detected by the Contractor's personnel shall be reported immediately to the Engineer and/or the nearest Forest official.

**107.14 Responsibility for Damage Claims.** The Contractor shall indemnify and save harmless the Department and its officers and employees from all suits, actions, or claims of any character brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of the Contractor; or because of any claims or amounts recovered from any infringement of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workman's Compensation Act," or any other law, ordinance, order, or decree; and so much of the money due the Contractor under and by virtue of the Contract as may be considered necessary by the Department for such purpose may be retained for the use of the Department; or in case no money is due, the Surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Department; except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that adequate protection is provided by public liability and property damage insurance.

It is specifically agreed between the parties executing the Contract that it is not intended by any of the provisions of any part of the Contract to create the public or any member thereof a third party beneficiary thereunder, or to authorize anyone not a party to



the Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the Contract.

**107.15 Opening Section of Highway to Traffic.** Whenever any roadway, or portion thereof, is in an acceptable condition for travel, it shall be opened to traffic, as may be directed, and such opening shall not be held to be in any way an acceptance of the roadway, or any part of it, or as a waiver of any of the provisions of these specifications and the Contract. Necessary repairs or renewals made on any section of the roadway opened to travel under instructions from the Engineer, due to defective material or work, or to natural causes, other than normal wear and tear, pending completion and acceptance of the roadway, shall be performed at no cost to the Department.

If the Contractor is dilatory in completing shoulders, drainage structures, or other features of the work, the Engineer may give notification in writing and establish therein a reasonable period of time in which the work should be completed. If the Contractor is dilatory or fails to make a reasonable effort toward completion in this period of time, the Engineer may take action as provided in subsection 105.01. On such sections that are so ordered to be opened, the Contractor shall conduct the remaining construction operations so as to cause the least obstruction to traffic and shall not receive any added compensation due to the added cost of the work by reason of opening such section to traffic.

**107.16 Contractor's Responsibility for Work.** Until final acceptance of the project by the Engineer, the Contractor shall have the charge and care thereof and shall take every precaution against injury, theft, or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries, thefts, or damages to any portion of the work occasioned by any of the above causes before final acceptance, and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, of the public enemy, or of governmental authorities.

In case of suspension of work from any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project, provide for normal drainage and maintenance of the traveled way, and shall erect any necessary temporary structures, signs, or other facilities. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under the Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

The protection of the work shall be accomplished at no cost to the Department except for the work required to maintain the traveled way.

In case of errors or negligence on the part of the Contractor, any expenses incurred by the Department for engineering, inspection, testing, design, or evaluation relative to correction of the work will be assessed against the Contractor.

**107.17 Contractor's Responsibility for Utility Facilities and Services.** At points where the Contractor's operations are adjacent to railroad or utility facilities, damage to which may result in loss or inconvenience, work shall not begin until all arrangements necessary for the protection thereof have been made.

The Contractor shall cooperate with the owners of any utility facilities in their removal and rearrangement operations so that these operations may progress in a reasonable manner, that duplication of rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

In the event of interruption of utility services, as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. If utility service is interrupted, repair work shall be continuous until the service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

**107.18 Furnishing Right-of-Way.** The Department is responsible for the securing of all necessary rights of way in advance

of construction within the limits indicated on the plans. Acquisition of right-of-way by the Department does not include areas required by the Contractor for material sources (borrow, gravel, topsoil, sod, etc.), plant sites, equipment storage, stockpiles, disposal of waste or excess material, or any other areas required for the proper prosecution of the work. The Contractor is responsible for obtaining, at no cost to the Department, areas outside the right-of-way required for such purposes and shall, at the Engineer's request, furnish copies of agreements with the property owners. The Contractor may, with the approval of the Engineer, use areas within the right-of-way that are outside the construction limits for these purposes. Erosion control, prevention of water pollution, and restoration of all such areas, both inside and outside the right-of-way, shall be performed by the Contractor according to the specifications and at no cost to the Department.

**107.19 Personal Liability of Public Officials.** In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the Contract, there shall be no liability upon the Commission, Engineer, or their authorized representatives, either personally or as officials of the Department, it being understood that in all such matters they act solely as agents and representatives of the Department.

**107.20 No Waiver of Legal Rights.** Final acceptance according to subsection 105.17(b) shall not preclude or estop the Department from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Department be precluded or estopped from recovering from the Contractor or the Surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill obligations under the Contract. A waiver on the part of the Department of any breach of any part of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, shall be liable to the Department for any or all of the following: fraud or such gross mistakes as may amount to fraud, the Department's rights under any warranty or guaranty, or any latent defects in the work.

## **SECTION 108 PROSECUTION AND PROGRESS**

**108.01 Subletting of Contract.** The Contractor will be permitted to sublet a portion of the Contract, except that work amounting to not less than 30% of the total Contract amount (based on the Contract unit prices) must be performed by the Contractor's organization. No subcontractor shall further subcontract any portion of the work without the written consent of the Contractor and acknowledgment of the Engineer. If consent and acknowledgment are given, the first tier subcontractor may further subcontract a portion of his work not to exceed 70% of the work originally subcontracted to him by the Contractor. Second tier subcontractors will not be permitted to subcontract any portion of the work. No subcontracts, or transfer of contract, shall in any case release the Contractor of liability under the Contract and bond.

The Contractor shall submit and file with the Engineer a signed copy of each subcontract. No work may be performed by a proposed subcontractor until the Contractor has received acknowledgment by the Engineer.

It shall be the responsibility of the Contractor to determine that all parties performing work amounting to \$20,000 or more are currently licensed by the Contractors Licensing Board for the State of Arkansas.

The Contractor shall pay all subcontractors their respective subcontract amount within 10 calendar days after the Contractor receives payment from the Department. The payment amount shall be according to the terms of the subcontract, except that the Contractor shall not require or withhold a retainage in excess of 10% of the amount due to the subcontractor. Amounts withheld as retainage from subcontractors must be returned within thirty calendar days after the subcontractor's work is satisfactorily completed, whether the Contractor's work is complete or not. The term "satisfactorily completed" for the purpose of this prompt return of retainage provision is defined as when; 1) the subcontractor's work is completed in accordance with the plans and specifications, 2) all required paperwork, including material certifications, payrolls, etc., has been received and approved by the Engineer; 3) the

subcontractor does not have past due balances with suppliers for work associated with the project; and 4) the Engineer has determined the final quantities for the subcontractor's portion of the work. Delay or postponement of payment to a subcontractor may only be effected after the Contractor has established good cause and received written approval from the Engineer. If the Contractor fails to pay the subcontractors within the required periods, all or any portion of subsequent payments due the Contractor may be withheld by the Engineer.

In addition to the allowable retainage specified above, the Contractor may withhold from payments due to the subcontractor amounts owed by the subcontractor to the Contractor for items on the Contract. Payments to subcontractors in the form of joint checks made payable to the subcontractor and any other party shall be documented either in the approved subcontract or by a separate written agreement between the Contractor and the subcontractor. **No other deductions from the full amount due will be allowed.**

Contractors must include in their subcontract agreements notice to subcontractors of their right to prompt payment and return of retainage, and provisions that require the subcontractor to pay second tier subcontractors as provided above, with the same restrictions on retainage.

**108.02 Prosecution of Work. (a) Preconstruction Conference.**

A preconstruction conference, when applicable, will be held for each contract as soon as possible after the execution of the Contract and generally before the work begins. The Engineer will notify the Contractor, utility companies, and other interested parties of the date and place for the conference.

**(b) Work Order.** The following shall apply to the various work orders applicable to the prosecution of the work:

(1) Except as provided herein, no work shall be performed under the Contract until the Engineer has issued a Work Order.

The Contractor shall notify the Engineer of intent to begin work at least 72 hours before work is begun.

(2) The delivery to the Department for execution of the Contract and bonds properly executed on behalf of the Contractor and surety and the minimum 72 hours advance notice as required

above shall constitute the Contractor's authority to begin the following items of work:

- Mobilization;
- Preparation of shop drawings and other required submissions;
- Ordering, fabrication, assembly, and/or stockpiling of materials;
- Driving Test Piling; and
- Contract surveying, when Roadway and/or Bridge Construction Control is included in the Contract.
- Erection of advance warning signs.

Such advance work shall be subject to the Contractor's assumption of the risk of cancellation of the award and the following:

- The Contractor shall, on commencing such operations, take all precautions required for public safety and shall observe all the provisions in the Contract;
- In the event of cancellation of the award, the Contractor shall at Contractor expense do such work as necessary to leave the site in a neat condition to the satisfaction of the Engineer;
- In the event of cancellation of the award, all work performed shall be deemed to be at the Contractor's expense; and
- All work done under this subsection in accordance with the Contract before its execution by the Commission will, when the Contract is executed, be considered authorized work and will be paid for as provided in the Contract.

Unless otherwise notified in writing, no time will be assessed for work performed prior to the effective date of a Work Order.

No payments will be made prior to the date established by the Engineer under Subsection 109.07, which date will be after the effective date of a Work Order.

The Contractor shall not be entitled to any additional compensation or an extension of time for any delay, hindrance, or interference caused by or attributable to commencement of work before the effective date of a Work Order.

**(3) Partial Work Order.** A Partial Work Order may be issued which will describe the specific items and/or limits of

work to be performed under the Partial Work Order. Assessment of contract time will be as described in the Work Order and payment will be made according to Section 109.

**(4) Full Work Order.**

**a. Fixed Completion Date Contract.** Unless the Contractor is otherwise advised in writing, the Work Order for a fixed completion date contract shall become effective on the day following the execution of the Contract by the Department. Should the effective date fall on Saturday, Sunday, a legal holiday designated in Subsection 101.01(c), Monday following a holiday on Sunday, or Friday preceding a holiday on Saturday, the effective date shall be the next work day. The written Work Order from the Engineer will follow with the effective date being as specified.

**b. Working Day Contract.** Unless the Contractor is otherwise advised in writing, the Work Order for a working day contract shall become effective on the fifteenth calendar day following the execution of the Contract by the Department. Should the effective date fall on Saturday, Sunday, a legal holiday designated in Subsection 101.01(c), Monday following a holiday on Sunday, or Friday preceding a holiday on Saturday, the effective date shall be the next work day. The written Work Order from the Engineer will follow with the effective date being as specified. No time will be assessed for any work performed including erection of traffic control devices during the 10 calendar day period following the effective date of the Work Order. The assessment of contract time, according to Subsection 108.06, will begin on the eleventh calendar day following the effective date of the Work Order.

Except as specified in 108.02(b)(2) above, no work of any type, including the erection of traffic control devices, shall begin before the effective date of the Work Order.

**(c)** The Contractor shall begin the work to be performed under the Contract not later than 10 calendar days after the effective date of the Work Order. If the Contractor is unable to begin the work within this time period, the Engineer shall be so notified in writing. Unless

the Engineer gives written approval for the delay in beginning the work, contract time will be assessed according to Subsection 108.06.

(d) The Department allocates its resources to a contract based on the total time allowed in the Contract. The Contractor may propose an accelerated work schedule indicating an early completion date; however, the Department cannot guarantee the Department's resources will be available to meet the accelerated schedule. No additional compensation or extension of time will be allowed if the Contractor is unable to meet the accelerated schedule due to the unavailability of the Department's resources or for other reasons beyond the Department's control.

**108.03 Limitation of Operations.** The Contractor shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic. Due regard shall be given to the location of detours and to the provisions for handling traffic. No work shall be opened up to the prejudice or detriment of work already started. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

**108.04 Character of Workers, Methods, and Equipment.** The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or by any subcontractor who, in the opinion of the Engineer, does not perform work in a proper and skillful manner, or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for



the proper prosecution of the work, the Engineer may suspend the work by written notice and withhold moneys due until such orders are complied with.

All equipment that is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property, or other highways will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the Contract, the Contractor is free to use any methods or equipment that are demonstrated to the satisfaction of the Engineer as being capable of accomplishing the Contract work in conformity with the requirements of the Contract.

When the Contract specifies that the construction be performed by using certain methods and/or equipment, such methods and/or equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified in the Contract, authority from the Engineer to do so must be requested. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as a result of an authorized change in methods or equipment under these provisions.

**108.05 Temporary Suspension of Work.** The Engineer will have the authority to suspend the work wholly or in part for such period or periods necessary, due to unsuitable weather or other

conditions unfavorable for the suitable prosecution of the work. If it should become necessary to stop work for an indefinite period, the Contractor shall store all materials in such manner that they will not obstruct or impede the traveling public nor become damaged in any way, and shall take every reasonable precaution to prevent damage or deterioration of the work performed; provide suitable drainage of the roadway by opening ditches and shoulder drains; maintain the traveled way; erect temporary structures where directed; etc.

The Contractor shall not suspend the work nor remove any equipment or materials essential to the completion of the current phase of the project without the permission of the Engineer.

If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for a period of time not originally anticipated, customary, or inherent to the construction industry and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment within ten (10) business days of the receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost and/or time required for the performance of the Contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the Contract in writing accordingly. The Engineer will notify the Contractor of a determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

No Contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of the Contract.

**108.06 Determination of Time of Completion and Extension of Contract Time. (a) General.** The time allowed for the

completion of the work included in the Contract will be stated in the proposal and Contract, and will be known as the "Contract Time". The contract time will be specified as a fixed completion date or as working days.

The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project according to the plans and specifications within the contract time. The Contractor shall advance the work so that the available time is appropriately utilized in order to complete the work within the contract time.

Unless an emergency is declared, the Contractor shall not perform work that requires inspection on Sundays or legal holidays designated in Subsection 101.01(c) and the actual holiday if it falls on a Saturday or Sunday. If the Commission declares Friday following Thanksgiving Day as a Departmental holiday, the Contractor shall not perform work that requires inspection.

No claim for an extension of time will be considered as a result of failure of the Engineer to furnish interpretations of the plans and specifications until 30 calendar days after receipt of such demand in writing as required by Subsection 105.01, and not then unless such request for an interpretation is reasonable and made in good faith.

The Engineer will determine the date upon which the Contract is substantially complete and time assessment will cease. In the event cleanup is necessary or items found at the final inspection are to be corrected, the Contractor shall complete this work in a timely manner or the Engineer will resume time charges.

**(b) Fixed Completion Date.** When the contract time is specified as a fixed date, it will be the date on which all work on the project shall be substantially complete. The Contractor shall take into consideration all normal conditions considered unfavorable to the normal progress of the work and place a sufficient work force and equipment on the project to ensure completion of the work within the contract time. Inaccessibility to a portion of the work due to utility conflict or utility work, either of which prevents effective utilization of 60% of normal forces and equipment for at least 60% of the Contractor's normal work hours, will be considered as an adverse working condition for time exceeding that specified in the Contract for the utility adjustment.

**(c) Working Days.** When the contract time is specified in working days, time will be assessed for each day on which, in the judgement of the Engineer and subject to the limitations below, conditions allow the Contractor to effectively utilize 60% of normal forces and equipment to prosecute the work required at that time, for at least 60% of the Contractor's normal work hours, regardless of whether the Contractor actually works.

The Engineer will not assess a working day when conditions exist beyond the control and without the fault of the Contractor that prevent the utilization of forces and equipment as defined above. Also, for the purpose of assessment of working days, inaccessibility to a portion of the work due to utility conflict or utility work, either of which prevents utilization of forces and equipment as defined above, will be considered as an adverse working condition for time exceeding that specified in the Contract for the utility adjustment. The ability of vendors, suppliers, and subcontractors to provide materials and/or services is considered within the Contractor's control for the purpose of assessment of working days.

Should the Contractor prepare to begin work on any day on which inclement weather, or the conditions resulting from the weather, prevent the work from beginning at the usual starting time, and the crew is dismissed as a result, the Contractor will not be charged for a working day whether or not conditions change during the day and the rest of the day becomes suitable for construction operations.

Time from December 21 through March 15, inclusive, will not be assessed against the contract time.

Saturdays and Department recognized holidays, other than those designated above, which may be declared by the Department for certain special or unusual circumstances, will be optional to the Contractor as working days, and time will not be assessed unless work is performed that requires inspection. If work is performed, contract time assessment will be based upon the same conditions as a normal working day.

Contract time will be assessed during a Partial Work Order period according to Subsection 108.02(b)(3).

Contract time will not be assessed during a full suspension of the work as ordered by the Engineer. During a partial suspension of the work as ordered by the Engineer, the contract time will be assessed

in direct proportion to the ratio of the money value of the items not suspended to the total contract amount.

At the end of each estimate period, the Engineer will furnish the Contractor a written statement showing each working day charged during the preceding period and the total number of working days charged to date. If the Contractor disagrees with the working days charged by the Engineer, then the Contractor shall, within 10 calendar days after receipt of the statement, give the Engineer written notice of such disagreement and the reasons therefor. Subsequent handling of this dispute shall be according to Subsection 105.01. If the Contractor fails to protest the Engineer's determination of working days charged within the 10 calendar day period, the Contractor shall be deemed to have accepted the time charged for that period as correct and no subsequent request for review will be considered.

**(d) Extension of Contract Time.** If the Contractor is unable to complete the work within the contract time as specified, at any time prior to the final acceptance of the project, a written request may be made to the Engineer for an extension of time. This request must contain specific dates and the detailed circumstances relative to the time extension desired. The Contractor's contention that insufficient time was specified is not a valid reason for an extension of time.

All extensions of time, except extensions due to overruns, will be documented by Change Order.

Any extended time for completion shall be in full force and effect the same as though it were the original contract time.

**(1)** An extension of time will be granted:

**a.** On fixed completion date projects, if the Work Order is not issued within 30 calendar days after the execution of the Contract. An extension of time will be given based on the number of days delayed beyond the 30 calendar days.

**b.** On fixed completion date projects, for time elapsing between the effective dates of any order from the Engineer for a complete or partial suspension of the work, when such suspension is due to no fault of the Contractor. Days assessed during a partial suspension period will be determined by dividing the money value of the work

performed during the partial suspension period by the money value of one day. The money value of one day will be based on the ratio of the total contract amount to the number of calendar days from the date of the work order through the fixed calendar date stipulated in the Contract, both dates inclusive.

c. On fixed completion date projects, if the total dollar value of accumulated current estimates or the final estimate, **exclusive of incentives and disincentives**, exceeds the dollar value of the total contract bid, the completion date will be extended by the number of calendar days obtained by multiplying the contract time as set forth in the Contract by that percentage that the dollar value of the estimate exceeds the dollar value of the total contract bid. When this occurs, the extension of time will be based upon the number of calendar days from the date of the work order through the fixed calendar date stipulated in the Contract, both dates inclusive.

d. On jobs on which time is specified in working days, the contract time will be increased in the same proportion that the total dollar value, **exclusive of incentives and disincentives**, exceeds the total contract bid.

(2) An extension of time will be considered, based upon documented evidence submitted by the Contractor, if:

a. The Contract requires the furnishing of critical materials and the Contractor experiences a delay in delivery because of Federal priorities for defense needs or because of nationwide shortages. Additional contract time may be allowed in an amount equal to the actual lost time resulting from such delay. To obtain additional contract time, the Contractor shall document and file with the Engineer all evidence pertaining to the original agreement with the material supplier or manufacturer. This evidence must indicate that delivery would be made at or before the time the materials would be needed in the normal sequence of construction operations for incorporation in the work. In the event that no prior agreement has been made for furnishing a critical material, and the Contractor is unable

to locate a supplier or manufacturer that can deliver the material when needed, the Engineer shall be advised of this situation in writing, indicating the date that delivery will be made and the date of the original request for such material. In either of these situations, when work has progressed to the point that critical materials not delivered are delaying progress of the project, the Contractor may make a written request to the Engineer for additional contract time.

**b.** The work has been delayed by any act or omission of the Commission.

**c.** Preparatory work to be performed by the Owner or by others specified in the Contract has not been accomplished and the delay is not the fault of the Contractor.

**d.** Weather conditions or the condition of the ground or materials were significantly abnormal and these conditions significantly delayed the work. For consideration of a time extension based on weather conditions, the Contractor shall submit, in writing, documented evidence of the conditions that existed for the specific days requested. The Engineer will verify the validity of the request.

**e.** Change Orders involve extra work and the time needed to complete this extra work would exceed the normal time extension as a result of overruns, based on money value, the completion date may be extended by Change Order to provide for this difference.

**f.** It is determined that anticipated time extensions due to overruns did not materialize due to underruns in other items.

**g.** The work was delayed because of conditions not described herein that were beyond the control and without fault of the Contractor.

**108.07 Failure to Complete Work on Time.** Time is an essential element of the Contract and it is important that the work be pressed vigorously to completion. The cost to the Department of the administration of the Contract, including engineering, inspection, and supervision, will be increased as the time occupied in the work

is lengthened. Loss will accrue to the public due to delayed completion of the contemplated facility.

For each calendar day or working day, as specified, that work remains uncompleted after the contract time has expired, the sum specified in the proposal and Contract will be deducted from any money due the Contractor, not as a penalty, but as liquidated damages.

Should the amount otherwise due the Contractor be less than the amount of such liquidated damages, the Contractor and the Surety shall be liable to the Department for such deficiency.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the Department of any of its rights under the Contract.

**108.08 Default and Termination of Contract.** The Engineer will give written notice of delay, neglect, or default to both the Contractor and the Surety if the Contractor:

(a) Fails to begin the work under the Contract within the time specified in the Work Order, or

(b) Fails to perform the work with sufficient workers, equipment, or materials to assure prompt completion of the work, or

(c) Performs the work negligently or unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable or unsuitable, or

(d) Discontinues the prosecution of the work, or

(e) Fails to resume work that has been discontinued within 10 calendar days after notice to do so, or

(f) Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or fails to provide a replacement bond within 10 calendar days, containing all the guarantees of the original bond, if the Surety should be declared in default and/or liquidation, or

(g) Fails to settle all valid claims for materials, labor, or supplies in an expedient manner, or



(h) Allows any final judgment to stand unsatisfied for a period of 10 calendar days, or

(i) Makes an assignment for the benefit of creditors, or

(j) Fails to refund any moneys due the Commission due to errors in determining pay quantities for estimates within 30 calendar days, or

(k) Fails to appropriately cooperate with the Department, the public, or others associated with the work or to provide proper superintendence of the work, or

(l) Fails to comply with contract requirements, or

(m) Is a party to fraud, or

(n) For any other cause whatsoever, fails to carry on the work in a manner acceptable to the Department.

If the Contractor or Surety, within a period of 10 calendar days after written notice from the Engineer, does not proceed according to the notice, the Commission will, upon written notification from the Engineer of the facts relative to delay, neglect, or default, and the Contractor's failure to comply with the written notice, have full power and authority, without violating the Contract, to take the prosecution of the work out of the hands of the Contractor. The Commission may appropriate or use any or all materials and equipment associated with the project as may be suitable and acceptable and may enter into an agreement for the completion of the Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of the Contract.

All costs and charges incurred by the Commission due to any of the above will be deducted from any moneys due or which may become due the Contractor. If such expense exceeds the sum that would have been payable under the Contract, the Contractor and the Surety shall be liable and shall pay to the Commission the amount of such excess. Such charges shall include but not be limited to the cost of completing a part or all of the work under the Contract, for calculating and collecting any compensating taxes due under Ark. Code Ann. §26-53-201 et seq. and Ark. Code Ann. §17-22-401 et seq. (formerly Act 125 of 1965), and for the collection of any overpayments due the Commission.

The Department may, by written order, terminate the Contract or any portion thereof after determining that for reasons beyond either Department or Contractor control the Contractor is prevented from proceeding with or completing the work as originally contracted for, and that termination would be in the public interest. Reasons for termination may include, but need not be necessarily limited to: executive orders of the President relating to prosecution of war or national defense; national emergency that creates a serious shortage of materials; orders from duly constituted authorities relating to energy conservation; and restraining orders or injunctions obtained by third-party citizen action resulting from national or local environmental protection laws or where the issuance of such order or injunction is primarily caused by acts or omissions of persons or agencies other than the Contractor.

When contracts, or any portion(s) thereof, are terminated before completion of all items of work in the Contract, payment will be made for the actual number of units or items of work completed at the contract unit price, or as mutually agreed for items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Reimbursement for organization of the work (when not otherwise included in the Contract) and moving equipment to and from the project will be considered where the volume of work completed is too small to compensate the Contractor for these expenses under the contract unit prices, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained by the Contractor for the work, that have been inspected, tested, and accepted by the Engineer, and that are not incorporated in the work may, at the option of the Engineer, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer.

Termination of a contract or a portion thereof shall not relieve the Contractor of responsibilities for the completed work, nor shall it relieve the Surety of its obligation for and concerning any just claims arising out of the work performed.

**108.09 Vacant.**

**108.10 Suspension or Termination of Contract Because of Insufficient Appropriation of Funds.** When the construction of the project is being financed, in whole or in part, with funds provided by an agency or agencies of government other than the State of Arkansas and should such agency or agencies fail to appropriate and make available sufficient funds for the normal prosecution of the Contract, the Commission reserves the right to:

- delay issuance of the initial work order to the Contractor until sufficient funds have been made available,
- suspend construction operations on the project after the Work Order has been issued until sufficient funds have been made available, or
- terminate the Contract upon giving 30 calendar days written notice to the Contractor.

If suspension of construction operations is ordered, the requirements of Subsection 108.05, as applicable, shall govern.

If the Contract is terminated by the Commission, the requirements of Subsection 108.08, as applicable, shall govern.

If it becomes necessary to suspend work because of insufficient funds, additional time for completion will be allowed equal to the period during which work is necessarily so suspended. In no case will additional compensation be allowed for such suspension of work except an equivalent extension of time for completion of the Contract.

**108.11 Termination of Contractor's Responsibility.** The Contract will be considered complete when all work has been finished, the final inspection made by the Engineer, and the project accepted by the Department. The Contractor's responsibility shall then cease, except as may be required by law or as set forth in the Surety bonds and insurance policies.

## **SECTION 109 MEASUREMENT AND PAYMENT**

**109.01 Measurement of Quantities.** Work acceptably completed under the Contract will be measured by the Engineer according to United States Standard measures or the International

System of units (SI, or metric). **The unit of measure designated by the contract, be it US Standard or metric, will be the governing dimension for all inspection, testing, staking, and quantities on the project.** Only actual quantities will be paid for unless otherwise specified. Unless otherwise specified, the following listed methods will be used:

(a) For computing volumes of excavated materials, such as excavation, embankment, borrow, soil aggregate, etc., specified for measurement by the cubic yard (cubic meter), the average end area method will be used.

(b) Structures will be measured to the neat lines as shown on the plans or as finally constructed at the direction of the Engineer.

(c) Items that are measured by the linear foot (meter), such as pipe culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed.

(d) In determining the area for items bid on a square yard (square meter) or acre (hectare) basis, except as noted below, the longitudinal measurement will be made along the actual surface of the item and not horizontally, and transverse measurements shall conform to the dimensions shown on the plans or as directed by the Engineer. For items measured by the square yard (square meter), no deduction will be made for any fixture or opening having an area of 9 square feet (1 square meter) or less.

In determining the area for clearing and/or grubbing items bid on an acre (hectare) basis, the longitudinal and transverse measurements will be made on a horizontal basis. The area will be computed to the nearest 0.01 acre (0.01 ha).

In determining the area for all seeding and mulch cover items bid on an acre (hectare) basis, when the area is a strip of varying width running approximately parallel to the centerline of the roadway, the longitudinal dimension will be measured horizontally and the transverse dimension will be measured parallel to the surface of the area seeded and/or mulched. For other areas of seeding and mulch cover items, all measurements will be made parallel to the surface of the area seeded and/or mulched. The area will be computed to the nearest 0.01 acre (0.01 ha). No deduction will be made for driveways, streets, and similar gaps that are 20' (6 m) or less in the

dimension parallel to the centerline of the roadway, nor for ditch paving or similar construction that is 6' (2 m) or less in width.

(e) Materials that are specified for measurement by the cubic yard (cubic meter) in vehicles shall be hauled in approved vehicles and measured therein at the point of entry on the project. Approved vehicles for this purpose may be of any type or size satisfactory to the Engineer, provided the body is of such type that the actual volume of the contents may be readily and accurately determined. No vehicle will be allowed to haul before measurements have been taken by the Department for determination of volumetric capacity.

The volume will be computed to the nearest 0.01 cubic yard (0.01 cu m) and rounded to the nearest 0.1 cubic yard (0.1 cu m). The capacity of each vehicle shall be plainly marked on such vehicle and the marking shall not be changed without permission of the Engineer. In addition, each vehicle shall bear a plainly legible identification number.

The Contractor shall strike off and level the loads and the inspector will inspect each load to check its volume at the point of entry on the project.

When requested by the Contractor and approved by the Engineer, materials specified to be paid for by the cubic yard (cubic meter) may be measured by weighing the material according to (f) below and converting to cubic yards (cubic meters) by a constant factor, computed by determining the average weight of a minimum of three loads, deducting for moisture in excess of 5%, and dividing the known volume by the computed weight.

(f) Materials that are specified for measurement by the ton (metric ton) shall be hauled in approved vehicles bearing a plainly legible identification number and weighed on accurate, approved scales furnished by the Contractor and inspected by a registered scale mechanic at least once a year and before their use after each move. Scales shall be located at the loading point or other approved location.

The scales shall be an automatic weighing system, with digital or springless dials, and equipped with an automatic ticket printer. An automatic ticket printer is defined as a device connected to the weighing system in such manner that it automatically detects the weight determined by the system. It shall store and recall the TARE

weight when the operator enters the truck identification. It shall print the following information on the ticket:

- Gross, Tare, and Net weights.
- Identification of the truck.
- Current date.
- For asphalt mixtures, the time of loading or weighing.
- A unique ticket number (may be preprinted on the tickets).

The NET weight should be computed by the weighing system; however, it may be computed manually and keyed in for printing.

When the net weight of the material is determined by batch weights, the scales used shall meet all applicable requirements specified for truck scales, including automatic ticket printing, except that the GROSS and TARE weights will not be required.

The ticket shall accompany each load delivered to the project. In addition to the items shown above that must be printed by the ticket printer, the following information shall also be shown on each ticket:

- Identification of the project.
- Identification of the material being delivered, including mix design numbers for asphalt mixtures.

The ton shall be the short ton of 2000 pounds. (The metric ton shall be 1000 kg.) Vehicles used to haul materials measured by weight shall be weighed empty for each load, or shall be weighed daily or from time to time during the day as the Engineer may direct, to establish the tare weight of each load. The scales furnished shall be capable of weighing the entire loaded vehicle at one time.

Deduction will be made for the weight of moisture in aggregates in excess of 5% of the oven-dry weight of the material.

When requested by the Contractor and approved by the Engineer, aggregates specified to be paid for by the ton (metric ton) may be measured by the cubic yard (cubic meter) in vehicles as specified in (e) above and converting to tons by a constant factor established by determining the average weight of a minimum of three loads, deducting for moisture in excess of 5%, and dividing by the known volume.

(g) Asphalt binders, liquid asphalts, and asphalt emulsions will be measured by the gallon (liter or kiloliter) or by the ton (metric ton) in

distributors, transfer tanks, supply tanks, or tank cars as may be appropriate; or may be measured by other methods specified under the individual item. Volumetric measurements of asphalt binders and liquid asphalts will be corrected to 60° F (15 °C) using correcting tables from Chapter 11, Section 1, of the American Petroleum Institute's *Manual of Petroleum Measurement Standards*. Volumetric measurements of asphalt emulsions will be corrected to 60° F (15 °C) using the expansion coefficient factor of 0.00025 per degree Fahrenheit (0.00045 per degree Celsius). Water added to dilute emulsified asphalt will not be included in the pay quantity.

Volumetric measurements made in the various types of tanks, including distributors, may be based on calibration of the tanks made by the Engineer, an authorized employee of another State Department of Transportation, a private laboratory approved by the Engineer, or by the manufacturer. If the calibration has not been made by the Engineer, the Department reserves the right to verify the calibration before the use of the distributor or tank. In the case of railroad tank cars or distributors, the outage table furnished for each tank by the manufacturer may be used in lieu of actual calibration of the tank.

The Contractor shall furnish, at no cost to the Department, all necessary equipment, materials, and assistance for such calibration or verification. The Contractor shall furnish the Engineer with an outage table, obtained from the shipper, for each railroad tank car containing asphalt material received and unloaded on the project. When shipment is made by tank truck, the Contractor shall furnish the Engineer with a copy of the delivery ticket for each load showing the gallons (liters) at the temperature when loaded, but in no case shall such delivery ticket be used as a sole basis of payment in lieu of measurement through a calibrated distributor or tank. Pay quantities will include only the material actually used on the work at the direction of the Engineer.

**(h)** Timber will be measured by 1000 foot board measure, (M.F.B.M.) [cubic meter]. Measurements will be based on nominal width and thickness based on applicable grading rules.

**(i)** The term "gage" (or "gauge"), when used in connection with the measurement of plates, will mean the U.S. Standard Gage.

Wire and wire mesh for concrete reinforcing will be specified by wire size number as shown in AASHTO M 32.

(j) Cement will be measured by the ton (metric ton). Fly ash or ground granulated blast-furnace slag used as a replacement for cement will be measured as cement.

(k) A station (metric station) when used as a definition or term of measurement will be 100 linear feet (100 meters) measured horizontally.

(l) The term "lump sum" when used as an item of payment will mean complete payment for the work described in the Contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

It is the intent of these Specifications that ALL measurements of pay quantities shall be made according to the system of measurement used in the Contract. If a pay quantity in a metric contract is measured in English units and it is not feasible to re-measure the quantity in metric units, the conversion factors listed in the following table will be used to convert the measured quantity to the pay quantity. The Contractor will be responsible for converting any products purchased for incorporation into the work into the Contract units. Any products manufactured by the Contractor or subcontractor for incorporation into the work shall be produced in the units designated in the Contract. The results of the conversion will be rounded to the appropriate number of significant figures, but in no case to a precision greater than 0.01 unit.



**Conversion Factors for Pay Quantities**

<b>Multiply</b>	<b>by</b>	<b>to get</b>
inch	25.4000	millimeters (mm)
foot	0.3048	meter (m)
yard	0.9144	meter (m)
mile	1.6093	kilometer (km)
square inch	645.1600	square millimeter (sq mm)
square foot	0.0929	square meter (sq m)
square yard	0.8361	sq m
acre	0.4047	hectare (ha) [10,000 sq m]
cubic inch	16.3871	cubic centimeter (cc)
cubic foot	0.0283	cubic meter (cu m)
cubic yard	0.7646	cu m
gallon	3.7854	liter (L)
pound	0.4536	kilogram (kg)
ton (2000 lb)	0.9072	metric ton (mton) [1,000 kg]

**109.02 Scope of Payment.** Payments to the Contractor will be made for the actual quantities of contract items completed and accepted according to the plans and specifications and if, upon completion of the construction, these actual quantities show either an increase or decrease from the quantities given in the proposal schedule, the contract unit prices will still prevail, except as provided in Subsections 109.03 or 109.04.

The Contractor will receive and accept the compensation herein provided as full payment for furnishing all materials, labor, equipment, tools, and incidentals necessary to the completed work; for performing all work contemplated and embraced under the Contract; for all loss or damage arising out of the nature of the work, or from the action of the elements, or from any unforeseen difficulties or obstructions that may arise or be encountered during the prosecution of the work until its final acceptance by the Commission; for all risks of every description connected with the prosecution of the work; for all expenses incurred by, or in consequence of, the temporary suspension or discontinuance of the work as herein specified; for any infringement of patent, trade mark, or copyright; for all costs of permits, licenses, fees, and taxes; and for completing the work in an acceptable manner according to the plans and specifications. The payment of current or final estimate, or of retained percentage, shall in no degree prejudice or affect the obligation of the Contractor, at no cost to the Department, to repair, correct, renew, or replace any defects or imperfections in the

construction of the roadway and its appurtenances, or in the strength of or quality of materials used therein or thereabouts, or relieve the Contractor from the payment of all damages due to such defects; provided such defects, imperfections, or damages shall be discovered on or before the final inspection or acceptance of the entire work. No retained percentage payable under the Contract, or any part thereof, shall become due and payable, if the Commission so elects, until the Commission is satisfied that the Contractor has fully settled or paid for all materials and equipment used in or upon the work, and for all labor done in connection therewith, and the Commission, if it so elects, may pay any or all such accounts wholly or in part and deduct the amount or amounts so paid from the final estimate.

Any overpayments made to the Contractor or Surety, from whatever cause, are due and payable to the Department upon receipt by the Contractor or Surety of a request setting forth the particulars, regardless of pending claims or intention of the Contractor or Surety to file a claim.

**109.03 Payment and Compensation for Altered Quantities.** When alterations in plans or quantities of work not requiring supplemental agreements are ordered and performed as provided in Subsection 104.02 or 104.03, and when such alterations result in an increase or a decrease of the quantity of work to be performed, the Contractor shall accept payment in full at the contract unit prices for the actual quantities of work accomplished, except as provided in Subsection 104.02 or 104.03, and no allowance will be made for anticipated profits, organization or overhead expense, or interest. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

**109.04 Extra and Force Account Work. (a) Supplemental Agreement.** Extra work performed under a Supplemental Agreement shall be agreed upon by both the Engineer and the Contractor and shall be documented by an approved Change Order before the work is performed. When the Engineer deems it impractical to handle extra work on a unit price basis, payment specified in the Supplemental Agreement may be by any method agreed upon by both the Engineer and the Contractor. Mutual agreement between the Engineer and the Contractor as to the amount to be paid and method of payment under a Supplemental Agreement

may be based on an estimate of the costs of performing the work; detailed information such as required for Force Account work; or any other logical method to which both parties agree which estimates costs incurred, excluding loss of anticipated profits and organization or overhead expense.

**(b) Force Account.** Work ordered and accomplished by Force Account shall be documented by an approved Change Order **prior to beginning the work.** Payment for work accomplished on a Force Account basis, shall be made according to the following:

**(1) Labor.** For all labor and foremen employed on the specific operation, the Contractor will receive the current local rate of wage, or the wage stipulated in the Contract, for each and every hour that said labor and foremen are actually engaged in such work, to which will be added an amount equal to 20% thereof. Only the actual amount of insurance and payroll taxes imposed by law and paid by the Contractor on the labor used will be allowed. No charge shall be made by the Contractor for organization or overhead expense. The number of laborers and foremen employed in the work shall be subject to regulation by the Engineer, and the number so employed shall not exceed the number the Engineer deems most practical and economical for the work.

**(2) Materials.** For all materials used, if furnished by the Contractor, the Contractor will receive the actual cost of such materials, including freight, hauling, and handling charges, as shown by original receipted bills or certified statements, to which cost will be added a sum equal to 15% thereof.

**(3) Equipment.** For any Contractor owned machinery or special equipment (other than small tools) which has been authorized by the Engineer, the Contractor shall receive the rental rates specified in the Change Order authorizing the work. The hourly rental rates shall be determined from the applicable monthly schedule in the current edition of the *Rental Rate Blue Book for Construction Equipment*, published by EquipmentWatch, a PRIMEDIA Business Directories and Book Group, as follows:

The established rental rate shall be equal to the monthly rate for the basic equipment plus the monthly rate for applicable

attachments, both divided by 176, all multiplied by the regional adjustment factor and the rate adjustment factor, plus the estimated hourly operating costs.

For equipment not listed in this schedule, the Contractor shall receive a rental rate as agreed upon and specified in the Change Order for the work. If agreement cannot be reached, the Department reserves the right to establish a rate based on similar equipment in the schedule or on prevailing commercial rates in the area.

Equipment that must be rented or leased specifically for extra work required by Change Order shall be authorized in writing by the Engineer. The Contractor shall be paid the invoice price for the rented or leased equipment, but not to exceed the applicable "Blue Book" rate, plus the estimated hourly operating costs.

When it is necessary to obtain equipment from sources beyond the project limits exclusively for extra work of less than one month duration, the cost of transferring the equipment to the site of the work and return will be allowed as an additional item of expense. Where the move requires the use of a hauling unit, the move-in allowance will be limited to the rental rate, as computed above, for the hauling unit plus operator wages. In the event that the equipment is transferred under its own power, the moving allowance will be limited to one half of the hourly rental rate, as computed above, plus operator's wages. In the event that the move-out is to a different location, payment will in no instance exceed the amount of the move-in. Move-in allowance shall not be made for equipment brought to the project for extra work but which is subsequently retained on the project and utilized for completion of other contract items or related work.

Standby time will be paid only on valid and documented claims made for equipment under Section 104.02 or on equipment ordered brought to the project or ordered held on the project by the Engineer. Equipment already on the project to complete other contract items will not be considered for payment for standby time.

Equipment authorized or deemed by the Engineer to be on a standby basis shall be paid for at the standby rental rate for the number of hours in the Contractor's normal work day, but not to

exceed 8 hours per day. The standby rental rate shall be computed by the following formula:

$$\text{Standby rate} = \frac{\text{Established rental rate} - \text{Operating costs}}{2}$$

Time will be recorded to the nearest one quarter hour for purposes of computing compensation to the Contractor for equipment utilized under these rates.

The equipment rates as determined above shall be full compensation for providing the required equipment and no additional compensation will be made for other costs such as, but not limited to, fuels, lubricants, replacement parts, or maintenance costs. Cost of repairs, both major and minor, as well as charges for mechanic's time utilized in servicing equipment to ready it for use before moving to the project, and similar charges will not be allowed.

(4) The compensation as herein provided shall be received by the Contractor as payment in full for extra work done on a Force Account basis, and shall include the proper supervision of the work as well as furnishing small tools and equipment required by the labor employed, without additional compensation other than provided in clauses (1), (2), and (3) of this subsection. The Contractor's representative and the Inspector shall compare records of the extra work done on a Force Account basis, at the completion of certain units of the work or at intervals considered most practical. Copies of those records shall be made in duplicate, upon suitable forms provided for this purpose, and signed by both the Inspector and Contractor's representative, one copy each being forwarded to the Engineer and to the Contractor. All claims for extra work done on a Force Account basis, shall be submitted to the Engineer by the Contractor upon certified statements, to which shall be attached original receipted bills or certified statements covering the cost of and the freight charges on all materials used in such work, and said statements shall be filed not later than the tenth day of the month following that in which the work was actually performed, and shall include all labor, equipment, and material accounts properly chargeable to the work. Payment will then be made on the next regularly scheduled estimate following receipt of all required documents.

**109.05 Vacant.**

**109.06 Vacant.**

**109.07 Partial Payments. (a) Current Estimates.** The Engineer will make in writing, at two-week intervals, an estimate of the materials in place and the amount of work performed during the preceding period and the value thereof at the contract unit prices. Payments for lump sum items will be made in proportion to the amount of work accomplished, as determined by the Engineer. Payments made on current estimates shall be subject to correction on any subsequent current estimate and/or on the final estimate.

The estimate period will begin on Monday and the initial beginning date will be established by the Engineer at the preconstruction conference.

The Engineer may withhold any current estimate or portion thereof if the Contractor is negligent or delinquent in submitting any required forms or documents, or if a timely response is not given to a request made by the Department for information, price quotations, or other data pertinent to the prosecution of the work.

**(b) Materials Estimates.** At the request of the Contractor, the Engineer may at any time submit a materials estimate which will include the value of all aggregates, signing and lighting materials, precast concrete products, pipe culverts, piling, bridge railing, guard fence, reinforcing steel, structural steel, steel wire mesh, or other approved manufactured or commercially produced materials, delivered on the job site or placed in an approved storage area, but not incorporated into the work at the time of such estimate, provided the total value of such materials, including freight charges, appearing on any one estimate is not less than Twenty Thousand Dollars for paid invoices or Fifty Thousand Dollars for unpaid invoices, and only with agreement of the Surety. The approved storage area for materials for which advanced payment is made must be located within the State of Arkansas. This requirement may be waived if the Contractor provides the Department a separate bond for the full amount of the requested estimate. This Advance Materials Payment Bond shall remain in effect until the full amount of the advance payment has been recovered. All estimates in which materials allowances are made shall be approved by the Engineer in writing before payment and the Contractor shall be responsible for the

storage, safekeeping, and delivery in acceptable condition of all materials for which payments have been allowed.

Materials estimates will be allowed only for those materials that will be permanently incorporated into the work. The quantities allowed on a materials estimate will not exceed the plan quantities or quantities established by approved change order. Payments made on materials estimates will be deducted as the material is incorporated into the work.

To request advance payment for stockpiled materials for which the Contractor has paid in full, the Contractor shall submit the following documentation:

1. Written request for advance payment for stockpiled material, signed by the Contractor and the Surety.
2. Documentation of the quantity and cost of the material.
3. For commercially produced or manufactured material, receipted (paid) bills or invoices, signed by a duly authorized Officer of the firm supplying the materials and properly notarized.
4. For materials produced by the Contractor, detailed statements showing the delivered cost of the material. Such statements shall also include receipted (paid) bills or invoices for royalty payments and/or a Certification of Ownership signed by a duly authorized Officer of the firm supplying the material and properly notarized.
5. Certification by the Contractor that the material meets the Specification requirements for the stage of production at which the material is stored.

To request advance payment for stockpiled materials for which the Contractor has NOT paid in full, the Contractor shall submit the following documentation:

1. A written request for advance payment for stockpiled material, signed by the Contractor, the Supplier, and the Surety. This statement shall plainly state that the materials have not yet been paid for and that the Supplier shall be paid in full within 10 calendar days from the Contractor's receipt of payment by the Department. It shall further state that the Contractor shall provide the Department with paid invoices within 10 calendar

days of payment to the Supplier and that the Surety agrees to responsibility for payment should the Contractor fail to so pay.

2. Documentation of the quantity and cost of the material.
3. For commercially produced or manufactured material, unpaid bills or invoices, signed by a duly authorized Officer of the firm supplying the materials and properly notarized.
4. Certification by the Contractor that the material meets the Specification requirements for the stage of production at which the material is stored.

**109.08 Surplus Materials.** Materials purchased or produced according to the plans or Contract, actually delivered and on hand and surplus to the needs of the project through any act or omission of the Department, may with the approval of the Engineer, be purchased by the Department. Payment will be made through the current or final estimate and shall be based on actual delivered cost to the Contractor as shown by receipted, paid bills, or by an approved certified statement of cost of production. All materials

paid for as provided above shall be placed in the possession of the Department at the site and become the property of the Department.

**109.09 Acceptance and Final Payment.** The Engineer will approve the estimate for final payment after previous payments have been deducted, and will notify the Contractor and Surety of such approval.

Before delivery of the final payment, the Engineer shall receive from the Contractor a written acceptance of the final estimate as payment in full for the work done. The final estimate shall be considered as the final payment even though it may be a zero amount. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

## **SECTION 110 PROTECTION OF WATER QUALITY AND WETLANDS**

**110.01 General.** This work shall consist of measures taken to prohibit the degradation of water quality and wetlands. The purpose



is to limit, control, and contain fill materials, soil erosion, sedimentation, and other harmful wastes resulting from construction operations that could result in harm to the wetlands and waters of the United States. These requirements apply even if Corps of Engineer (C of E) Section 404 or National Pollutant Discharge Elimination System (NPDES) Permits are not required for the project.

The requirements of this Section apply to all activities under the Contract. The Contractor should be aware that requested modifications to the Contract and/or individual permits may not be approved.

The Contractor shall comply with all applicable Federal, State, and local permits and requirements on sites outside of the right-of-way limits utilized by the Contractor for the benefit of the project. While the primary enforcement of these requirements for locations off of the right-of-way rests with the applicable regulatory government agency, the Department retains the right and authority to inspect and enforce Contractor compliance should violations come to the attention of the Department.

**110.02 Responsibility of the Contractor.** The Contractor shall comply with the requirements of the Federal Water Pollution Control Act, 33 USC § 1251 et seq., the Arkansas Water and Air Pollution Control Act, Ark. Code Ann. § 8-4-101 et seq., and the regulations, orders, or decrees issued pursuant thereto. In the event of conflict between these regulations, orders, or decrees and the provisions shown on plans, the more restrictive requirements shall apply.

**110.03 C of E Section 404 Permit for Department Right-of-Way and Contractor Facilities. (a) General.** All requirements of the Contract and Specifications shall apply to the Contractor's activities covered by the Department's C of E Section 404 Permit on or off the right-of-way. Section 404 of the Federal Water Pollution Control Act, as amended, establishes a permit program for the regulation of discharges for dredged or fill material and excavation in wetlands and other waters of the United States.

**(b) Responsibility for Initial Section 404 Permit.** The Department will obtain all required Section 404 Permits for essential work on the right-of-way before the Contract is awarded. Contract documents will detail the location and amount of permanent and/or

temporary fills, excavation, and clearing activities allowed under the Section 404 Permit.

**(c) Contractor Requested Section 404 Permit Modifications.**

The Contractor shall submit a request on a form provided by the Department to the Engineer for any activity involving wetlands or waters of the United States on or off the right-of-way and not covered by the Department's C of E Section 404 Permit prior to performing the activity. The Contractor shall be prepared to prove there is no practicable alternative to the Section 404 Permit change being requested. The Engineer will make a within 10 business days concerning the necessity or practicability of the request. The Department will then apply for Section 404 Permit modifications it determines to be necessary or practicable. The C of E review of proposed modifications to a Section 404 Permit may require 60-120 calendar days. These requested changes may be denied or modified by the Department or C of E. Requested modifications that require mitigation may be at the Contractor's expense.

If the Department declines to consider a Section 404 Permit modification request by the Contractor for an off right-of-way activity, the Contractor may apply for his own Section 404 Permit.

**(d) Compensation and Extension of Contract Time.**

The Contractor will not be granted additional compensation or contract time due to requested modifications to the Section 404 Permit that are considered by the Engineer to be for the convenience of the Contractor. If, however, due to no fault of the Contractor, a Section 404 Permit modification involving on right-of-way activities is deemed by the Engineer to be necessary, additional contract time and/or compensation may be considered according to the provisions of Section 104.

**110.04 NPDES Permit (a) General.** Federal requirements mandate that excessive amounts of pollutants be prevented from exiting construction sites. The Arkansas Department of Environmental Quality (ADEQ) has issued the NPDES Permit for owners of facilities discharging storm water associated with construction activity located in the State of Arkansas. Copies of the NPDES Permit are available from ADEQ.

NPDES Permit coverage is required for all construction sites that will result in land disturbance of one acre or more, by activities such

as clearing, grading, or excavating, in accordance with the following:

- (1) Automatic Coverage (Small Construction) Sites: Small Construction Site permits are required for any construction activity that will disturb/expose a total of one acre or more, but less than five acres. This also applies to any construction activity that will disturb/expose less than one acre, if it is part of a plan that will ultimately disturb/expose one acre or more.
- (2) Large Construction Sites: Large Construction Site permits are required for any construction activity that will disturb/expose a total of five acres or more.

The Department will obtain NPDES Permit coverage for essential work on the right-of-way before the Contract is awarded. The Contractor will be responsible for posting the NPDES Permit Notice of Coverage (NOC) at the construction site prior to commencing construction. The Engineer will provide the NOC to the Contractor to post on the project at a safe, publicly accessible location near where construction is actively underway. The Contractor shall move it as necessary to comply with the NPDES Permit requirements.

All off-site areas, including storage sites or borrow areas or waste areas, are operated by the Contractor. The Contractor shall be responsible for obtaining any required NPDES permits for off-site areas. Off-site areas within city limits are subject to city planning regulations and may require clearance from the city. Off-site areas that fall within the jurisdiction of a “Qualifying Local Program” (QLP) as defined in the NPDES Permit, must comply with the requirements of the QLP. The Contractor shall obtain clearances and approvals of this type for their off-site areas.

The Contractor shall be responsible for obtaining all required permits for the operation of dedicated asphalt and dedicated concrete plants operated by the Contractor for, or located on, the project.

**(b) Storm Water Pollution Prevention Plan.** The Department will develop a Storm Water Pollution Prevention Plan (SWPPP) for the project, as required. Any measures required by the SWPPP are included in the plans, specifications, supplemental specifications, and special provisions. The Engineer will maintain the SWPPP at

the project field office or, if a field office is not provided, the SWPPP will be maintained with the Department's on-site personnel.

Prior to beginning work on the project, the Contractors shall complete the Contractor Identification section of the Storm Water Pollution Prevention Plan as required by Part II.4.B of the NPDES Permit.

The Contractor shall inform the Engineer sufficiently in advance of planned construction activities and conduct construction activities in a manner to allow the SWPPP to be modified to accommodate the activities.

The Contractor shall be responsible for compliance with all applicable terms and conditions of the NPDES Permit as it relates to activities on the construction site, including installation and maintenance of Best Management Practices (BMPs) and other controls required by the SWPPP. Special provision(s) for the protection of endangered species will be a part of the Contract, if applicable.

**(c) Controls and Measures.** All controls are designed and installed with the primary goal of retaining sediment on site to the maximum extent practicable.

The Contractor shall provide the following information, in writing, to the Engineer sufficiently in advance of installation to allow incorporation into the SWPPP:

- The sequence of major activities, the erosion and sediment control items associated with the major activities, and the timing of implementation for those items are required for the SWPPP.
- A planned sequence of major activities, with the associated BMPs.
- Amendments to the planned sequence of major activities.
- Stabilized or wheel washing vehicle exits from the construction site as required to prevent tracking of material onto the public roadway.
- Temporary sanitary facilities provided and properly maintained by the Contractor.

- Concrete washout waste areas to be utilized to prevent concrete waste from being discharged into water bodies.
- Storage areas for fuel and other potentially hazardous materials and truck washing areas with appropriate controls to prevent non-storm water discharges.

**(d) Non-storm water discharges.** The Contractor shall not release any materials except the following non-storm water discharges that are authorized by the NPDES Permit: discharges from firefighting activities; fire hydrant flushings; wash water (without detergent or spilled material); water used to control dust; potable water sources including waterline flushings; irrigation drainage; air conditioning condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated.

All other non-storm water discharges are prohibited unless in compliance with and covered by a separate NPDES permit.

**(e) Releases in excess of reportable quantities.** Instructions to be followed after the release of a hazardous substance or oil are provided in Subsection 107.01(f) of the Standard Specifications and Part I of the NPDES Permit.

The Contractor shall submit the following information as soon as possible, but no later than 72 hours after knowledge of the release, to the Engineer for submission to ADEQ: A written description of the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and steps to be taken in accordance with the NPDES Permit for forwarding to ADEQ.

**110.05 Standard Conditions. (a) General.** The following conditions are required on all projects for the protection of water quality and wetlands:

- Compliance with all conditions of the C of E Section 404 Permit, NPDES Permit, Short Term Activity Authorization (STAA), Section 7 of Endangered Species Act, and Section 401 Water Quality Certification.
- To the maximum extent practicable, discharges of dredged or fill material into waters of the United States shall be avoided or minimized through the use of other practicable alternatives.

- Construction activities shall not cause unacceptable interference with navigation.
- No activity shall substantially interrupt the movement of the species of aquatic life native to the water body, including those species which normally migrate through the area.
- Under a Nationwide Section 404 Permit, no activity shall occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in official study status. Standard (individual) Section 404 Permits shall be obtained for activities occurring in these rivers.
- No storage of petroleum, other chemical products, waste materials, trash, etc., shall be allowed within 100 feet (30 meters) of a wetland or water body boundary or elevation as shown on the plans. The Engineer reserves the right to limit the storage of any material within the floodplain of a stream to preclude the possibility of an unlawful discharge to the stream.
- To move clean water around the construction area without causing additional turbidity or sediment, the use of construction staging, cofferdams, pipe culverts, lined channels, sandbagged material, barrier wall, or other suitable materials or methods, as approved by the Engineer, shall be utilized for directing or confining water from the work area. This water shall be returned to the water body downstream from the construction site. The options utilized should consider the minimization of sedimentation and turbidity as a primary objective.
- If material or debris resulting from Contractor operations enters a waterway, it is considered an unpermitted fill material under the Section 404 Permit and the Engineer shall determine whether it may remain. If it is determined that the material is to be removed from the waterway, the Engineer will review for possible approval the Contractor's method of removal. Options for removal should consider the minimization of turbidity as a primary objective.
- No asphaltic material shall be disposed of in wetlands or waters of the United States.

- Temporary bridges or other structures shall be used whenever it is necessary to ford any body of water on the project more than twice in any six month period.
- Equipment shall not be operated in any body of water on the project except when required to construct channel changes or structures.
- Cofferdams needed for work in water shall be constructed from non-erodible materials.
- Materials excavated during construction shall be placed on dry land outside the channel banks of all streams, at least 10 feet (3 meters) from the channel banks of a perennial stream, and at least 25 feet (8 meters) from the channel banks of a 5 cubic feet/second (CFS) or larger stream. This includes channelized streams and relief channels. This material shall be properly contained or stabilized to minimize erosion and degradation of water quality and be removed before the beginning of the wet season.

**(b) Wetland Areas.** Wetland areas on and off the right-of-way shall be preserved and protected whenever possible. Work in or near wetlands shall be performed in a manner that will minimize harm to the wetlands. The Contractor shall be responsible for the protection of adjacent wetlands.

- Clearing of wetlands shall be limited to the minimum necessary for the completion of the project.
- Wetland areas inside or outside the construction limits shall not be used for storage, parking, access, borrow material, haul roads or any other construction support activity unless specifically approved in advance by the Engineer and according to the applicable Section 404 Permit.
- When heavy equipment is working in wetlands, appropriate measures such as placing the equipment on mats, shall be taken to minimize soil disturbance.
- Material shall not be wasted or temporarily stockpiled in wetlands.

**(c) Temporary Fill.**

- Unless otherwise provided, temporary work ramps or haul roads, when permitted, shall provide sufficient waterway openings to allow the passage of expected high flows during the time the ramp or haul road is in place.

- Temporary fills or structures, if washed downstream, are considered to be unauthorized fill under the C of E Section 404 Permit and the Engineer shall determine whether it may remain. If it is determined that the material is to be removed from the waterway, the Contractor shall submit, in writing, the proposed method of removal to the Engineer for possible approval. When considering options for removal, the Contractor shall consider the minimization of turbidity as a primary objective. Replacement of original fill may require a Section 404 Permit change or an additional Section 404 Permit.
- All fill for temporary work ramps or haul roads placed within the channel banks of a stream, within 10 feet (3 meters) of the channel banks of a perennial stream, and within 25 feet (8 meters) of the channel banks of a 5 cubic feet/second (CFS) or larger stream, shall be constructed using a riprap of the size specified in Subsection 816.02(a)(2), or larger material. This includes channelized streams and relief channels. A minimal amount of clean stone or gravel may be placed on top of the temporary fill in order to obtain a smooth working surface. The clean stone or gravel utilized shall have less than twelve percent passing the #200 (0.075 mm) sieve. Upon removal, salvaged material that meets the requirements of Subsection 816.02 will be paid for when reused in areas which require the utilization of riprap.
- Unless specifically authorized under the Section 404 Permit as temporary or permanent fill material, bridge demolition rubble shall not be dropped into a water body or wetland.
- All fill material shall be free from toxic pollutants in harmful amounts.
- All temporary fills shall be removed and the affected areas returned to their preexisting elevation.
- All temporary fill in any body of water or wetland shall be properly contained or stabilized to minimize erosion and degradation of water quality.

**(d) Erosion and Sediment Control.** The Contractor shall install, construct, and maintain erosion and sedimentation control items as shown on the plans or as directed by the Engineer.



- The Contractor shall install, construct, repair, and maintain erosion and sedimentation control items within three business days of being instructed to do so by the Engineer. However, if heavy equipment is required and the Engineer agrees that conditions do not allow heavy equipment to be used, a longer time frame may be allowed. The Contractor shall submit adequate documentation to the Engineer that proves conditions are not suitable for the use of heavy equipment and that there is no alternative to its use. When conditions become suitable, as determined by the Engineer, the Contractor shall proceed with the required actions to be completed within three business days after receiving notification.
- Minimizing time of exposure of disturbed ground is a primary objective. Therefore, disturbing an area and postponing subsequent work could result in the Contractor being required to stabilize the area at no cost to the Department. Unless modified on the plans or directed by the Engineer, the total surface area of disturbed soil on the right-of-way at any one time shall be limited to a maximum of 20 acres (8 hectares). Disturbed soil is defined as exposed bare soil denuded of vegetative cover or lacking stabilization. Stabilized soil is defined as soil that is covered by grass, seeded and mulched, mulched, covered by erosion control matting, or covered by permanent stabilization as shown on the plans or as directed by the Engineer. The Engineer will have the authority to increase or decrease the limitation on surface area of disturbed land based upon the Contractor's capability to effectively control erosion and sedimentation on these areas and contain the sediment within the right of way limits, including temporary construction easements (TCE). The Contractor shall be responsible for making the necessary arrangements with the proper owner(s) and for reclaiming sediment and stabilizing the area that is not contained within these limits. This work will be the responsibility of the Contractor and shall be performed at no cost to the Department.
- Cut and fill slopes shall be completed and stabilized in increments not to exceed 25 feet (8 meters), measured vertically, as the construction progresses.
- Completed areas within buffer zones adjacent to water bodies as shown on plans or otherwise designated by the Engineer,

shall receive permanent seeding, temporary seeding, or mulch cover as soon as possible, but in no case more than five business days after completion, or sooner as directed by the Engineer.

- All other completed areas, including increments of cut and fill slopes described above, shall receive permanent seeding, temporary seeding, or mulch cover within 14 calendar days after completion, or sooner as directed by the Engineer.
- Disturbed areas that are temporarily abandoned shall be stabilized within 14 calendar days after activity ceases. Payment for this work will be made if abandoned due to no fault or negligence of the Contractor. Payment will not be made for temporary stabilization required by Contractor negligence, by the lack of proper Contractor scheduling, or for the convenience of the Contractor.
- Excavation, including silt removed from erosion and sedimentation control devices, shall not be deposited where it can be eroded into waters of the United States. At locations of drainage structures, care shall be taken to prevent mounds of excavation on the inlet end from washing through the structure or on the outlet end from washing downstream.
- Water pumped during any dewatering activity shall be diverted into a sediment basin of the appropriate type as shown on the standard drawings or other device as approved by the Engineer. This sediment basin or device and its holding capacity shall be approved by the Engineer. No turbid discharge to waters of the State shall be allowed.
- Off-site vehicle tracking of sediments and the generation of dust shall be minimized. The Contractor shall construct stabilized entrances to the work areas as necessary to eliminate off-site tracking of soils. Work involved in constructing stabilized entrances will not be measured or paid for separately, but full compensation therefore will be considered included in the contract unit prices bid for other items of the Contract. Sediment tracked from the construction site shall be removed by sweeping at a frequency to minimize off-site impacts to water bodies.
- After cut sections are constructed, the tops of backslopes will be rounded to blend the slopes into natural ground when

practicable. At transitions from cut to fill, ditches shall be tailed out to prevent erosion of the toe of slope.

- Temporary erosion and sedimentation control devices shall not be removed or destroyed by the Contractor without permission from the Engineer.

Additional temporary and permanent erosion and sedimentation control items necessary on the right-of-way to contain discharges that are not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls, shall be performed as ordered by the Engineer and will be paid for either at unit bid prices or as provided for in Subsection 109.04.

**110.06 Pollutants. (a) General.** The Contractor shall employ best management practices to prevent pollution by spills. Pollutants such as chemicals, fuels, lubricants, asphalt, raw sewage, concrete drum wash water, and other harmful wastes shall not be discharged into or alongside any waters of the United States, but shall be disposed of in accordance with governing State and Federal regulations. Storage of these materials shall not be allowed within 100 feet (30 meters) of a wetland or water body.

**(b) Spill Prevention.**

**(1) Good Housekeeping.**

- The quantity of materials stored on the project should be limited, as much as practical, to that quantity required to perform the work in an orderly sequence and should be stored in a neat, orderly manner in their original containers with the original manufacturer's label.
- Manufacturer's recommendations for proper use and disposal of materials shall be followed. All disposal shall be according to all local, State and Federal regulations in a permitted landfill or permitted disposal facility.
- The Contractor should inspect daily to ensure proper use and disposal of materials.

**(2) Hazardous Products.**

- Hazardous products shall be kept in original containers with their original labels unless they are not re-sealable or are damaged.
- Material Safety Data Sheets shall be retained on site and shall be available to all personnel at all times.

- If surplus products must be disposed of, manufacturer's recommendations and local, State, and Federal regulations shall be followed.

**(3) Product Specific Practices.** The Contractor shall limit the amount of petroleum products and other chemicals in work areas adjacent to wetlands, water bodies, and other sensitive areas. The following product specific practices shall be followed on-site:

- **Petroleum Products.** All on-site vehicles shall be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products shall be stored in tightly sealed containers that are clearly labeled. All asphalt substances used on-site shall be applied according to manufacturer's recommendations and/or Department specifications. Construction of berms, or other similar measures, may be required for storage/refueling areas as a best management practice to restrict spill areas.
- **Fertilizers.** Fertilizers shall be applied only in the manner and amounts required by the specifications. Material shall be stored in a covered area and shall not be exposed to precipitation. Partially used bags shall not be discarded, but removed and disposed of properly. No storage of these materials shall be allowed within a wetland or floodplain.
- **Paints and Solvents.** All containers shall be tightly sealed and stored when not required for use. Excess material and waste shall not be discharged, but shall be properly disposed of according to manufacturers' instructions and/or State and Federal regulations. No storage of these materials shall be allowed within a wetland or floodplain.
- **Concrete Trucks.** Concrete trucks shall be allowed to discharge surplus concrete or drum wash water on site only in areas designated in the SWPPP. Discharge areas shall not be in or where the discharge can be washed into wetlands or water bodies.
- **Concrete Curing Agents.** Concrete curing agents shall be applied only in the manner and amount required by the

specifications. Excess material shall not be allowed to run off the area being treated.

**(c) Spill Reporting and Cleanup Practices.** All spills shall be reported as described in Subsection 107.01(f).

In addition, the practices below shall be followed:

- All spills shall be cleaned up immediately after discovery or contained until appropriate cleanup methods can be employed.
- The spill area shall be contained and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- Manufacturer's recommended methods for spill cleanup shall be followed along with proper disposal methods in accordance with local, State, and Federal regulations referred to previously.

Further, where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR §§ 110, 117, or 302, occurs on the right-of-way during a 24-hour period, the following action shall be taken by the Engineer:

- A report shall be submitted to the Arkansas Department of Environmental Quality within five calendar days of the knowledge of the release. The report shall include a written description of the release (including the type and estimate of the amount of material released); the date that such a release occurred; the circumstance leading to the release; and the corrective actions taken.
- The Storm Water Pollution Prevention Plan must be modified within 14 calendar days of knowledge of the release by addition of the above information. Review and modification of the plan must be made to identify measures to prevent the recurrence of such releases, and to respond to such releases.

If the spill occurs on a site off of the right-of-way, the Contractor shall follow the reporting procedures as described above.

**110.07 Contractor Negligence.** If the Contractor violates the requirements of a C of E Section 404 Permit, NPDES Permit, STAA, or any other requirement of these specifications, and fails to

properly maintain, install and/or construct erosion and sediment control items, the Engineer may take, but is not limited to, one or more of the following actions:

- Cessation of other project related work,
- Withholding of Contractor payments,
- Suspension of the Project,
- Default of the Contract.

All work required due to the violation of provisions of C of E Section 404, NPDES Permits, or other requirements of these specifications that results from Contractor negligence, carelessness, or failure to perform work as scheduled, shall be performed by the Contractor at no cost to the Department. In addition, the Contractor will be assessed the amounts of any and all fines and penalties assessed against and costs incurred by the Department which are the result of the Contractor's failure to comply with a C of E Section 404 Permit or NPDES Permit.

Failure to comply with the conditions of the C of E Section 404 Permit may result in the C of E issuing a cease and desist order for all permitted activities. Obtaining a new Section 404 Permit from the C of E may require 60-120 calendar days processing time.

The Department will not be responsible for any delays or costs due to the Contractor's failure to comply with the above special conditions. The Contractor will not be granted additional compensation or contract time due to loss of Permits for noncompliance.

In the event that pollutant spills occur which are the result of the Contractor's actions or negligence, the clean-up shall be performed by the Contractor at no cost to the State.

**110.08 Method of Measurement and Basis of Payment.** Work required to comply with this section will not be paid for separately, but shall be considered included in the unit prices bid for other items of the work.

**DIVISION 200**

**SITE PREPARATION AND EARTHWORK**

**SECTION 201**

**CLEARING AND GRUBBING**

**201.01 Description.** This work shall consist of cutting, removing from the ground, and properly disposing of trees, stumps, hedge, brush, roots, logs, weeds, rubbish, sod refuse dumps, sawdust piles, lumbering slash, and other materials within the limits of the right-of-way or other designated areas that interfere with the work or are considered objectionable.

This work shall also include selective clearing, preserving existing vegetation, scalping, and the preservation of objects designated to remain.

**201.02 General.** Areas shall be classified as clearing and/or grubbing when trees are 4" (100 mm) or more in diameter measured 12" (0.3 m) above the ground. The area shall be classified as scalping if the trees or stumps are less than 4" (100 mm) in diameter measured 12" (0.3 m) above the ground.

**(a) Clearing.** The cutting and removal of all trees, brush, and other objectionable growth, and the removal and disposal of logs, rubbish piles, refuse dumps, sawdust piles, lumbering slash, and other objectionable matter from the surface of the ground in the areas shown on the plans or designated by the Engineer.

**(b) Grubbing.** The grubbing and removal of all stumps, roots, and other objectionable matter, lying wholly or in part below the surface of the ground.

**(c) Selective Clearing.** The trimming of selected trees and shrubs, the removal from the ground and disposal of logs, root pods, brush, refuse dumps, and other undesirable debris, and the cutting, removal, and disposal of all undergrowth, stumps, and standing trees, except those trees and shrubs designated to be preserved. The selective clearing areas will be shown on the plans.

**(d) Preserved Vegetation.** Areas of the right-of-way containing trees and brush and designated on the plans as Preserved Vegetation areas shall not be disturbed except as described below. This operation normally applies to areas of natural growth occurring in

the medians, interchanges, and wide rights of way between a line 10' (3 m) beyond the construction limits and the right-of-way lines, or as designated.

**(e) Scalping.** Areas not classified as clearing and grubbing and that are within construction limits shall be scalped, if appropriate. Scalping shall include the removal and disposal of material such as saplings less than 4" (100 mm) in diameter measured 12" (0.3 m) above the ground, logs, brush, roots, grass, residue of agricultural crops, refuse dumps, and decayed matter.

**(f) Clearing and Grubbing Trees.** The cutting, grubbing, and removal of individual, isolated trees and stumps greater than 4" (100 mm) diameter measured 12" (0.3 m) above the ground as shown on the plans or designated by the Engineer to be removed.

**201.03 Construction Requirements.** Work required under Section 110 and other applicable NPDES requirements shall be conducted in conjunction with clearing and grubbing. The construction limits for the project shall be cleared as defined above, except those objects designated to remain shall be carefully protected from abuse, marring, or damage during construction operations. Trees shall be felled and removed in such a manner as to avoid injury to other trees or other objects designated to remain. In case of injury to bark, limbs, or roots of vegetation designated to remain, the Contractor shall repair such damage by corrective pruning or other appropriate methods. Trees or other debris falling outside the right-of-way shall be removed and disposed of according to these specifications.

Holes remaining after removal of trees, stumps, etc., shall be backfilled with material approved by the Engineer and compacted as directed except in areas to be excavated. The Contractor shall complete the operation by blading, bulldozing, or other approved methods, so that the right-of-way shall be free of holes, ditches, or other abrupt changes in elevations that resulted from the clearing and grubbing operations.

**201.04 Clearing and Grubbing.** The construction limits shall be cleared of stumps, brush, logs, rubbish, trees, and shrubs, with the exception of such trees, shrubs, and areas designated on the plans or by the Engineer for preservation. Grubbing will not be required in areas that will have a fill height of 3' (1 m) or more above



undisturbed stumps cut within 6" (150 mm) of the natural ground. Sound stumps may be left outside the construction limits when they are severed flush with or below the natural ground, or the slope line in areas to be rounded at the top of the back slopes.

Low-hanging, unsound, or unsightly branches shall be removed from trees or shrubs designated to remain. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20' (6 m) above the roadbed surface. Trimming shall be done by skilled workers and according to good tree surgery practices.

Merchantable timber in the clearing area that has not been removed from the right-of-way before the date that the Contract is awarded by the Department shall become the property of the Contractor, unless otherwise provided.

When perishable material is burned, it shall be under the constant care of a competent watcher. Burning shall be accomplished at such times and in such manner that the surrounding vegetation, adjacent property, or anything designated to remain on the right-of-way will not be jeopardized. Upon notice from the Engineer that meteorological conditions render burning undesirable, the Contractor shall cease all burning until notified by the Engineer that meteorological conditions are suitable for a resumption of burning operations.

When specified, burning will not be permitted unless the material to be burned is placed in an incineration pit and an acceptable forced air combustion device is used that will minimize the emission of smoke, fly ash, and other pollutants. This device shall be constructed so that the forced air is directed over the fire by plenums or ducts. The use of open fans or mulch blowers will not be permitted. The Contractor shall comply with all Federal, State, County, and City laws, regulations, or ordinances applicable to the disposal of clearing and grubbing material. Materials and debris that cannot be burned shall be removed from the right-of-way and disposed of at locations off the project, outside the limits of view from any public road, street, park, or other public facility.

The Contractor shall make all necessary arrangements with the property owner for obtaining suitable disposal locations. Disposal operations and final cleanup of the sites, including seeding and stabilization, shall comply with the requirements of Section 110.

The costs involved in obtaining disposal sites, hauling, cleanup and stabilization for erosion control will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the Contract. When requested by the Engineer, the Contractor shall furnish copies of all agreements with property owners.

**201.05 Selective Clearing.** This work shall be performed in such a manner as to leave the designated areas in a park-like condition and susceptible to economical mowing. Disposal of all material shall comply with the methods set out in the Clearing and Grubbing requirements.

Stumps, trees, and shrubs, except those designated to be preserved, shall be severed flush with or below the ground.

Trimming of selected trees and shrubs shall be performed as described in Subsection 201.04.

Movement and operation of equipment shall be such that roots, branches, and trunks of trees and shrubs selected for retention will not be scarred, broken, or otherwise damaged to the extent that the life of the plant is endangered.

**201.06 Preserved Vegetation.** Trees, shrubs, brush, vines, and other natural perennial vegetation shall be protected in the areas designated as Preserved Vegetation.

Areas designated as Preserved Vegetation shall not be used for parking, storage, or other construction support activities that will damage vegetation or compact the soil. Care shall be taken to prevent spills of materials hazardous to vegetation such as oil, hydraulic fluid, salts, etc. Erosion and sedimentation control shall be such that sediment is not deposited in depths greater than 2" (50 mm) within any portion of the Preserved Vegetation area.

Clearing and grubbing may be required through preserved vegetation areas for drainage outlets, channels, or other required construction.

Where fence is to be installed along the right-of-way line in wooded areas, the Contractor may clear trees from a strip approximately 10' (3 m) wide adjacent to and within the right-of-way to accommodate fence erection equipment. The Contractor shall exercise care so that other trees, shrubs, grass and other

vegetation designated to remain are not damaged. Such clearing in areas designated as Preserved Vegetation or where clearing would otherwise not be required will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the Contract.

**201.07 Scalping.** The Contractor shall scalp areas where excavation or embankment is to be made, except that mowed sod need not be removed where the embankment to be constructed is more than 3' (1 m) in height.

All suitable material resulting from the scalping operations shall be placed on the finished slopes, adjacent to the area from which it is obtained, after the excavation or embankment operations are complete.

Unsuitable material shall be disposed of as specified for Clearing and Grubbing.

**201.08 Method of Measurement. (a) General.** Quantities for Clearing and Grubbing, Selective Clearing, and Clearing and Grubbing Trees as shown on the plans and in the Proposal shall be considered as final quantities and no further measurement will be required unless, upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities. Measurements for revisions must be made before removing the part of the item in question.

**(b) Clearing, Grubbing, and Selective Clearing.** Clearing and/or Grubbing will be measured by the acre (hectare) or by the station (metric station), as shown on the plans or designated by the Engineer. Selective Clearing will be measured by the acre (hectare).

**(1) Acre.** Measurement will be to the nearest one hundredth of an acre (hectare) (0.01 acre) (0.01 ha) and will be determined by the horizontal measurement of each tract. The boundary of each tract will be a line extending along the outside of the trunks of the outermost trees or stumps.

**(2) Station (Metric Station).** Measurement will be by the centerline station (metric station), rounded upward to the next whole station (metric station), and shall include all the area within the right-of-way including easements. When station (metric station) measurement is specified, a station (metric

station) will be measured for payment when any tree meeting the requirements for clearing and/or grubbing is removed within that station (metric station).

**(c) Scalping.** Scalping areas of existing vegetation and additional vegetation, resulting from work required by Section 110, will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the Contract.

**(d) Preserved Vegetation.** Preserved vegetation areas shown on the plans or designated by the Engineer will not be measured for payment.

**(e) Clearing and Grubbing Trees.** When specified, individual, isolated trees greater than 4" (100 mm) in diameter, measured 12" (0.3 m) above the ground, will be measured by each tree and/or stump removed.

**201.09 Basis of Payment.** Clearing and Grubbing for borrow sites and material sources outside the right-of-way limits will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the items being excavated for use on the roadway.

Work for clearing, grubbing, and/or selective clearing, completed and accepted and measured as provided above, will be paid for at the contract unit price bid per acre (hectare) or per station (metric station) for Clearing and Grubbing, per acre (hectare) for Selective Clearing, and per each for Clearing and Grubbing Trees, as the case may be, which price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work, including the cost of repairing damaged trees that are designated to remain.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Clearing	Acre (Hectare) or Station (Metric Station)
Grubbing	Acre (Hectare) or Station (Metric Station)
Selective Clearing	Acre (Hectare)
Clearing and Grubbing Trees	Each

## **SECTION 202**

### **REMOVAL AND DISPOSAL OF STRUCTURES**

**202.01 Description.** This work shall consist of the removal and satisfactory disposal of curb and gutter; portland cement or asphalt concrete driveways, parking areas, sidewalks, and steps; concrete pavement; existing fence; guardrail; retaining walls; manholes; catch basins; concrete or masonry basements, foundations, or slabs; tanks and lines; approach slabs and gutters; and old culverts, all of which are not designated or permitted to remain. The work may also include demolishing and/or removing from the site remaining buildings, or portions thereof, which are more particularly described on the plans and/or in the Special Provisions, together with all appurtenances, either attached or detached, including but not limited to canopies, porches, awnings, piping, poles, attached signs, auxiliary buildings, or sheds.

The provisions of Section 202 shall not apply to underground storage tanks.

**202.02 General.** The attention of the bidder is directed to the necessity for careful examination of the entire site to determine, at the time of bid preparation, the full extent of work to be accomplished. The entire site shall be cleared of all man-made obstructions and debris, of whatever nature, and prepared in all respects for the construction of the highway facilities.

The Contractor shall provide traffic control according to Section 603 and shall not unnecessarily interfere with the use of any adjacent sidewalks, streets, or roads.

Salvage materials in buildings to be demolished and materials in other man-made obstructions will become the property of the Contractor and shall be removed from the project site. The Contractor shall have no claim against the Department because of the absence of any pre-existing buildings, materials, equipment, or fixtures from the items to be removed.

Moveable buildings remaining for the Contractor's disposition may be removed from the right-of-way intact if the Contractor so elects, or they may be demolished in place with the removal of resulting material and debris.

**202.03 Construction Requirements.** The disposal of all materials and debris shall be according to Section 201.

All surface items such as curb, curb and gutter, driveways, parking areas, walks, steps, pavement, and walls shall be separated or broken away from the adjacent part of any structure designated to remain in place by a vertical saw cut along the line designated by the Engineer. The edge of the structure left in place shall be approximately vertical with no abrupt changes in alignment. Any damage to or removal of the structure designated to remain in place shall be repaired or replaced at no cost to the Department.

Holes, ditches, or other abrupt changes in elevation caused by the removal operations that could obstruct drainage or be considered hazardous or unsightly shall be backfilled, compacted, and left in a workmanlike condition.

Old culverts or parts thereof that interfere with the new construction shall be removed. Steel and timber superstructures and abutments, and the tops of all concrete and masonry box culverts that are to be abandoned shall be removed entirely. Concrete and masonry abutments and headwalls shall be removed entirely or broken down to an elevation at least 2' (0.6 m) below the subgrade elevation; this work will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for Removal and Disposal of Pipe Culverts.

Where old box culverts or pipe culverts are to be extended or otherwise incorporated into the new work, only such part of the old structure shall be removed as to provide a proper connection to the new work. The connecting edges or joints shall be cut, chipped, and trimmed to the required lines and grades without weakening or damaging the part of the structure to be retained.

Work required in cutting back an existing concrete box culvert that is to be extended shall be accomplished according to the applicable standard drawing(s). For a pipe culvert extension, the headwall and the attached end joint of concrete pipe or the flared end section on all types of pipe shall be removed to accommodate the extension. This work will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the items involved in the culvert extension.

Pipe culverts, the tops of which are located within 3' (1 m) of the elevation of the finished roadway, shall be removed. Pipe culverts at lower elevations, if in suitable condition as determined by the Engineer, may be abandoned in place, in which case the headwalls shall be removed and the ends of the culvert plugged by means of concrete or large dumped rock plugs, at no cost to the Department.

Material from old culverts determined by the Engineer to have salvage value shall become the property of the Department. Salvaged material shall be carefully removed to avoid damage and shall be placed in neat piles of like material outside the construction limits but within the right-of-way. Other salvaged material shall be disposed of by the Contractor as approved by the Engineer.

At the Contractor's option, and to the extent compatible with proper progress of the work, the removal of existing masonry may be coordinated with the grading operation. Broken concrete, stone, brick, and like material may be placed in embankments in parallel layers, with no material closer than 12" (0.3 m) to the subgrade surface. The voids shall be completely filled with suitable material and thoroughly compacted. The material may be used in the construction of riprap, tree wells, and similar structures. When used as riprap, broken concrete shall comply with Section 816.

Trenches resulting from the removal or demolition of old culverts shall be filled with approved material placed in layers according to Section 606.

The removal and disposal of water wells, including plugging, shall be accomplished using the current policies and procedures of the Arkansas Water Well Construction Commission for water well closures.

Existing basements, sumps, pits, or septic tanks that are outside the construction limits shall be backfilled as soon as feasible. Backfill shall be compacted to the extent practicable. Masonry and broken concrete, free of organic matter, may be used for such backfill to an elevation not less than 2' (0.6 m) below finished elevation. The area shall be dressed and left in a neat condition.

Masonry foundations shall be obliterated, or if in fill sections, may be left in place if covered by not less than 2' (0.6 m) of embankment. Floor slabs left in place shall be shattered and left in a permeable condition. Broken concrete, free of protruding

reinforcing steel, may be placed in embankment according to Subsection 210.09 covering the use of rock in embankment.

The removal and disposal of approach slabs and gutters shall include the removal and disposal of the drop inlets, spillway pipe, and spillway outlet that are a part of the approach gutter. The Contractor shall fill with earth and/or other suitable material all holes where drop inlets and spillway pipes have been removed. Earth in the holes shall be thoroughly compacted with a mechanical tamper until it is as firm and unyielding as the surrounding material.

When necessary, the Contractor may clear a strip approximately 10' (3 m) wide adjacent to and within the right-of-way to accommodate removal equipment. Clearing shall be performed according to Subsection 201.06. When such clearing is performed in an area where clearing would otherwise not be required, it will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the Contract.

**202.04 Method of Measurement.** The removal and disposal of the various items covered by this specification will be measured by the linear foot (meter), square yard (square meter), or each. The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

Backfill material and compaction thereof will be measured and paid for under Section 210 for the applicable item(s). All materials for the removal and plugging of water wells shall be considered included in the unit price bid for the item "Removal and Disposal of Water Well."

**202.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid for the specific items, which price shall be full compensation for removing, clearing, salvaging, storing, and disposing of all materials removed; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.



Periodic payments will be made in proportion to the amount of structure removed.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal and Disposal of _____	Linear Foot (Meter), Square Yard (Square Meter), or Each

### **SECTION 203**

## **REMOVAL AND DISPOSAL OF UNDERGROUND STORAGE TANK SYSTEMS**

**203.01 Description.** This work shall consist of the excavation, removal, and satisfactory disposal of underground storage tank systems and their contents at the locations specified. The work will also include the removal and disposal of portland cement or asphalt driveways, parking areas, sidewalks, curbs, islands, foundations, or slabs, when necessary for the removal of the tank.

The Contractor is responsible for insuring that all work is executed and inspected in compliance with all local, State, or Federal codes, laws, ordinances, rules, and regulations applicable to the particular class of work.

**203.02 General Requirements.** The attention of the bidder is directed to the necessity for careful examination of the entire site to determine, at the time of bid preparation, the full extent of work to be accomplished. The entire site shall be cleared of all man-made obstructions and debris, of whatever nature, and prepared in all respects for the construction of the highway facilities.

The Contractor shall not unnecessarily interfere with the use of any adjacent sidewalks, streets, or roads.

Salvage materials will become the property of the Contractor and shall be removed from the project site. The Contractor shall have no claim against the Department because of the absence of any preexisting materials, equipment, or fixtures from the items to be removed.

**203.03 Construction Requirements.** The methods employed in

performing the work shall be in compliance with 40 CFR § 280, *Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)*, and *American Petroleum Institute Recommended Practice 1604, Second Edition, December 1987, Removal and Disposal of Used Underground Petroleum Storage Tanks*.

The Contractor shall perform measurements consisting of a visual inspection and a measurement using an EPA approved Organic Vapor Analyzer (OVA), and soil sample(s) where contamination is most likely to occur. The sample(s) shall be analyzed by a laboratory certified by the ADEQ for the presence of benzene, toluene, ethyl benzene, and xylene (BTEX), using EPA Method 8021 or 8260, and for total hydrocarbons using ADEQ's "Arkansas Total Petroleum Hydrocarbons (TPH) for Soils." The result of the soil analysis shall be provided to the ADEQ and the Engineer before any payment is made.

The Contractor shall excavate outside the limits of the tank perimeter at least to that point where the OVA reading is less than 100 ppm total hydrocarbons. If the limits of the original installation excavation can be determined, the excavation shall normally be made at least to the same limits. Excavation beyond the required limits made for the Contractor's convenience will not be measured or paid for.

The Contractor will test the excavated material with the OVA and if the hydrocarbon levels are above 100 ppm the material shall be handled in one of the following methods:

- 1) Deposited in a solid waste landfill provided that the material is accepted by the landfill operator, or
- 2) Spread on an impermeable material and aerated until the hydrocarbon level is below 100 ppm. When the OVA reading has been reduced to below 100 ppm, the Contractor may then use the material in the backfill operation or dispose of it at an approved off-site location.

If the visual inspection reveals only minor contamination and the OVA reading is less than 100 ppm total hydrocarbon, and the results of the soil sample analysis are within acceptable limits as determined

by ADEQ, then the site shall be backfilled with suitable material and compacted as directed by the Engineer.

If the excavated material is not suitable or is not sufficient in quantity for use as backfill material, the Contractor shall provide acceptable material for use as backfill.

If tank systems not shown on the plans, free product, or extensive contamination are encountered, excavation and backfill activities will be suspended until a detailed site assessment and remediation plan can be developed by the Department. The Department may, at its option, delete all or any portion of the remaining work under this Section at that site.

**203.04 Method of Measurement.** (a) Removal and Disposal of Underground Storage Tank Systems shall be measured by the unit, a unit being defined as one individual tank system which includes the tank and all lines connected to it.

(b) Backfilling Underground Storage Tank Systems will be measured by the cubic yard (cubic meter). The measurement shall be made of the hole from which the tank was removed. The measurement shall be to the nearest whole cubic yard (cubic meter). Backfilling of trenches required to remove pipe lines will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Removal and Disposal of Underground Storage Tank Systems.

(c) Excavation for Underground Storage Tank Systems will be measured by the cubic yard (cubic meter). The quantity shall be the same as the quantity for Backfilling Underground Storage Tank Systems, less the volume of the tank.

(d) Treatment or Disposal of Excavated Material will be measured by the cubic yard (cubic meter). The measurement will be that portion of the excavated material for which the hydrocarbon levels are above 100 ppm when tested with the OVA.

**203.05 Basis of Payment.** (a) Removal and Disposal of Underground Storage Tank Systems, completed and accepted and measured as provided above, will be paid for at the bid price for Removal and Disposal of Underground Storage Tank Systems of the size specified, which price shall be full compensation for inerting or purging; for removal and disposal of the tank system including its

contents; for all required sampling and testing; and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work. The size specified shall be interpreted as the nominal or rated capacity of the tank.

(b) Backfilling Underground Storage Tank Systems completed and accepted and measured as provided above, will be paid for at the unit price bid per cubic yard (cubic meter) for Backfilling Underground Storage Tank Systems, which said price shall be full compensation for furnishing, hauling, placing, and compacting the material; and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(c) Excavation for Underground Storage Tank Systems completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Excavation for Underground Storage Tank Systems, which said price shall be full compensation for excavating within the limits defined above; and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(d) Treatment or Disposal of Excavated Material completed and accepted and measured as provided above will be paid for at the contract price bid per cubic yard (cubic meter) for Treatment or Disposal of Excavated Material, which said price shall be full compensation for hauling and depositing in an approved solid waste landfill or for spreading and aerating; and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal and Disposal of Underground Storage Tank Systems (_____)	Each
(110 Gal. to 750 Gal.) (400 L to 3000 L)	
(751 Gal. to 1500 Gal.) (3001 L to 6000 L)	
(1501 Gal. to 2500 Gal.) (6001 L to 10000 L)	
(2501 Gal. to 3500 Gal.) (10001 L to 15000 L)	
Backfilling Underground Storage Tank Systems	Cubic Yard (Cubic Meter)

Excavation for Underground Storage	
Tank Systems	Cubic Yard (Cubic Meter)
Treatment or Disposal of	
Excavated Material	Cubic Yard (Cubic Meter)

## SECTION 204 VACANT

### SECTION 205 REMOVAL OF EXISTING BRIDGE STRUCTURES

**205.01 Description.** This item shall consist of the removal of existing bridge structures according to the plans and specifications and as directed.

Removal of structures over which traffic will be maintained during the construction period shall be delayed until the new road has been completed and opened to traffic.

**205.02 Construction Requirements.** Except when the plans designate that material from the existing bridge shall become the property of the Contractor, all material of serviceable quality shall be placed in a suitable location near the site as approved by the Engineer, and shall remain the property of the Owner. Torches may be used for dismantling steel bridges as approved by the Engineer. Nails and spikes shall be withdrawn from timber before being stacked.

Bridge demolition shall be accomplished in such a manner that turbidity and sedimentation are minimized. The method of demolition and removal shall be approved by the Engineer. The Contractor shall comply with all applicable requirements of Section 110.

Debris from bridge removal shall not enter the waterway unless approved as temporary or permanent fill allowed by a C of E 404 permit and/or the U. S. Coast Guard. If material or debris resulting from the Contractor's operations does enter the waterway, the Engineer will make a determination based on the applicable permits whether or not the material may remain. If it is determined that the material is to be removed from the waterway, the Engineer must pre-

approve the Contractor's method of removal.

When specified on the plans as "salvage for re-erection," all materials of serviceable quality shall remain the property of the Owner. The removal of the material from the project site shall be coordinated with Department Forces as directed by the Engineer. Pins, bolts, nuts, washers, and other metal parts shall be placed in well-sealed boxes. Structural members of truss spans shall be match marked and the distance center to center of shoes shall be accurately measured and marked on the lower chord before dismantling. Dismantling of steel bridges by using a torch will not be permitted when salvaged for re-erection. Care shall be exercised to avoid damaging or destroying any member or part of serviceable quality in dismantling the structure. Any member rendered unfit for further use through the carelessness of the Contractor shall be replaced at no cost to the Department.

Unless otherwise designated on the plans or directed by the Engineer, substructure units shall be removed to a minimum depth of 2' (0.6 m) below subgrade or final ground surface, and to a greater extent if necessary to avoid interference with new construction work. Obstructions shall be removed from the established waterway.

Material that is not salvaged shall be disposed of as provided in Subsections 104.07 and 201.04.

**205.03 Method of Measurement.** Removal of Existing Bridge Structures will be measured on the lump sum basis for each bridge.

Except where specific pay items are shown on the plans and in the Contract, work involved in complying with the requirements of Section 110 will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Removal of Existing Bridge Structure.

**205.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract lump sum price bid for Removal of Existing Bridge Structure (Site No.\_\_), which price shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

Periodic payment will be made under this item in proportion to the amount of work accomplished.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal of Existing Bridge Structure (Site No.____)	Lump Sum

**SECTION 206**  
**FLOWABLE SELECT MATERIAL**

**206.01 Description.** This item shall consist of the furnishing, mixing, and placing a flowable mixture of portland cement, fly ash, sand, and water for backfilling bridge abutments, pipe culverts, box culverts, structural plate pipe and arches, or other uses as approved by the Engineer. The material shall be placed in close conformity with the lines, grades, dimensions, and details shown on the plans or established by the Engineer.

**206.02 Materials.** The materials used in the flowable select material shall conform to the applicable requirements of Section 802. The Portland cement, fly ash, and chemical admixtures shall be listed on the QPL.

**(a) Mix Design.** The mix design will be prepared by the Contractor. The mixture will be proportioned to produce a flowable mixture without segregation. Material for one cubic yard (cubic meter), absolute volume, shall be as follows:

Cement	80 - 100 lbs. (45 - 60 kg)
Fly ash	220 - 300 lbs. (130 - 180 kg)
Sand	Variable to equal one cubic yard (cubic meter)
Water	Approximately 65 gallons (300 liters)

The minimum flow of the mixture shall be 8" (200 mm) as determined by the test method described herein. The unit weight shall be a minimum of 110 lbs./cubic foot (1750 kg/cu m).

The mix design shall be accompanied by the following documentation:

- A listing of the weights of all components of the proposed mix (water and admixtures may be measured by volume);

- Certified test results for flow and unit weight.

When unsatisfactory results or other conditions make it necessary, a new mix design will be established.

**(b) Sampling and Testing.** Sampling and testing will be performed by the Department.

The flow test shall consist of filling a 3" (75 mm) diameter x 6" (150 mm) high open-ended cylinder to the top with the flowable material mixture. If necessary, the top of the mixture will be struck off level. The cylinder will then be pulled straight up and the flow will be measured by the approximate diameter of the mixture. There shall be no evidence of segregation in the mixture.

The unit weight shall be determined according to AASHTO T 121, except that rodding and tapping shall not be done.

**206.03 Construction Requirements. (a) Measurement of Materials.** Materials for flowable select material shall be measured according to Section 802.

**(b) Mixing Flowable Select Material.** Mixing of flowable select material shall be according to Section 802.

**(c) Handling and Placement.** The Contractor shall provide sufficient supervision, labor, equipment, tools, and materials to assure proper production, delivery, and placement.

When deemed necessary by the Engineer, the flowable select material shall be contained within the designated area by metal or wood forms that are sufficiently tight as to keep the loss of material to a minimum, or by other means as approved by the Engineer.

The flowable select material shall be discharged from the mixer and conveyed into the space to be filled according to Section 802. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed by the Engineer. Placing of other material over flowable select material may begin after the flowable select material has taken its initial set, is stable, and does not displace under equipment.

**206.04 Method of Measurement.** Flowable Select Material will be measured by the cubic yard (cubic meter). The quantities shown on the plans will be considered the final quantities and no further measurement will be made unless, in the opinion of the Engineer or



upon evidence furnished by the Contractor, substantial variations exist between the quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

**206.05 Basis of Payment.** Work completed, accepted, and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Flowable Select Material, which price shall be full compensation for designing the mix; for furnishing, mixing, and placing the material; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Flowable Select Material	Cubic Yard (Cubic Meter)

**SECTION 207  
STONE BACKFILL**

**207.01 Description.** This item shall consist of the excavation and disposal of unsuitable material and furnishing, hauling, placing, spreading, and consolidating Stone Backfill at locations designated by the Engineer. At other locations where undercutting is required and Stone Backfill is not designated by the Engineer, the provisions of Section 210 shall apply.

**207.02 Materials.** Stone for Stone Backfill shall be hard, durable, crushed stone aggregate, as manufactured by local quarries, ranging in size from 1½" (40 mm) minimum to 6" (150 mm) maximum. It shall not contain more than 5% by weight of shale, slate, or other deleterious matter. The stone shall be uniformly graded and the amount passing the 1½" (37.5 mm) sieve shall be not more than 10% by weight. When backfilling with Stone Backfill to subgrade elevation, or to an elevation below subgrade when directed by the Engineer, the top 4" to 6" (100 mm to 150 mm) shall be material complying with Section 303 for Class 7 Aggregate Base Course. This material will be measured and paid for as Stone Backfill.

**207.03 Construction Methods.** The area shall be excavated and the Stone Backfill shall be placed within the limits shown on the plans or as designated by the Engineer. The excavated material shall

be disposed of by the Contractor as approved by the Engineer. The stone may be dumped into the areas undercut without regard to depth of layer. The stone shall be spread, shaped, and consolidated to the line and grade determined in the field by the Engineer to provide a firm and unyielding foundation for the subgrade and/or base course.

**207.04 Method of Measurement.** Stone Backfill will be measured by the ton (metric ton).

**207.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Stone Backfill, which price shall be full compensation for excavation and disposal of unsuitable material; for furnishing, hauling, placing, shaping, and consolidating material; and for all labor, equipment, tools, and incidentals necessary to complete the work. Excavation and backfill authorized by the Engineer that is in excess of the volume occupied by the Stone Backfill will be measured and paid for under the appropriate Sections of the Standard Specifications for the appropriate classification of material.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Stone Backfill	Ton (Metric Ton)

## **SECTION 208**

### **FENCE REMOVED AND RECONSTRUCTED**

**208.01 Description.** This item shall consist of removing and reconstructing existing fences, including gates, where shown on the plans or designated by the Engineer, and shall be done in conformity with the plans and according to these specifications. This specification covers all types of fence removal and reconstruction, other than masonry or concrete fence.

**208.02 Construction Requirements.** The Contractor may clear a strip approximately 10' (3 m) wide within the right-of-way to accommodate fence removal and construction equipment. Clearing shall be performed according to Section 201.06. When such clearing is in a location where clearing would otherwise not be required, the

clearing will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Fence Removed and Reconstructed.

The fence shall be reconstructed in a manner satisfactory to the Engineer, with posts thoroughly tamped into place and the fencing firmly attached to the posts. Where existing posts are set in concrete, the fence shall be reconstructed in the same manner except that the old concrete shall be removed from the posts and the posts set in new concrete meeting the requirements of Subsection 619.02.

Materials that are not in a condition to be moved shall be replaced by serviceable material of the same type and size. Replacement material shall be furnished by the Contractor and be satisfactory to the Engineer. Excess and unserviceable material shall be disposed of according to Section 201.

**208.03 Method of Measurement.** Fence Removed and Reconstructed will be measured by the linear foot (meter) of fence in its reconstructed location. Such measurement will not include fences removed but not replaced. Gates removed and reconstructed as part of a fence will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Fence Removed and Reconstructed. Separate gates shown on the plans that are removed and reconstructed will be measured by the unit in place in the new location. Such measurement will not include separate gates removed but not reconstructed. Gates will be measured and paid for separately only when shown on the plans.

**208.04 Basis of Payment.** Work completed and accepted and measured as provided above, will be paid for at the contract unit price bid per linear foot) for Fence Removed and Reconstructed or per each for Gates Removed and Reconstructed, which price shall be full compensation for any clearing within the right-of-way necessary to establish a true line and/or work area; for dismantling, moving, and reconstructing; for furnishing necessary material; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Fence Removed and Reconstructed	Linear Foot (Meter)
Gates Removed and Reconstructed	Each

## **SECTION 209 REMOVING AND REPLACING BASE COURSE AND ASPHALT SURFACING**

**209.01 Description.** This item shall consist of the removal of the base course and asphalt surfacing, or the removal of base course alone, from detours or existing roadways, at the locations shown on the plans or as designated by the Engineer; the stockpiling of the material if necessary; the thorough mixing of the materials; and the replacement of the mixed materials on the subgrade, selected material course, or base course, as shown on the plans or as directed by the Engineer. This work shall be completed according to these specifications and in proper sequence with other work in the Contract.

**209.02 Construction Requirements.** The Contractor shall scarify, break down, and mix all or any part of the ACHM material with the base course and handle according to the requirements of this Section. The volume of ACHM removed and replaced with the base course will be included in the measurement and payment under 209.03 and 209.04.

The Contractor shall have the option of removing and disposing the ACHM material. The ACHM material may be broken up and incorporated in an embankment provided that the material is mixed with the embankment material and kept at least 12" (0.3 m) below the finished grade. ACHM material shall not be placed in embankment areas where piling is to be placed or driven. If the contractor elects to use this option, removal and disposal of the ACHM material will be measured and paid for as unclassified excavation.

When the asphalt surface consists of one or more layers of Asphalt Surface Treatment, the asphalt material shall be scarified, broken down, and thoroughly mixed with the base course material.

The material may be removed and stockpiled pending construction of the subgrade, selected material course, or base course; or hauled directly and placed on the subgrade, selected material course, or base course that has been completed and accepted as to grade, width, and compaction. Care shall be exercised in removing the material so that soil from the subgrade is not included with the material. Replaced material shall be spread and compacted according to Section 303.

If the material is placed in stockpiles, the sites of the stockpiles shall be clean and uniform, and the placing and removal of the materials shall be conducted in such manner that there will be a minimum of waste. Excessive material wasted during the removal and replacing operation shall be replaced at no cost to the Department.

**209.03 Method of Measurement.** Removing and Replacing Base Course and asphalt surfacing will be measured by the cubic yard (cubic meter) by either of the following methods:

**Method No. 1.** The material will be measured by the cross section method and volume computed by the average end area method. The material may be measured either in its original position or in a uniform windrow or stockpile, before being placed in its final position. When the material is measured in a windrow or stockpile, the computed volume will be reduced 30% for swell.

**Method No. 2.** The material will be measured in vehicles according to Section 109. When measurement is made in vehicles, allowances will not be made for wastage of materials during transportation from the loading to the unloading point and the volume measured at the point of entry on the road will be reduced 30% for swell. The Contractor shall level the loads adequately to ensure that each load contains the expected volume. The Engineer will inspect each load to check its volume.

**209.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Removing and Replacing Base Course and Asphalt Surfacing, which price shall be full compensation for removing the base course and asphalt surfacing from detours or existing roadways; for mixing the materials and stockpiling if necessary; for loading, hauling, and delivering on the

road; for spreading and shaping; for watering, manipulating, finishing, and compacting; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removing and Replacing Base Course and Asphalt Surfacing	Cubic Yard (Cubic Meter)

**SECTION 210  
EXCAVATION AND EMBANKMENT**

**210.01 Description.** This item shall consist of excavation, construction of embankment, and disposal or compaction of all material that is encountered within the limits of the work not being removed under some other item. The work shall be accomplished in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer. All excavation will be classified as common excavation, rock excavation, or unclassified excavation.

**210.02 Quality Control and Acceptance.** It is the intent of these specifications that all embankments, fills, and backfills and the top 6" (150 mm) of the roadbed in cut sections shall be compacted to the specified density at or near the optimum moisture content. To that end, certain tests for quality control and acceptance shall be performed as specified herein. If the result of any test shows that the required minimum density has not been obtained, corrective action shall be taken. Such corrective action may include, but is not limited to, additional compactive effort; scarifying, adjusting moisture content and recompacting; or removal of unsuitable material and replacement with suitable material. Except for removal and replacement of unsuitable material below finished subgrade elevation in cut sections or below natural ground in fill sections, all corrective actions shall be performed by the Contractor at no cost to the Department.

When the Engineer determines that the material is so rocky that it cannot be tested for density by the specified methods, acceptance will be as determined by the Engineer.

**(a) Quality Control.** The Contractor shall determine the maximum laboratory density and optimum moisture content for each soil type encountered on the project. The maximum laboratory density will be determined according to Subsection 210.10. The Contractor shall furnish the Department split samples of each soil used to determine laboratory densities. The Engineer may require additional laboratory densities when significant changes in the soils encountered on the project are evident.

The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing. The Contractor's facilities shall be separate from any Field Laboratory and/or Field Office furnished under the Contract. The Contractor shall provide the Engineer with the opportunity to observe all quality control sampling and testing. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. Test reports shall be signed and copies made available to the Engineer if requested.

In-place densities shall be determined according to Subsection 210.10.

When the results of any test show that the minimum required density has not been obtained, corrective actions shall be taken, followed by a re-test in the same location. The original and re-test reports shall be cross-referenced.

Establishing the frequency of sampling and testing for quality control is the Contractor's responsibility, however the Contractor will be required to make certain tests as specified in Subsection 210.02(b).

**(b) Acceptance Testing.** The Contractor shall perform acceptance testing using the same methods specified for quality control testing. Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory

qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The item of work being tested shall not be considered complete or accepted until passing test reports are submitted to the Engineer.

The minimum frequency of acceptance testing by the Contractor shall be one test for density and moisture content per each 3000 cubic yards (2500 cu m) of embankment placed except that at least one test shall be performed on each layer of embankment. The location will be randomly selected by the Engineer using AHTD 465. The results of all tests shall be at or above the minimum required density and the moisture content should be near the optimum. If the result of any test does not meet these requirements, corrective action shall be taken and a re-test will be taken at the same location.

In addition to the required acceptance tests, the Engineer may require the Contractor to test any location that, by visual observation, appears to be defective.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

All acceptance testing performed by the Contractor shall be subject to observation by Department personnel. All test reports shall be signed and submitted to the Engineer by the next business day after the tests are performed.

The Department will obtain and test a minimum of one sample, taken at the frequency established in the Department's *Manual of Field Sampling and Testing Procedures*, for verification testing in accordance with Subsection 106.11.

**(c) Measurement and Payment.** All work required under this subsection will not be paid for separately, but full compensation



therefor will be considered included in the contract unit prices bid for the various earthwork items included in the Contract.

**210.03 Vacant.**

**210.04 Vacant.**

**210.05 Classes of Excavation. (a) Common Excavation.** Common excavation shall consist of all excavation not included as rock excavation or excavation that is otherwise classified.

**(b) Rock Excavation.** Rock excavation shall consist of igneous, metamorphic, and sedimentary rock that cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of 0.5 cubic yard (0.5 cu m) or more.

**(c) Unclassified Excavation.** Unclassified excavation shall consist of the excavation and disposal of all materials of whatever character encountered in the work.

**210.06 Borrow.** Borrow material shall consist of a soil, or a mixture of soil and stone or gravel or other acceptable material, reasonably free from sod, stumps, logs, roots, or other perishable or deleterious matter, and shall be capable of forming a stable embankment when compacted. The stone or gravel shall be of such size as not to interfere with compaction requirements specified in Subsection 210.10. Unless otherwise designated in the Contract, the Contractor shall make all arrangements for obtaining borrow and shall pay all costs involved. Also see the requirements of Sections 106 and 107.

The Contractor shall notify the Engineer sufficiently in advance of opening any borrow areas so that cross section elevations and measurements of the ground surface after stripping may be taken.

When requested in writing by the Contractor and approved by the Engineer, material may be obtained from the right-of-way and used in lieu of off-site borrow material. When the material is obtained within the limits of the Contract, payment will be made for material obtained from the right-of-way at either: 1) the unit price bid for Borrow, less an agreed royalty, or 2) the applicable item of excavation, whichever results in the lower cost to the Department. If the site is located outside the limits of the Contract, the material will be paid for at the unit price bid for Borrow, less an agreed royalty.

For the purposes of this paragraph, the phrase "limits of the Contract" is defined as the entire right-of-way, including easements, between the beginning and ending stations of the project outside the limits of excavation shown on the plans or as changed by the Engineer for any purpose other than obtaining additional material. On projects where there are designated exceptions, the beginning and ending stations shall be the beginning and ending stations of the exceptions. Included in the planned excavation will be any excavation made beyond the beginning and ending stations that is made for the purpose of blending the new construction to the existing roadway, whether shown on the plans or not.

**210.07 Construction Requirements.** The excavation and embankments for the roadway, intersections, and entrances shall be finished to reasonably smooth and uniform surfaces. No materials shall be wasted unless they are surplus to the needs of the project or are deemed unsuitable by the Engineer, and only with the permission of the Engineer. Before beginning excavation, grading, and/or embankment operations in any area, all necessary work in that area shall have been performed according to Sections 201, 202, and 203, except that some removal items in Section 202 (e.g., curb, culverts, etc.) may be removed simultaneously and in coordination with excavation operations, provided such delay in removal of these items does not adversely affect the proper completion of excavation and construction of embankments.

Unless otherwise specified, rock shall be excavated to a minimum depth of 8" (200 mm) and not to exceed a maximum depth of 12" (300 mm) below subgrade within the limits of the roadbed, and the excavation backfilled with material designated on the plans or approved by the Engineer. Care shall be taken that undrained pockets shall not be left in the surface of the rock.

Borrow material should not be placed until after the roadway excavation has been placed in the fill. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume as measured in the borrow area. All borrow areas shall comply with Section 106.

Obliteration of old roadways may include excavation and rough grading of the old roadway and/or the addition of borrow to restore approximately the original contour of the ground or to produce a

pleasing appearance by forming natural, rounded slopes. Roadway obliteration will be paid for as excavation and/or borrow as appropriate.

Unless otherwise provided for on the plans or in the specifications, the removal of any existing base course or asphalt pavement necessary for constructing new pavement connections, or of asphalt paving in existing island locations or other areas not specifically addressed, will be measured and paid for as unclassified excavation.

When the Contractor's excavation operations encounter a restraining condition as defined in Subsection 107.10, operations shall be temporarily discontinued. Work in the area shall not resume until the disposition of the restraining condition has been accomplished.

Where natural ground conditions or excavation to the finished grade section results in a subgrade or slopes of unsuitable soil, the Engineer may require the Contractor to undercut the unsuitable materials and backfill with approved material to the elevation designated by the Engineer. The Engineer may designate as unsuitable those soils that cannot be stabilized in place through normal drying and compactive efforts when satisfactory weather and ground conditions exist. Normal drying and compactive effort shall be considered to be the work required in processing and compacting the natural ground (including the bottom of a cut section) to a maximum depth of 12" (300 mm) after the soil is brought to near optimum moisture content. Undercut directed by the Engineer will be measured and paid for under the appropriate classification of excavation. The Contractor shall conduct construction operations so that the Engineer can take the necessary measurements before the backfill is placed.

In the construction of embankment, grading operations shall be conducted, as far as practicable, so that the most suitable soil is placed in the top layer of the embankment. To that end, the Engineer may order specific excavated materials, either from the regular roadway section or from borrow pits, placed in stockpiles for future use. Material thus stockpiled shall be measured in its original position and paid for at the contract unit price for Common Excavation, Unclassified Excavation, or Borrow, as the case may be. All material removed from the stockpile for placement in the

embankment shall be measured in the stockpile by the conventional cross section method and payment for the second handling in removing from the stockpile and placing in the roadway embankment will be paid for at the contract unit price for Common Excavation or Unclassified Excavation, as the case may be. No adjustment will be made for shrinkage or swell.

It is intended that the right-of-way be left in a neat and presentable condition at the completion of the grading work, and especially that it be left in a condition that can be economically mowed where terrain will permit. To that end, stump holes, piles of loose material, and other scars on the surface shall be dressed by use of a motor patrol or other suitable equipment. No direct payment will be made for this work but it shall be considered as a part of the several items of excavation.

Particular care and discretion shall be exercised in the location and use of haul lanes through tree screens in order to preserve existing growth. Haul lanes shall have prior approval by the Engineer.

**210.08 Excavation Operations.** All suitable material removed from the excavation shall be used, as far as practicable, in the formation of the embankment, in the subgrade, slopes, and shoulders, and at such other places as directed. Unsuitable material removed may be placed on the slopes or other locations on the project if designated by the Engineer. No payment will be made for any excavated material that is used for purposes other than those designated, except as provided under Subsection 104.06.

All excess or unsuitable excavated material that cannot be used in embankments may be placed on the side slopes of the nearest fill in a satisfactory manner and shall be placed so as to maintain a distinct shoulder line by generally keeping all such material at least 24" (0.6 m) below the subgrade elevation.

Excavated material that cannot be utilized as described above shall be hauled away and disposed of by the Contractor. Selection and procurement of sites for the disposal of material removed from the project shall be the responsibility of the Contractor. Sites used for the disposal of unused material shall be left in a neat and presentable condition. The Contractor shall have a written agreement with the property owner, and shall comply with the

requirements of Subsection 107.10 and Section 110. Work involved in disposing of the material, including obtaining the sites, hauling, seeding and stabilization, and complying with Section 110, will not be paid for separately, but full compensation therefor will be considered included in the contract unit price(s) bid for the appropriate classification(s) of excavation.

Except in solid rock or other materials that in the judgment of the Engineer require a modified slope, all slopes shall be trimmed to the slopes shown in the cross section drawings, and care must be exercised so that no material shall be loosened below the required slopes. All roots, stumps, and other foreign matter in the sides and bottoms of the ditches or drainage outlets shall be removed or cut to conform to the slope, grade, and shape of the section shown. Side ditches shall be excavated reasonably true to lines, grades, and cross sections as shown on the plans or as directed.

When excavating in rock, at locations shown on the plans or designated by the Engineer, a presplit or breakline shall be produced along the cut slope, except presplitting will not be required in cuts less than 6' (2 m) in depth. When blasting rock in cuts less than 6' (2 m) in depth, a reasonably uniform face shall be left, regardless of whether the excavation is carried beyond the specified slope. All breakage and slide materials shall be removed by the Contractor and disposed of as directed.

The presplitting or breakline involves a single row of holes drilled along the neat excavation line and the blasting charge fired before any adjoining main excavation area is blasted. To establish the breakline, holes for presplitting shall be so spaced and of such diameter that they can be properly loaded and tamped so as to produce a relatively smooth plane along the designated backslope before shooting the interior portion of the cut. The exact spacing and diameter shall be determined by the Contractor to accomplish the desired finished section and shall be changed if the pattern of drilling and blasting fails to do so. In the event the cut is too deep for the presplitting to be done in one operation, an 18" (0.5 m) offset or bench will be allowed for each succeeding line of drill holes. Presplitting operations shall be discontinued when the rock face is of such character that no apparent advantage is gained.

The presplit slope face shall not deviate more than 1' (0.3 m) from a plane passing through adjacent drill holes, except

where the character of the rock is such that, as determined by the Engineer, irregularities are unavoidable. The 1' (0.3 m) tolerance shall be measured perpendicular to the plane of the slope. In no case shall any portion of the slope encroach on the roadbed.

The Contractor's attention is called to the fact that where traffic must be maintained, all necessary precautions shall be taken to protect the traveling public during blasting operations. The Contractor will be required to comply with all Federal, State, and local laws and regulations pertaining to the storage and use of explosives.

The Engineer shall, at all times, have the authority to prohibit or halt the Contractor's blasting operations if it is apparent that through the methods being employed, the required slopes are not being obtained in a stable condition or the safety and convenience of the traveling public is being jeopardized.

Boulders and rock fragments not incorporated in embankments shall not be left scattered about over the right-of-way but shall be disposed of as directed. Payment will be made for the removal of such material from its original position only.

All rock on the cut face that is loose, hanging, or that creates a potentially dangerous situation shall be removed or stabilized, to the Engineer's satisfaction, during or upon completion of the excavation in each lift. Drilling of the next lift will not be allowed until this work has been completed.

**210.09 Embankment Construction.** Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or outside the right-of-way; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits, and other depressions within the roadway area. Only approved materials shall be used in the construction of embankments and backfills.

Rocks, broken concrete, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing

embankments, or when embankment is built ½ widths at a time, the slopes shall be continuously benched as the work is brought up in layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Unless otherwise specified, material thus cut out shall be recompacted along with the new embankment material at no cost to the Department. If the Engineer directs such material to be wasted or placed in another location, the excavated material will be measured and paid for under the appropriate item of excavation.

Unless otherwise shown on the plans, where an embankment less than 3' (1 m) in height is to be made, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be constructed and later placed on the completed embankment slopes. The cleared surface shall then be completely broken up by plowing, scarifying, or disking to a minimum depth of 6" (150 mm). The area shall then be recompacted and stabilized according to Subsection 210.10.

Whenever a compacted road surface containing asphalt or granular material lies within 3' (1 m) of the subgrade, such old road surface shall be scarified to a depth of at least 6" (150 mm). This scarified material shall then be recompacted to a stable condition.

If embankment material can be deposited on one side only of abutments, wing walls, piers, or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning or excessive pressure against the structure. When noted on the plans, the fill adjacent to the end bent of a bridge shall not be placed higher than the bottom of the backwall of the bent until the superstructure is in place. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be conducted so that the embankment is always at approximately the same elevation on both sides of the structure.

Roadway embankment shall be placed in parallel layers not exceeding 10" (250 mm), loose measurement, and shall be compacted as specified and stable before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness before compacting. As the compaction of each layer progresses, continuous leveling and manipulating will

be required to assure uniform density. Water shall be added or removed, as necessary, to obtain the required density. Construction equipment shall be routed uniformly over the entire surface of each layer. The Contractor shall be responsible for the stability of each layer. The material in each layer will be considered stable when it will not rut and/or pump under construction operations.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, such material may be placed in the embankment in layers not exceeding in thickness the approximate size of the larger rocks (30" [750 mm] maximum). Rock or boulders too large to permit placing in 30" (750 mm) layers shall be reduced in size as necessary to permit this placement. The 12" (300 mm) of the embankment immediately below finished subgrade may be placed in one layer with no rock exceeding 10" (250 mm) in its greatest dimension. Each layer shall be constructed so that rock voids are substantially filled with rock fines and/or earth. The rock shall be placed and manipulated in uniform layers and rock fines and/or earth shall be distributed throughout each embankment layer and manipulated as herein indicated. Rock shall not be end dumped over the edges of the layer being constructed, but shall be deposited on the layer and moved ahead so as to advance the layer with a mixture of rock fines and/or earth.

The Contractor shall be responsible for the stability of all constructed embankments and shall restore, at no cost to the Department, any portions that have become displaced due to carelessness or negligent work. After the completion of a section of roadway, it shall be maintained at finished grade and cross section by blading when and to the extent directed by the Engineer.

In those portions of embankments that are immediately adjacent to structures or are for other reasons inaccessible to the compaction equipment in use, only suitable material shall be used and it shall be placed in successive parallel layers of not more than 6" (150 mm) thickness, loose measurement. Each layer shall be uniformly mixed and compacted to the requirement of the specific item using mechanical equipment. Hand tamping will not be permitted.



Embankments shall be constructed in sections of not less than 200' (60 m) in length, or the full length of the embankment if less than 200' (60 m).

**210.10 Compaction Requirements.** The natural ground surface on which an embankment less than 3' (1 m) in height is to be constructed, the roadbed through sections in excavation, and all embankments shall be compacted as described in this subsection. Compaction will not be required in cleared areas where grubbing is not required and it is impractical to work compaction equipment.

All equipment, tools, and machinery used on this work shall be suitable for the soil to be compacted, and shall be maintained in good operating condition. Unless otherwise provided, compaction of earthwork shall be accomplished by any satisfactory method or methods that will obtain the density hereinafter specified.

The material in each layer of embankment shall be compacted to a uniform density of not less than 95% of the maximum laboratory density. Specified density will not be required immediately adjacent to wingwalls of box culverts.

Percent coarse particles retained on the #4 (4.75 mm) sieve shall be determined according to AASHTO T 27 and the maximum laboratory density determined as follows:

<u>% Retained - #4 (4.75 mm) Sieve</u>	<u>Test Method</u>
10 Max.	AASHTO T 99, Method A
11 - 30	AASHTO T 99, Method C
31 Min.	AASHTO T 180, Method D

**Note:** Instead of AASHTO T 224, correction for coarse particles retained on the 3/4" (19.0 mm) sieve shall be determined by replacing with an equal mass of material passing the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

The in-place density shall be determined by using AASHTO T 310, Direct Transmission. The moisture content shall be determined by AASHTO T 310 or AHTD Test Method 347 or 348.

The moisture content of the material being compacted through out each entire layer shall be substantially that of optimum moisture of the particular soil type. It shall be the responsibility of the Contractor to bring the moisture content throughout each layer of the

embankment to be compacted to substantially that of optimum moisture by the addition of water or by aeration as may be necessary to increase or decrease moisture under the conditions encountered.

The density of the embankment shall be obtained and maintained or restored before placing a subsequent layer of embankment, base course, or surfacing.

The following procedures are to be followed in securing the required compaction:

The embankment shall be constructed to grade over the full width in uniform layers parallel to the finished surface and not more than 10" (250 mm) in thickness, loose measure. Each layer shall have the moisture content and be compacted to meet the requirements herein before provided. The maximum depth of layer as specified may be modified by the Engineer as particular conditions justify, such as the placing of the first layer over marshy area, or on slopes too steep for the operation of equipment. In such areas the embankment may be constructed in one layer to the minimum elevation at which equipment can be operated and above such elevation the layers shall not exceed the specified maximum thickness of 10" (250 mm), loose measure.

Density requirements will not apply to portions of embankment constructed of material so rocky that it cannot be satisfactorily tested according to the above requirements. In such cases, the extent of compactive effort by rolling will be determined by the Engineer based upon the amount of breakage and consolidation that can be accomplished. When the nature of the material is such that consolidation by rolling is impractical, rolling will not be required.

After the roadbed has been excavated to line and grade, the surface shall be loosened to a minimum depth of 6" (150 mm) below the finished elevation, the entire area within the limits of the roadbed section processed, the material brought within the range of optimum moisture content, compacted, and stabilized to meet the requirements of these specifications. The section shall be reshaped to conform to the typical section during the compaction operation.

When the roadbed is excavated from solid rock and backfilled with material conforming to the definition for Common Excavation

or Unclassified Excavation, or with Borrow, the backfill shall be compacted as provided above.

Work involved in compaction as required by this subsection will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various classes of excavation and/or borrow.

**210.11 Compacted Embankment.** When the item "Compacted Embankment" is included in the Contract, the following provisions shall apply.

All excavation and embankment shall be constructed to reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

All suitable excavated material may be used in part or in total to construct the embankments within the areas of Compacted Embankment or it may be removed from the project and the embankments constructed with new material meeting the requirements of Borrow.

Embankment shall be constructed and compacted according to Subsections 210.09 and 210.10.

Where excavation to the finished grade section results in a subgrade or slopes of unsuitable material, the Engineer may require the Contractor to undercut the unsuitable material and backfill to the finished grade section with approved material. The excavation of unsuitable material will be measured and paid for under the appropriate classification of excavation and the backfill will be paid for as Compacted Embankment using the same measurements.

Material used to replace that removed by scalping areas of vegetation and/or mulch cover, resulting from work required by Section 110, will be paid for as Compacted Embankment. The Engineer may determine the volume by the average end area method or by measuring the average length, width, and depth of removal.

Borrow will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for Compacted Embankment and/or the appropriate classification of excavation. All work involved in excavation and construction of embankments will be measured and paid for as provided for in

Subsections 210.12 and 210.13 under the appropriate items of excavation, presplitting, and compacted embankment. Excavation or embankment constructed outside the plan limits without the specific approval of the Engineer will not be included in the measurement of excavation or embankment and will not be paid for.

**210.12 Method of Measurement. (a)** All accepted excavation and borrow will be measured in its original position by the cross section method or survey break line method, field collected or by using photogrammetric procedures. Volumes shall be computed by the average end area method to determine the amount of material removed. Measurements will include overbreakage or slides not attributable to carelessness of the Contractor, authorized excavation of solid rock below grade, and unsuitable materials below grade (undercut). When measuring quantities of undercut below subgrade, the Engineer may determine the volume of the excavation by measuring the average length, width, and depth of the excavation.

On projects with small quantities of borrow, and when approved in writing by the Engineer, borrow may be measured in vehicles according to Subsection 209.03, Method 2.

All quantities will be determined to the nearest whole cubic yard (cubic meter).

**(b)** Presplitting will be measured by the square yard (square meter) of plane surface of the final presplit cut face. The measurement will be subject to reduction because of avoidable overbreakage resulting from excessive blasting.

**(c)** Compacted Embankment when included in the Proposal will include all approved fill within the right-of-way or construction easement limits and will be measured in its final position by the cross section method or survey break line method, either field collected or by using photogrammetric procedures, and computed by the average end area method to determine the amount of fill volume required to complete the work according to the plans or as directed by the Engineer.

**(d)** When any pay item under this Section is shown on the plans, contract, or otherwise specified as plan quantity, the quantities for such items shall be considered as final quantities and no further measurement will be made except for undercutting of unsuitable material and backfilling with appropriate material. These final quantities will be revised if, in the opinion of the Engineer or upon

evidence furnished by the Contractor, substantial variations exist between the quantities shown on the plans and the actual quantities due to changes in alignment, grade, typical section, or apparent errors. If field measurement of quantities designated on the plans as plan quantity is deemed necessary, the change in the method of measurement will be documented by an approved change order and the Contractor shall allow the Engineer sufficient time to collect the necessary original field data, if required, before any earthwork is begun.

(e) Hauling of excavation material for placement in embankments or waste areas will not be paid for separately, but full compensation therefor will be considered included in the contract unit price(s) bid for the various classifications of excavation. Hauling of Borrow will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Borrow.

(f) For all earthwork to be measured, the Engineer shall have the following options:

- to obtain original and/or final cross sections in the field or by photogrammetric methods,
- to use as original cross sections the preliminary cross sections used in the design of the project,
- to use templated final cross sections in lieu of cross sections taken in the field,
- to use an electronic computer program to compute quantities from terrain models developed from field and/or photogrammetric data.

**210.13 Basis of Payment.** (a) The quantities of the various classes of excavation and for Borrow completed and accepted and measured as provided above will be paid for at the Contract unit price bid per cubic yard (cubic meter) for Common Excavation, Rock Excavation, Unclassified Excavation, or Borrow, as the case may be, which price shall be full compensation for excavation; for drilling and blasting; for formation of embankment; for compaction of earthwork; for performing quality control and acceptance sampling and testing; for furnishing and applying water and aerating of soils; for trimming of slopes; for disposal of surplus material; for hauling; for preparation and completion of subgrades and shoulders or roadway; for final cleaning up of the right-of-way; and for all labor, equipment, tools, and incidentals necessary to complete the

work. The Contract unit price bid for Borrow used in the planned embankment shall also be compensation for furnishing material, including royalties; for clearing and grubbing; for stripping and replacing topsoil; for excavating, sloping, trimming, loading and hauling; for performing quality control and acceptance sampling and testing; for confining live stock; for fence moved and replaced as required; for constructing, maintaining, and obliterating haul roads; for seeding and restoration as required; and for complying with Section 110 and Subsections 106.02 and 107.10.

(b) Presplitting completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Presplitting, which price shall be full compensation for drilling and blasting; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

(c) Compacted Embankment completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Compacted Embankment, which price shall be full compensation for all costs involved in furnishing and placing borrow; for hauling and placing excavation; for constructing the embankment according to Subsection 210.11; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Common Excavation	Cubic Yard(Cubic Meter)
Rock Excavation	Cubic Yard(Cubic Meter)
Unclassified Excavation	Cubic Yard(Cubic Meter)
Borrow	Cubic Yard(Cubic Meter)
Presplitting	Square Yard(Square Meter)
Compacted Embankment	Cubic Yard(Cubic Meter)

**SECTION 211 VACANT**

## SECTION 212 SUBGRADE

**212.01 Description.** This item shall consist of shaping, compacting, and otherwise preparing the completed roadbed for the placing of base and surface courses and pavements according to these specifications and in substantial conformity with the lines, grades, and cross sections shown on the plans.

**212.02 Construction Requirements. (a) General.** The subgrade shall be prepared in such a manner as to ensure that the base, surface course, or pavement will be placed on a firm foundation that is stable and reasonably free from dust pockets, wheel ruts, or other defects.

The subgrade area shall be scarified as necessary for shaping, and shaped and compacted to the required grade and section. A maximum deviation of 1/2" (13 mm), plus or minus, from the required grade will be permitted on the surface of the finished subgrade. Quality control and acceptance testing shall be according to Section 210 except that the minimum frequency of acceptance testing for density and moisture shall be one test per each 12,000 square yards (10,000 sq m) of subgrade area. The minimum depth of testing shall be 8" (200 mm) with the gauge in the direct transmission mode.

The in-place density shall not be less than 95% of the maximum laboratory density. The maximum laboratory density will be determined according to Subsection 210.10. In-place densities shall be determined according to Subsection 210.10.

Compaction shall be accomplished by any satisfactory method or methods that will obtain the density. The Contractor shall bring the moisture content of the material to be compacted to substantially that of optimum moisture by the addition of water or by manipulation and aeration as necessary to increase or decrease the moisture content under the conditions encountered.

When the subgrade is to be stabilized with lime or portland cement, the top 8" (200 mm) shall be compacted before treatment to the extent necessary to prevent rutting under normal operation of construction equipment.

Compaction operations may be omitted when an old stone or

gravel roadbed is used as a foundation or subgrade for a base course or pavement where scarifying for shaping is unnecessary and its stability is approved by the Engineer.

Existing asphalt surface course in place shall be scarified and the material broken down to a maximum size of 2" (50 mm) and shaped and compacted to a stable condition and to the required grade and section after being thoroughly mixed with any base course material that may be in place unless the Engineer considers the existing surface suitable for retention.

All soft and yielding material and other portions of the subgrade that will not compact readily when rolled or tamped shall be removed. Holes or depressions made by the removal of unsuitable material as directed above shall be filled with approved material and the entire subgrade brought to the lines, grade, and cross section shown on the plans and compacted to the required density.

If the succeeding course is not placed immediately after the subgrade has been prepared and the subgrade becomes cut up, rough, or unstable, it shall again be shaped and recompactd according to the above requirements.

**(b) Subgrade for Portland Cement Concrete Base or Pavement (Forms).** Portions of the subgrade composed of unsuitable materials shall be removed as directed, backfilled with approved material, and the entire subgrade brought to line and grade and compacted as specified above.

The subgrade shall be prepared for the paving by shaping and compacting to the full width according to the typical section shown on the plans. The material obtained in excess of that required for shaping due to variations in elevation shall be used to complete the shoulders, widen the roadbed, flatten the slopes, or be disposed of as shown on the plans or directed by the Engineer. After shaping, the entire area within the form lines shall be compacted to the required density. Any portion of the subgrade that is not accessible to normal compaction equipment shall be thoroughly compacted with manually operated mechanical tampers.

After the subgrade has been prepared and consolidated and the forms set and accepted, the surface of the subgrade shall be tested for crown and elevation using an approved scratch template held in a vertical position and moved backward and forward on the side



forms. The scratch template shall be so designed that the ends of the prongs will indicate the true position of the subgrade when the template is riding on the forms. Excess material indicated by the scratch template shall be removed. The use of a scratch template will not be required on subgrades or subbases constructed of materials other than earth or sand, but the required degree of accuracy on the subgrade or subbase surface shall be obtained by other approved methods.

To bring low areas up to the correct subgrade elevation, approved material shall be furnished and tamped or rolled until the filled material is as thoroughly compacted as the surrounding subgrade on which no additional material has been placed. The surface of low areas may require scarifying before adding and compacting the additional fill material. Ruts and depressions caused by hauling shall be filled and consolidated as they develop. As a final check of subgrade conditions, a template or planer shaped to the true cross section of the bottom of the pavement shall be drawn on the forms immediately ahead of concrete operations and any excess material shall be removed before the concrete is placed. Low places in the subgrade, as indicated by the final check, shall be filled with concrete and no additional compensation will be allowed for the extra quantities of concrete involved, or shall be filled with approved material and compacted to required density.

If the succeeding course is not placed immediately after the subgrade has been prepared and the subgrade becomes cut up, rough, or unstable, it shall again be shaped and recompactd according to the above requirements.

**212.03 Method of Measurement and Basis of Payment.** On paving or surfacing projects that include the construction of the roadbed, the scarifying, blading, shaping, compacting, and other work necessary to bring the roadbed to the requirements of these specifications will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various classes of excavation or the placing of the base course, surface course, pavement, or shoulders as applicable. Replacement of material removed by scalping areas of vegetation and/or mulch cover, resulting from work required by Section 110, will be paid for under the appropriate item as provided in the plans or in the Contract.

On paving or surfacing projects that do not include the construction of the roadbed, the removal and disposal of unsatisfactory material and additional material hauled in as required to fill holes or depressions in the roadway or otherwise correct deficiencies in grade or typical section will be measured and paid for under the appropriate item as provided on the plans or in the Contract. When only small quantities of additional material are required, measurement thereof may be made in vehicles according to Subsection 209.03, Method 2.

## **SECTION 213 SHAPING ROADWAY SECTION**

**213.01 Description.** This item shall consist of modifying the existing roadway to conform substantially to the typical section shown on the plans. This work shall include excavating and hauling or drifting subgrade material necessary in widening the existing roadway, making minor cuts and fills, and/or shaping and dressing the surface, shoulders, ditches, foreslopes, and backslopes to provide a uniform and well-drained subgrade, all according to the plans and these specifications or as directed.

**213.02 Construction Requirements.** Before the work is started, all grass, weeds, or rubbish of any nature that may be considered deleterious, shall be removed from within the construction limits and disposed of as directed.

Material obtained from shaping the ditches and slopes shall be spread over the existing roadway to a uniform grade. The grade of the existing roadway shall not be changed except as made necessary by the material obtained from the ditches and slopes. Deviations may be permitted so long as the grade constructed is free from sharp breaks, dips, and ridges and will provide a uniform riding surface. Sight distances over hill crests shall not be impaired.

The crown width of the roadway shall not be less than the roadway width shown on the plans. Sections of roadway with a crown width greater than the typical section shall not be reduced in crown width unless necessary to secure satisfactory ditches and slopes.

Foreslopes and backslopes may be variable to the extent feasible to aid balancing the earthwork, but no slope shall be steeper than the maximum shown on the plans.

Should there develop any depressions or narrow embankments where the material obtained from shaping the ditches and slopes is insufficient to construct a satisfactory roadway, sufficient additional material shall be obtained and placed under the provisions of Subsection 210.06 to bring the roadway to a satisfactory section.

Compaction of the roadbed shall comply with the requirements of Subsection 210.10. Quality control and acceptance testing shall be according to Section 210.

All existing drainage structures to be retained shall be cleaned. Where noted on the plans, inlet and outlet ditches shall be cleaned. Inlet and outlet ditches for new drainage structures shall be cleaned as required for proper drainage at locations noted on the plans.

Existing driveways and approach roads shall be reshaped and new driveways and approach roads constructed to the details and at the locations shown on the plans.

**213.03 Method of Measurement.** Shaping Roadway Section will be measured by the 100' (100 meter) survey station along the centerline of the roadway. This measurement will be made to the nearest foot (meter).

All additional material obtained for borrow will be measured and paid for according to Section 210. On projects with small quantities of borrow, and when approved by the Engineer, borrow may be measured in vehicles according to Subsection 209.03, Method 2.

**213.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per station (metric station) for Shaping Roadway Section, which price shall be full compensation for removing and disposing of grass, weeds, and rubbish; for excavating and hauling all material except borrow; for formation and compaction of embankment; for performing quality control and acceptance sampling and testing; for trimming and shaping slopes, shoulders, and subgrade of roadway; for cleaning existing drainage structures and inlet and outlet ditches; for shaping all approaches; and for the furnishing of all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Shaping Roadway Section	Station (Metric Station)

**SECTION 214  
SUBGRADE PREPARATION**

**214.01 Description.** This item shall consist of shaping, compacting, and otherwise preparing the existing roadbed constructed under a previous contract for the placement of base, subbase, and/or selected material to the tolerances shown on the plans and to the lines, grades, and cross sections shown on the plans or as directed by the Engineer.

**214.02 Construction Requirements.** This work shall be completed as required in Section 212 except that the subgrade shall be scarified to the depth necessary, not to exceed 12" (300 mm). The operation shall extend across the areas of roadbed to be occupied by selected material, subbase, or base material or as directed by the Engineer.

Excess material removed from high areas shall be moved and placed in low areas as needed. The Contractor will not be required to move such material more than 3300' (1 km). Excess material that cannot be used to fill low areas may be used to flatten slopes or as otherwise directed by the Engineer. In lieu of wasting excess material and obtaining suitable material to fill low areas, the Contractor may move excess material removed from high areas more than 3300' (1 km) at no additional cost to the Department for the additional haul distance.

Quality control and acceptance testing shall be according to Section 212.02.

**214.03 Method of Measurement.** Subgrade Preparation will be measured by the 100' (100 meter) survey station measured along the centerline of each set of lanes and/or each ramp. This measurement will be made to the nearest foot (meter).

**214.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit

price bid per station (metric station) for Subgrade Preparation, which price shall be full compensation for scarifying, blading, shaping, and compacting the existing subgrade; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work. Replacement of material removed by scalping areas of vegetation and/or mulch cover, resulting from work required by Section 110, will be paid for under the appropriate item.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Subgrade Preparation	Station (Metric Station)

### **SECTION 215**

#### **TRENCHING AND SHOULDER PREPARATION**

**215.01 Description.** This item shall consist of trenching, scarifying, blading, compacting, and otherwise preparing the existing shoulder for asphalt pavement widening within the limits shown on the plans and according to these specifications.

**215.02 Construction Requirements.** The existing shoulders shall be trenched and scarified to meet the lines, grades, and dimensions shown on the plans or as directed by the Engineer. The trenched material shall be spread over the existing slope and shall not obstruct drainage systems. Any trenched material unsuitable for placement on the slopes or excess material shall be disposed of according to the requirements for disposal of unsuitable material in Sections 110, 201, and 210.

The subgrade shall be compacted according to Subsection 210.10. Quality control and acceptance testing shall be according to Section 212.02.

**215.03 Method of Measurement.** Trenching and Shoulder Preparation will be measured by the 100' (100 meter) survey station along the centerline of each separate roadway. The measurement will be made to the nearest foot (meter) and includes both shoulders.

**215.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit

price bid per station (metric station) for Trenching and Shoulder Preparation, which price shall be full compensation for trenching, scarifying, and spreading material over the slopes; disposal of unsuitable or excess material; recompacting; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Trenching and Shoulder Preparation	Station (Metric Station)

**SECTION 216  
SCARIFYING AND RECOMPACTING  
SHOULDERS**

**216.01 Description.** This item shall consist of scarifying, blading, shaping, and recompacting the existing base material; preparing the existing shoulder for surfacing; and stockpiling the excess material at the designated locations.

**216.02 Construction Requirements.** When the existing asphalt surface consists of any type of ACHM, the layer(s) of ACHM shall be removed and disposed of as directed by the Engineer. When the existing surface consists of one or more layers of Asphalt Surface Treatment, the Contractor shall have the option, with the approval of the Engineer, of either removing and disposing of the surface material or scarifying, breaking down, and mixing the surface material with the underlying base course material. The existing base course shall be scarified to a depth of 4" (100 mm) to 6" (150 mm) and recompacted to a density, as determined by AASHTO T 310, Direct Transmission, of not less than 95% of the maximum laboratory density obtained by AASHTO T 180, Method D. Quality control and acceptance testing for density shall be according to the provisions of Section 306 except the minimum frequency of acceptance testing shall be based on a lot size of 6,000 square yards (5,000 sq m). The final elevation of the base course on the shoulders shall allow for the surface course as shown on the plans.

**216.03 Method of Measurement.** Scarifying and Recompacting Shoulders will be measured by the square yard (square meter). The length will be measured to the nearest foot (meter), horizontally and parallel to the centerline, and the width will be the width of the finished base course shoulder. Width in excess of that shown on the plans or authorized by the Engineer will be excluded from the measurement.

**216.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Scarifying and Recompacting Shoulders, which price shall be full compensation for scarifying, blading, shaping, and recompacting base material; for performing quality control and acceptance sampling and testing; for loading, hauling, and stockpiling excess material; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Scarifying and Recompacting Shoulders	Square Yard (Square Meter)

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**DIVISION 300  
BASES AND GRANULAR SURFACES**

**SECTION 301  
LIME TREATED SUBGRADE**

**301.01 Description.** This item shall consist of treating the existing subgrade with water and lime according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and cross section shown on the plans.

**301.02 Composition.** The mixture shall be composed of the soil in the existing subgrade, lime, and water. The mixture shall contain not more than 8% by weight of lime. At least 30 days before the beginning of lime treatment, adequate quantities of soil and lime shall be supplied to the Materials Division for determination of lime requirements. The Engineer will specify, based on laboratory tests, the exact percentage of lime to be used.

The type of lime used shall be either quicklime or hydrated lime as shown in the Contract.

**301.03 Materials.** The materials shall comply with the following requirements:

(a) **Water.** All water used in mixing shall be clean and free from injurious amounts of oil, salt, or other deleterious substances, and shall be free of vegetable matter or other foreign materials.

(b) **Lime.** The lime shall comply with AASHTO M 216.

(c) **Soil.** The soil shall be the soil in the existing subgrade.

**301.04 Construction Requirements.** (a) **Preparation of Subgrade.** Before beginning the lime treatment, the subgrade shall be shaped to the required grade and section and compacted to sufficient density to prevent rutting under normal operation of construction equipment. Soft areas shall be corrected to provide uniform stability before lime application. Any material in temporary cross roads, bridge approaches, or other areas that extends above the elevation of the proposed subgrade shall be removed and disposed of, as directed.

(b) **Preparation of Soil.** The proposed roadbed shall be scarified to the depth and width indicated on the plans for the subgrade treatment. The scarified material shall be partially pulverized. The depth of scarification shall be carefully controlled and operations

conducted in a manner to provide that the subgrade material below the depth of the proposed treatment shall remain undisturbed.

**(c) Application of Lime.** The rate of application of lime shall be as determined by laboratory design or as directed. Hydrated lime may be applied to the partially pulverized material either in a slurry or in the dry condition. Quicklime (slurry) shall be applied to the partially pulverized material in a slurry. Quicklime (dry) shall be applied to the partially pulverized material in the dry condition. Spreading shall be accomplished by adding either the slurry or dry lime uniformly to the surface of the material. Spreading equipment, including truck spreaders, shall be of a type and design capable of uniformly distributing the lime without excessive loss.

No equipment, except water trucks and that equipment used for spreading and mixing, shall be permitted to pass over the spread lime until it is mixed with subgrade material.

Any procedure that results in excessive loss or displacement of the lime shall be immediately discontinued.

**(d) Addition of Water.** Water shall be applied to the spread lime immediately after placing to moisten the lime and form a dust palliative. Water shall be added during mixing operations to moisten the mixture but the total water added to the mixture including that added to form a slurry shall not exceed the optimum by more than 5%.

**(e) Mixing.** Mixing may be accomplished by means of rotary tillers, pulvimixers, or other mechanical equipment. The first stage of the mixing process shall continue until the lime and moisture are thoroughly and uniformly dispersed throughout the mixture. After this has been completed, the surface shall be rolled with pneumatic rollers until sealed sufficiently to shed rain.

After the first mixing stage, the mixture shall be allowed to set for a minimum of 3 days or until the mixture becomes friable. During this period, the surface shall be sprinkled as necessary to keep it moist.

After this period, the mixture shall be scarified and thoroughly and uniformly mixed with rotary tillers or pulvimixers until the soil is thoroughly pulverized and mixed with the lime. During the mixing, water shall be added to keep the moisture within  $\pm 2\%$  of the optimum.

**(f) Compaction.** After the materials have been satisfactorily mixed and pulverized, the full depth of the mixture shall be compacted to a uniform density of not less than 95% of the maximum laboratory density. Percent coarse particles retained on the #4 (4.75 mm) sieve shall be determined according to AASHTO T 27. The maximum laboratory density shall be determined as follows:

<b><u>% Retained</u></b>	<b><u>Test Method</u></b>
<b><u>#4 (4.75 mm) Sieve</u></b>	
10 Max.	AASHTO T 99, Method A
11 - 30	AASHTO T 99, Method C
31 Min.	AASHTO T 180, Method D

**Note:** Instead of AASHTO T 224, correction for coarse particles retained on the 3/4" (19.0 mm) sieve shall be determined by replacing with an equal mass of material passing the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

The in-place density shall be determined by using AASHTO T 310, Direct Transmission. The moisture content shall be determined by AASHTO T 310 or AHTD Test Method 347 or 348. Sprinkling may be necessary during the compaction to maintain the desired moisture content. Compaction shall be accompanied by sufficient blading to eliminate surface irregularities and to maintain the required section.

**(g) Finishing.** During the final stages of the compaction, the surface of the subgrade shall be shaped to the lines, grades, and cross sections shown on the plans. When required, the surface may be lightly scarified and bladed. Final rolling of the completed surface shall be accomplished with a pneumatic roller.

**301.05 Maintenance.** The Contractor shall, at no cost to the Department, maintain the treated subgrade until the next course is applied. The maintenance shall be considered as part of the processing of the treated subgrade.

**301.06 Seasonal and Temperature Limitations.** Application of lime will not be permitted when the surface temperature is below 50° F (10° C), nor shall it be applied before April 1 or subsequent to a date in October sufficiently early to give reasonable assurance that all mixing, spreading, and rolling will be complete on or before October 31, except by written permission of the Engineer.

**301.07 Quality Control and Acceptance.** Quality control and acceptance testing shall be according to Subsection 210.02 except that the minimum frequency of testing for density and moisture shall be one test per each 12,000 square yards (10,000 sq m) of subgrade area. The minimum depth of testing shall be 8" (200 mm) with the gauge in the direct transmission mode.

**301.08 Method of Measurement.** (a) Processing Lime Treated Subgrade will be measured by the square yard (square meter).

Water will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Processing Lime Treated Subgrade.

(b) Lime will be measured by the ton (metric ton).

**301.09 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Processing Lime Treated Subgrade will be paid for at the contract unit price bid per square yard (square meter) for Processing Lime Treated Subgrade.

(b) Lime will be paid for at the contract unit price bid per ton (metric ton) for Quicklime (slurry) in Treated Subgrade, Quicklime (dry) in Treated Subgrade, or Hydrated Lime in Treated Subgrade, as applicable. Water used in the slurry method will not be measured and paid for directly.

The contract unit prices mentioned above will be full compensation for preparation of the subgrade; for furnishing, hauling, placing, and applying materials; for pulverizing, watering, mixing, compacting, and finishing; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete and maintain the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Processing Lime Treated Subgrade	Square Yard (Square Meter)
Quicklime (slurry) in Treated Subgrade	Ton (Metric Ton)
Quicklime (dry) in Treated Subgrade	Ton (Metric Ton)
Hydrated Lime in Treated Subgrade	Ton (Metric Ton)

## SECTION 302 SELECTED MATERIAL

**302.01 Description.** This item shall consist of a foundation course for base courses. It shall be constructed on the prepared subgrade according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and typical cross section shown on the plans.

**302.02 Materials.** Selected material shall consist of a satisfactory sandy type soil or mixture of sandy soil and stone or gravel. The maximum size of gravel or stone particles shall be 3" (75 mm).

The material furnished shall be free from sod, stumps, logs, roots, or other perishable or deleterious matter; shall be the class called for in the Contract; and shall comply with the requirements listed below for that particular class:

<u>Class</u>	<u>Maximum Percent Passing #200 (0.075 mm) Sieve</u>	<u>Maximum Plasticity Index</u>
SM-1	25	3
SM-2	35	6
SM-3	35	10
SM-4	50	6

It shall be the responsibility of the Contractor to furnish a material that will remain stable and will not rut under construction operations.

When it becomes necessary to admix materials to attain compaction requirements, such material and admixing shall be at no cost to the Department.

The finished material shall comply with specification requirements.

**302.03 Construction Requirements.** The selected material shall be placed on a completed and approved subgrade substantially conforming to the grades and cross section shown on the plans.

The subgrade shall be prepared as specified in Section 212, and shall be free from an excess or deficiency of moisture at the time of placing the selected material. The selected material shall not be

placed on a frozen subgrade and shall be placed in layers not to exceed 10" (250 mm) in depth, loose measure. When vibrating or other approved types of special compacting equipment are used, the depth of a single layer of selected material may be increased to 12" (300 mm), loose measure, upon approval of the Engineer.

The material in each layer of selected material shall be compacted to a uniform density of not less than 98% of the maximum laboratory density. Percent coarse particles retained on the #4 (4.75 mm) sieve shall be determined according to AASHTO T 27. The maximum laboratory density shall be determined as follows:

<u>% Retained - #4 (4.75 mm)</u>	<u>Test Method</u>
<u>Sieve</u>	
10 Max.	AASHTO T 99, Method A
11 - 30	AASHTO T 99, Method C
31 Min.	AASHTO T 180, Method D

**Note:** Instead of AASHTO T 224, correction for coarse particles retained on the 3/4" (19.0 mm) sieve shall be determined by replacing with an equal mass of material passing the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

The in-place density shall be determined by using AASHTO T 310, Direct Transmission. The moisture content shall be determined by AASHTO T 310 or AHTD Test Method 347 or 348. It shall be the responsibility of the Contractor to maintain the moisture content of each layer of material being compacted at substantially optimum either by addition of water or by aeration.

The Contractor shall be responsible for the stability of all selected material placed under the Contract until final acceptance of the work. The replacement of any portions that become displaced due to carelessness or negligent work on the part of the Contractor shall be at no cost to the Department.

**302.04 Quality Control and Acceptance.** Quality control and acceptance shall be according to the provisions of Section 306.

**302.05 Method of Measurement.** Selected Material will be measured in vehicles either by the cubic yard (cubic meter) or by the ton (metric ton).

**302.06 Basis of Payment.** Work completed and accepted and measured as provided above, will be paid for at the contract unit price bid per cubic yard (cubic meter) or ton (metric ton) for Selected Material, of the particular class specified, which price shall be full compensation for preparing the subgrade and furnishing material; for placing, adding moisture, aerating, manipulating, and compacting; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Selected Material (Class SM____)	Cubic Yard (Cubic Meter) or Ton (Metric Ton)

### **SECTION 303 AGGREGATE BASE COURSE**

**303.01 Description.** This item shall consist of a foundation course for surface course, for other base courses, or for pavements. It shall be constructed on the prepared subgrade, subbase, or other completed base course according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and typical cross section shown on the plans.

**303.02 Materials.** Aggregate Base Course shall be gravel, crushed stone, and/or steel slag so proportioned as to meet the requirements for a class of aggregate specified in Table 303-1. Steel slag is allowed for Classes 1 and 2 only. Classes 7 and 8 shall be any mechanically crushed natural rock or stone of igneous, sedimentary, and/or metamorphic origin produced from a solid geological formation by quarrying methods.

The Contractor shall have the option of using any higher numbered class Aggregate Base Course than that specified, provided that payment will be for the class specified.

Material furnished for Aggregate Base Course, Class 3 through Class 8, shall have a percent of wear by the Los Angeles Test not greater than 45 as determined by AASHTO T 96.

When it is necessary to blend two or more materials, each material shall be proportioned separately through mechanical feeders to ensure uniform production. Premixing or blending to avoid separate feeding will not be permitted. Production of material by blending materials on the roadway to obtain a mixture that will comply with the requirements specified herein will not be permitted.

For the purpose of this specification, shale and slate are not considered to be gravel or stone. The material furnished shall not contain more than 5% by weight of shale, slate, and other objectionable, deleterious, or injurious matter.

For Classes 1 and 8 materials, the fraction passing the #200 (0.075 mm) sieve shall not be greater than three-fourths of the fraction passing the #40 (0.425 mm) sieve. For Classes 3 through 8 the fraction passing the #40 (0.425 mm) sieve shall have a liquid limit not greater than 25.

To ensure that gravel is uniformly graded, the difference between the percent passing the various sieves shall be as follows for Classes 3, 4, and 5:

	<b>Sieve</b>	<b>Percent</b>
3/4" - 3/8"	(19.0 mm - 9.5 mm)	5 min.
3/8" - #4	(9.5 mm - 4.75 mm)	5 min.
#4 - #10	(4.75 mm - 2.00 mm)	5 min.
#10 - #40	(2.00 mm - 0.425 mm)	4 min.

When the material contains aggregate larger than that specified above for the class called for in the Contract, the oversize aggregate shall be removed by screening or by screening and crushing. The removal of large size aggregate by hand methods will not be permitted.

**303.03 Construction Requirements.** The base course material shall be placed on a completed and approved subgrade or existing base that has been bladed to substantially conform to the grade and cross section shown on the plans.

The subgrade shall be prepared as specified in Section 212 and shall be free from an excess or deficiency of moisture at the time of placing base course material. The subgrade shall also comply, where applicable, with the requirements of other items that may be contained in the Contract that provide for the construction,



reconstruction, or shaping of the subgrade or the reconstruction of the existing base course.

Base course material shall not be placed on a frozen subgrade or subbase.

The aggregate shall be placed on the subgrade or other base course material and spread uniformly to such depth and lines that when compacted it will have the thickness, width, and cross section shown on the plans.

If the required compacted depth of the base course exceeds 6" (150 mm), the base shall be constructed in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 6" (150 mm) except when vibrating or other approved types of special compacting equipment are used, the compacted depth of a single layer of base course may be increased to 8" (200 mm) upon approval of the Engineer. Each layer shall be stable before advancing to the next layer sequence.

The material shall be spread the same day that it is hauled. Spreading shall be performed in such manner that no segregation of coarse and fine particles nor nests or hard areas caused by dumping the aggregate on the subgrade will exist. Care shall be taken to prevent mixing of subgrade or unspecified material with the base course material during the blading and spreading operation.

Aggregate shall not be dumped or mixed on an existing or newly constructed ACHM course or PCC Pavement that will not be overlaid under the same Contract or on any open graded base course. Mechanical spreading equipment shall be used, if necessary, to place the base course on the subgrade.

If sufficient working space is not available to allow proper aeration or addition of water to the base, the base material shall be mixed by any satisfactory method before placement.

Each course shall be thoroughly mixed for the full depth of the course and shall be compacted by any satisfactory method that will produce the density hereinafter specified. The aggregate shall be maintained substantially at optimum moisture during the mixing, spreading, and compacting operations, water being added or the material aerated as may be necessary. The specified grade and cross section shall be maintained by blading throughout the compaction operation. The material in each course shall be compacted to a

density, as determined by AASHTO T 310, Direct Transmission, of not less than 98% of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D. Aggregate base course placed in areas outside of the normal traveled way, such as driveways, islands, gore areas, other incidental construction, and restricted width areas outside of the normal traveled way which cannot accommodate a full width roller shall be compacted to a density, as determined by AASHTO T 310, Direct Transmission, of not less than 95% of the maximum laboratory density. Shoulders are considered to be within the normal traveled way. The aggregate shall be compacted across the full width of application.

The compacted base course shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and recompacting to the specified density, as directed.

Where neither prime coat nor surfacing is provided in the same Contract with the base course, the material in the base course shall be uniformly compacted, stable, and free of segregated areas.

The Contractor shall maintain the base course in a satisfactory condition until accepted.

**303.04 Quality Control and Acceptance.** Quality control and acceptance shall be according to the provisions of Section 306.

**303.05 Method of Measurement.** Aggregate Base Course will be measured in vehicles either by the cubic yard (cubic meter) or by the ton (metric ton).

**303.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) or ton (metric ton) for Aggregate Base Course of the particular class specified, which price shall be full compensation for preparing the subgrade; for furnishing material; for spreading, finishing, watering, manipulating, and compacting; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

In cases where the combined specific gravity of the material used for Aggregate Base Course exceeds 2.80 and the method of measurement is by the ton (metric ton), the quantity of material will be adjusted for payment by multiplying the quantity of the material used by a specific gravity of 2.80 and dividing by the higher specific gravity.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Aggregate Base Course (Class__)	Cubic Yard (Cubic Meter) or Ton (Metric Ton)

**SECTION 304 VACANT**

**TABLE 303-1**  
**AGGREGATE BASE COURSE GRADING (AASHTO T 11 AND T 27)**  
**AND CRUSHING REQUIREMENTS (AHTD TEST METHOD 304)**

SIEVE (mm)	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	CLASS 8
	<b>PERCENT PASSING</b>							
3" (75)	100	100	100					
2" (50)	95-100	95-100	95-100					
1½" (37.5)			85-100	100	100	100	100	
1" (25.0)						60-100	60-100	100
¾" (19.0)	60-100	60-100	60-100	60-100	60-100	50-90	50-90	65-100
⅜" (9.5)	40-80	40-80	40-80	40-80	40-80			
#4 (4.75)	30-60	30-60	30-60	30-60	30-60	25-55	25-55	25-55
#10 (2.00)	20-50	20-50	20-45	20-45	20-45			
#40 (0.425)	10-35	10-35	10-35	10-35	10-35	10-30	10-30	10-30
#200 (0.075)	3-15	3-15	3-12	3-12	3-12	3-12	3-12	3-12
MAX. PLASTICITY INDEX (MINUS #40 MATL.)	13	10	6	6	6	6	6	6
(0.425 mm)								
MINIMUM PERCENT CRUSHED (RETAINED ON #4 [4.75 mm] SIEVE)					15			
MINIMUM PERCENT CRUSHER-RUN MATERIAL						90	90	90

## SECTION 305 RECONSTRUCTED BASE COURSE

**305.01 Description.** This item shall consist of reshaping an existing base course essentially true to grade and typical section, preparatory to the placement of a surface course of pavement and shall be constructed according to these specifications and essentially in conformity with the lines, grades, and typical sections shown on the plans.

**305.02 Materials.** When required, the Contractor shall furnish additional aggregate base course of the class specified, meeting the requirements of Section 303.

**305.03 Construction Methods.** The existing base course shall be scarified for its entire width as shown on the typical section to a uniform depth sufficient to eliminate all depressions and irregularities. The depth of scarification shall be carefully controlled to prevent contamination of the base material with subgrade. If the base material becomes contaminated due to the Contractor's work, the contaminated base shall be removed and replaced by the Contractor at no cost to the Department.

After the scarifying operation is completed, the roadbed shall be shaped to the specified grade and cross section and compacted by any satisfactory method that will obtain the density herein specified. The base course material shall be maintained at optimum moisture during the shaping and compacting operations by adding water or by aerating the material as necessary. The specified grade and section shall be maintained by blading throughout the compaction operation. The density of the compacted material in the reconstructed base course, as determined by AASHTO T 310, Direct Transmission, shall be not less than 95% of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D. The reconstructed base course shall be compacted across its full width.

The Contractor shall reshape all or any part of the base as many times as may be necessary to secure the desired results.

**305.04 Quality Control and Acceptance.** Quality control and acceptance shall be according to the provisions of Section 306.

**305.05 Method of Measurement.** Reconstructed Base Course will be measured by the station (metric station) measured along the centerline of the roadway. Roadways in each direction of a divided

highway will be measured separately, and additional areas outside the normal roadway will be converted to the normal measurement on an equivalent area basis.

**305.06 Basis of Payment.** Reconstructed Base Course completed and accepted and measured as provided above will be paid for at the contract unit price bid per station (metric station) for Reconstructed Base Course, which price shall be full compensation for all scarifying, spreading, and shaping; for all watering, manipulating, finishing, and compacting; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Reconstructed Base Course	Station (Metric Station)

## **SECTION 306**

### **QUALITY CONTROL AND ACCEPTANCE**

**306.01 Description.** To assure that the material used meets the requirements of the specifications, certain tests for quality control and acceptance will be performed as specified herein. The properties for which quality control and acceptance testing will be performed are gradation, density, moisture content, plasticity index, and thickness as specified in each Section.

**306.02 Quality Control.** The Department will furnish the Contractor with the maximum laboratory density and optimum moisture content for the material being used. The maximum laboratory density shall be determined as follows:

<u><b>% Retained - #4 (4.75 mm) Sieve</b></u>	<u><b>Test Method</b></u>
10 Max.	AASHTO T 99, Method A
11 - 30	AASHTO T 99, Method C
31 Min.	AASHTO T 180, Method D

**Note:** Instead of AASHTO T 224, correction for coarse particles retained on the 3/4" (19.0 mm) sieve shall be determined by replacing with an equal mass of material passing

the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

The in-place density shall be determined by using AASHTO T 310, Direct Transmission. The moisture content shall be determined by AASHTO T 310 or AHTD Test Method 347 or 348. A new maximum laboratory density and optimum moisture will be determined whenever the Engineer deems necessary or upon evidence provided by the Contractor.

The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing. The Contractor's facilities shall be separate from any Field Laboratory and/or Field Office furnished under the Contract. The Contractor shall provide the Engineer with the opportunity to observe all quality control sampling and testing. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. Test reports shall be signed and copies made available to the Engineer if requested.

If the result of any test shows that the required minimum density has not been obtained, corrective action shall be taken, followed by a re-test at the same location. The original and re-test reports shall be cross referenced. All corrective actions shall be performed by the Contractor at no cost to the Department.

Tests for gradation, liquid limit, and plasticity index shall be performed by AASHTO T 11, T 27, T 89, and T 90.

Although no minimum frequency of quality control testing is specified, the Contractor will be required to perform acceptance tests as specified in Subsection 306.03.

**306.03 Acceptance Testing.** Acceptance testing for thickness (when specified on the plans), gradation, plasticity index, density, and moisture content by the Contractor will be based on lots. The size of standard lots will be 1000 tons (1000 metric tons). Partial lots, of any size, may be established by the Engineer at any time. Test methods for acceptance shall be the same as specified for quality control testing. Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory

qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The item of work being tested shall not be considered complete or accepted until passing test reports are submitted to the Engineer.

The Contractor shall take one test for all properties in each lot or partial lot at a location randomly selected by the Engineer under AHTD Test Method 465.

If the material being furnished is crushed stone and the results of the first five tests for plasticity index (PI) show that the material is non-plastic, further tests for PL, LL, and PI may be waived by the Engineer. If a change in material occurs, testing for PI will be resumed. If the new material is crushed stone and the results of the first five tests for PI show that the material is non-plastic, further tests for PL, LL, and PI may again be waived by the Engineer.

In addition to the required acceptance tests, the Engineer may require the Contractor to test any location that, by visual observation, appears to be defective.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

All acceptance testing performed by the Contractor shall be subject to observation by Department personnel. All test reports shall be signed and submitted to the Engineer by the next business day after the tests are performed.

The Department will obtain and test a minimum of one sample, taken at the frequency established in the Department's *Manual of Field Sampling and Testing Procedures*, for verification testing in accordance with Subsection 106.11.

**306.04 Acceptance.** Each lot will be accepted as described herein.

**(a) Gradation and Plasticity Index. (1) Roadway Sampled Material.** If a lot or a partial lot fails gradation requirements, the



Contractor shall remove and replace that lot or partial lot with acceptable material at no cost to the Department. Tests will be performed on the replacement material as required for the original material. Acceptance of the replacement material will be the same as for the original material, based on the results of tests on the replacement material. Payment for the quantity in the original lot will be withheld or recovered, and released after the removal and replacement has been acceptably performed.

In lieu of removal and replacement of work rejected for gradation, the Contractor may request permission to attempt corrective actions and/or evaluation under Section 105.04. The Engineer will consider the request and will make a determination whether the requested corrective action and/or evaluation is in the best interest of the Department. This determination by the Engineer shall be final. In making this determination, the Engineer will consider the type of work involved; the corrective action proposed, the magnitude of the deviation; and any other factors deemed applicable to the work involved.

If a lot or partial lot is rejected for PI, the Contractor may request permission to attempt corrective action. The Engineer will consider the request and make a determination whether the proposed corrective action may be attempted; evaluate the material under Section 105; or require removal and replacement of the material. Corrective action or removal and replacement shall be performed by the Contractor at no cost to the Department.

When the material is non-plastic and tests for PI have been waived as specified in Subsection 306.03, the material will be accepted for PI without additional testing.

**(2) Stockpile Sampled Material.** Material used in mixes shall be sampled from the stockpile, tested, and accepted before being incorporated into the work. Stockpiled material found not to be in compliance with the specifications shall be replaced with acceptable material.

**(b) Density.** When a density requirement is specified, the results of all tests shall be at or above the minimum required density and the moisture content should be at or near the optimum. If the result of any test does not meet these requirements, corrective action shall be taken and a re-test will be taken at the same location. All

corrective action shall be taken by the Contractor at no cost to the Department.

**306.05 Measurement and Payment.** All work required under this subsection will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the item in which the material is being used.

## **SECTION 307 CEMENT TREATED BASE COURSE**

**307.01 Description.** This item shall consist of a treated base course, composed of a compacted mixture of existing subgrade or soil aggregate, Portland cement, and water, and shall be constructed according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and typical cross section shown on the plans.

Unless otherwise provided, the Contractor may use either the travel plant or central plant method as described below.

**307.02 Composition.** The mixture shall be composed of existing subgrade, base course and surface course materials, and/or an imported soil aggregate, with Portland cement and water added.

The mixture shall contain not less than 4% cement by volume of compacted mixture, 94 pounds (1420 kg) of cement being considered as 1 cubic foot (1 cu m ). At least 30 days before the beginning of stabilizing operations, adequate quantities of soil and cement shall be supplied to the Materials Division for determination of cement requirements. The Engineer will specify, based on laboratory tests, the exact percentage of cement to be used.

Specimens of soil aggregate, cement, and water shall develop a compressive strength of a least 400 psi (2.7 MPa) in 7 days.

**307.03 Materials.** The materials used shall comply with the following requirements:

(a) **Water.** Water used in mixing or curing shall be clean and free from injurious amounts of oil, salt, or other deleterious substances. Where the source of water is relatively shallow, it shall

be maintained at such a depth and the intake so enclosed as to exclude grass, vegetable matter, or other foreign materials.

**(b) Cement.** Unless otherwise specified, portland cement conforming to the requirements of AASHTO M 85, Type I shall be furnished. One of the following blended cements may be used in lieu of Type I:

- Portland-Pozzolan Cement, AASHTO M 240, Type IP (20% maximum)
- Slag-Modified Portland Cement, AASHTO M 240, Type IS (25% maximum)

Fly ash or slag cement shall not be substituted for blended cements. Cement shall be from sources that are listed on the Department's Qualified Products List and that have executed a certification agreement with the Department. When cement is furnished in sacks, each sack shall contain not less than 94 pounds (42.6 kg) of cement.

Fly ash or slag cement shall comply with Subsection 501.02(f). Fly ash or slag cement may be used as a partial replacement for the cement. Replacement amounts, not exceeding 25% by weight, shall be determined through trial batch investigations using the specific materials proposed for the project. Mixtures with fly ash or slag cement shall meet the same requirements as mixtures without fly ash/ slag cement. All trial batches required by this specification shall be accomplished by the Contractor, observed by the Engineer, and approved by the Engineer of Materials. Mixing of Class C and Class F fly ashes will not be permitted. Fly ash will not be allowed as a substitute for high early strength or blended cements.

For in-place stabilization, the fly ash/ slag cement and cement shall be blended to form a homogeneous mixture before application on the roadway.

The use of cement salvaged from used or discarded sacks will not be allowed. Cement placed in storage shall be suitably protected. Any loss of quality occurring during the storage period will be cause for rejection. If the cement furnished shows erratic behavior under the field conditions incident to the mixing and placing of the mixture, or in the time of the initial or final set, the Contractor will at once, without notice from the Engineer, cease the use of that brand of cement and furnish material of such properties as to ensure quality work conforming to these specifications.

(c) **Soil Aggregate.** Soil aggregate shall meet the requirements of Subsection 302.02 for any class provided therein.

(d) **Asphalt.**

(1) Emulsified asphalt shall comply with Subsection 403.03(d) for Grade CSS-1 or CSS-1h.

(2) Medium curing cut-back asphalt shall comply with Subsection 403.03(b) for the grade selected by the Engineer.

(3) Rapid curing cut-back asphalt shall comply with Subsection 403.03(a) for the grade selected by the Engineer.

The type of asphalt used for protection and cover for the treated base course shall be at the option of the Contractor, subject to the Engineer's approval.

**307.04 Construction Requirements.** Sufficient equipment shall be available so that the work may proceed in proper sequence to completion without unnecessary delay. Equipment, tools, and machinery used shall be maintained in a satisfactory working condition.

The application of cement and mixing of the cement and soil aggregate will be allowed only on an approved subgrade, free of excess moisture. No work will be allowed on a frozen subgrade. The Contractor's operations shall be such as to prevent the drifting of cement or dust off the right-of-way.

(a) **Preparation of the Roadbed.** Prior to other construction operations, the existing roadbed, including the shoulders, shall be brought to line and grade and shaped to the typical cross section of the completed roadbed and compacted to sufficient density to prevent rutting under normal operations of construction equipment. All soft areas shall be corrected to provide uniform stability. When soil aggregate is utilized, the subgrade shall be prepared according to Section 212.

(b) **Pulverizing.** After shaping and compacting the roadbed, the material to be processed shall be scarified and pulverized before application of cement. Pulverizing shall continue during mixing operations until a minimum of 80% by weight of the material, exclusive of coarse aggregate, will pass a #4 (4.75 mm) sieve. Material retained on a 3" (75 mm) sieve and other unsuitable material shall be removed.

**(c) Application and Mixing of Cement.** The application and mixing of cement with the aggregate material shall be performed according to one of the following methods:

**(1) Travel Plant Method.** The specified quantity of cement shall be applied uniformly on the material to be processed, and shall not exceed that which can be processed the same working day. When bulk cement is used the equipment shall be capable of handling and spreading the cement in the required amount. The moisture content of the material to be processed shall be sufficiently low to permit a uniform and intimate mixture of the aggregate material and cement.

Mixing shall be accomplished by means of a self-propelled or self-powered machine equipped with a mechanical rotor or other approved type of mixer that will thoroughly blend the aggregate with the cement. Mixing equipment shall be so constructed as to assure positive depth control. Care shall be exercised to prevent cement from being mixed below the depth specified. Machines designed to process less than the full width of base at a single pass shall be operated so that the full width of base can be compacted and finished in one operation. Water shall be uniformly added and incorporated in the mixture. The water supply and distribution equipment shall be capable of supplying the total required amount of water to the section being processed within 3 hours. If more than one pass of the mixer is required, at least one pass shall be made before water is added. Mixing shall continue after all water has been applied until a uniform mixture of aggregate, cement, and water has been obtained for the full depth of the course.

The aggregate and cement mixture that has not been compacted and remains undisturbed more than 30 minutes shall be remixed. In the event of rain adding excessive moisture to the uncompacted material, the entire section shall be reworked. Should the Contractor be unable to finish the section within the same day, the section shall be reconstructed and an amount equal to 50% of the original amount of cement added to the mixture at no cost to the Department.

**(2) Central Plant Method.** When a central plant is used, the soil aggregate, cement, and water shall be mixed in a pugmill either of the batch or continuous flow type. The plant shall be equipped with feeding and metering devices that will add the soil

aggregate, cement, and water into the mixer in accurately proportioned amounts as determined by the laboratory design. Aggregate and cement shall be dry-mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall continue until a uniform mixture of aggregate, cement, and water has been obtained.

The mixture shall be hauled to the roadway in trucks equipped with protective covers. Immediately before spreading the mixture, the subgrade or foundation course shall be moistened and kept moist, but not excessively wet, until covered by the mixture. The mixture shall be placed on the roadbed in a uniform layer by an approved spreader or spreaders. No more than 60 minutes shall elapse between adjacent spreader runs and not more than 60 minutes shall elapse between the time of mixing and the beginning of compaction. The layer shall be uniform in depth, and in such quantity that the completed base will conform to the required grade and cross section. Dumping of the mixture in piles or windrows will not be permitted.

**(d) Compaction and Surface Finish.** The mixture shall be compacted to a density, as determined by AASHTO T 310, Direct Transmission, of not less than 95% of the maximum laboratory density obtained by AASHTO T 134. The moisture content of the mixture during compaction shall not vary more than  $\pm 5\%$  from the optimum moisture as determined by AASHTO T 134.

The surface of the treated roadway shall be reshaped to the required lines, grade, and cross section after the mixture has been compacted. It shall then be scarified lightly to loosen any imprints left by the compacting or shaping equipment and rolled thoroughly. The operation of final rolling shall include the use of pneumatic tired rollers. The rolling shall be done in such manner as to produce a smooth, closely knit surface, free of cracks, ridges, or loose material, and conforming to the crown, grade, and line shown on the plans.

The density, surface compaction, and finishing operation shall not require more than two hours.

Water shall be added, if necessary, during the finishing operation to maintain the mixture at the proper moisture content for securing the desired surface.

Areas inaccessible to rollers or finishing and shaping equipment shall be thoroughly compacted to the required density by other approved compacting methods and shaped and finished as specified.

**(e) Joints.** As soon as final compaction and finishing of a section has been completed, the base shall be cut back perpendicular to the center line to a point where uniform cement content with proper density has been attained and where the vertical face conforms to the typical section shown on the plans. When the road mix method is used, a header shall be placed against the vertical face of the finished section and securely staked in place. This header shall be left in place until all mixing operations on the adjoining section have been completed, after which the header shall be removed and the trench backfilled with processed material. This material shall be compacted so that a well-sealed joint is formed and a smooth riding surface is obtained.

As an alternate to using a header, the subsequent day's operation may be started by cutting back into the previously placed course to the extent necessary to obtain uniform grade and compaction.

**(f) Surface Test.** The finished surface of the treated base course shall conform to the general surface provided for by the plans. It shall not vary more than  $\frac{1}{4}$ " (6 mm) from a 10' (3 m) straightedge applied to the surface parallel to the center line of the roadway, nor more than  $\frac{1}{2}$ " (12 mm) from a template conforming to the cross section shown on the plans. Excess material shall be disposed of as directed.

**(g) Protection and Cover.** Immediately after the rolling and shaping has been completed, the surface of the treated base course shall be covered by a protective coating of asphalt to prevent loss of moisture during the curing period and to serve as a prime coat for the later application of wearing course. The asphalt shall comply with the requirements listed herein and shall be applied by means of an approved pressure distributor at the rate of 0.1 to 0.3 gallon per square yard (0.4 to 1.1 L/sq m) to provide complete coverage without excessive runoff. The actual rate of application will be determined by the Engineer. When used, emulsified asphalt shall be diluted with an equal amount of water before application. At the time of application, the base shall be in a moist condition. The protective coating of asphalt shall be maintained until the wearing surface is placed. If the condition of the protective coating is

satisfactory, no additional prime coat will be required at the time of placement of the wearing surface.

Furnishing and placing asphalt will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Processing Cement Treated Base Course.

Finished portions of the roadway adjacent to construction that is traveled by equipment used in constructing an adjoining section shall be protected by means satisfactory to the Engineer. If earth covering is used on fresh bases, straw, hay, building paper, or similar material shall be placed under the earth so that the covering may be removed without damage to the base.

**307.05 Maintenance.** The Contractor shall, within the limits of the Contract, maintain the treated base material in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that occur. This work shall be done at no cost to the Department and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be replaced for the full depth of treatment. The Contractor shall construct the plan depth of cement treated base in one homogeneous mass. The addition of thin treated layers to provide the minimum specified depth will not be permitted.

**307.06 Seasonal and Temperature Limitations.** Application of cement will not be permitted when the surface temperature is below 40° F (5° C), nor shall it be applied before April 1. Application of cement shall be terminated sufficiently early to give reasonable assurance that all mixing, spreading, rolling, and curing of the cement treated base course and the application of the subsequent asphalt courses can be complete on or before the following dates, except by written permission of the Engineer:

Asphalt Surface Treatment - Roadway	September 30
Asphalt Surface Treatment - Shoulders	October 31
ACHM Binder Course	October 31
ACHM Surface Course	October 31

**307.07 Quality Control and Acceptance.** Quality control and acceptance shall be according to the provisions of Section 306 except the minimum frequency of testing shall be based on a lot size of 12,000 square yards (10,000 sq m).



**307.08 Method of Measurement.** (a) Processing Cement Treated Base Course will be measured by the square yard (square meter) or by the station (metric station) for the depth specified. When measurement by the station (metric station) is specified, roadways in each direction of a divided highway will be measured, and additional areas outside the normal roadway will be converted to the normal measurement on an equivalent area basis.

Water and asphalt will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit price bid for the item Processing Cement Treated Base Course.

(b) Portland cement and/or fly ash will be measured by the ton (metric ton).

(c) Soil Aggregate will be measured in place by the square yard (square meter) or by the station (metric station) for the width and depth specified, or in the pit by the cubic yard (cubic meter) as determined in Subsection 109.01(a), or in trucks by the ton (metric ton) or cubic yard (cubic meter) according to Section 209.03, Method 2. When measurement by the station (metric station) is specified, roadways in each direction of a divided highway will be measured and additional areas outside the normal roadway will be converted to the normal measurement on an equivalent area basis.

**307.09 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Processing Cement Treated Base Course will be paid for at the contract unit price bid per square yard (square meter) or per station (metric station) for Processing Cement Treated Base Course.

(b) Portland cement and/or fly ash will be paid for at the contract unit price bid per ton (metric ton) for Cement in Treated Base Course.

(c) Soil Aggregate will be paid for at the contract unit price bid per square yard (square meter), station (metric station), cubic yard (cubic meter), or ton (metric ton) for Soil Aggregate in Cement Treated Base Course.

The contract unit prices mentioned above will be full compensation for furnishing, hauling, and placing materials; for pulverizing, watering, mixing, compacting, finishing, and applying asphalt; for performing quality control and acceptance sampling and

testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Processing Cement Treated Base Course (___" [___mm] Uniform Thickness)	Square Yard (Square Meter) or Station (Metric Station)
Cement in Treated Base Course	Ton (Metric Ton)
Soil Aggregate in Cement Treated Base Course (___" [___mm] Compacted Depth)	Square Yard (Square Meter), Station (Metric Station), Cubic Yard (Cubic Meter), or Ton (Metric Ton)

## **SECTION 308 CEMENT STABILIZED CRUSHED STONE BASE COURSE**

**308.01 Description.** This item shall consist of a base course constructed on the completed and accepted subgrade according to these specifications and in conformity with the lines, grades, compacted thickness, and typical section shown on the plans or as directed by the Engineer.

**308.02 Composition. (a) Cement Content.** The quantity of cement, approximately 3 to 8% by weight, to be used with the aggregate and water shall be determined by the Engineer. The moisture in the mix shall be maintained within a range of  $\pm 1\%$  of optimum.

**(b) Laboratory Tests.** Specimens of aggregate, cement, and water must develop a compressive strength of at least 750 psi (5.2 MPa) in 7 days.

At least 30 days before beginning base construction, adequate quantities of materials shall be supplied to the Materials Division for determination of mix proportions. The Department will determine

the quantity of cement, the optimum moisture, and the maximum laboratory density and furnish this information to the Contractor.

**308.03 Materials.** Materials used in the mixture shall comply with the following requirements:

**(a) Aggregate.** Crushed stone shall comply with Subsection 303.02 for Class 7.

**(b) Cement.** Unless otherwise specified, portland cement conforming to the requirements of AASHTO M 85, Type I shall be furnished. One of the following blended cements may be used in lieu of Type I:

- Portland-Pozzolan Cement, AASHTO M 240, Type IP (20% maximum)
- Slag-Modified Portland Cement, AASHTO M 240, Type IS (25% maximum)

Fly ash or slag cement shall not be substituted for blended cements. Cement shall be from sources that are listed on the Department's Qualified Products List and that have executed a certification agreement with the Department. Fly ash or slag cement, if used, shall comply with Subsection 307.03(b).

**(c) Water.** The water for the base course shall be clean, clear, and free from injurious amounts of oil, salts, or other deleterious substances and shall not contain more than 1000 ppm of chlorides. If the water is of questionable quality, it shall be tested according to AASHTO T 26.

**(d) Asphalt.**

**(1)** Emulsified asphalt shall comply with Subsection 403.03(c) for Grade SS-1.

**(2)** Medium curing cut-back asphalt shall comply with Subsection 403.03(b) for the grade selected by the Engineer.

**(3)** Rapid curing cut-back asphalt shall comply with Subsection 403.03(a) for the grade selected by the Engineer.

The type of asphalt used for protection and cover for the cement stabilized base course shall be at the option of the Contractor, subject to the Engineer's approval.

**308.04 Construction Requirements. (a) Weather Limitations.** The cement stabilized base shall not be mixed or placed while the

atmospheric temperature is below 40° F (5° C) or when the weather is rainy.

**(b) Equipment.** Sufficient equipment shall be available so that the work may proceed in proper sequence to completion without unnecessary delay. Equipment, tools, and machinery used shall be maintained in a satisfactory working condition.

**(c) Forms.** When forms are required, they shall comply with Subsection 501.07.

**(d) Subgrade.** The subgrade shall be prepared according to the typical sections on the plans before placement of base. When the subgrade is constructed under the same Contract as the base, the subgrade shall be prepared according to Section 212. When the subgrade is constructed under a separate contract, preparation of the subgrade shall be according to Section 214.

**(e) Mixing.** Mixing shall be accomplished at a central mixing plant by either batch or continuous mixing. The aggregates and cement may be proportioned either by weight or by volume.

The plant shall be equipped with feeding and metering devices that will add the aggregate, cement, and water into the mixer in the specified quantities. Aggregate and cement shall be dry-mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall continue until a uniform mixture of aggregate, cement, and water has been obtained.

In all plants, cement shall be added in such a manner that it is uniformly distributed throughout the aggregates during the mixing operation.

The charge in a batch mixer, or the rate of feed into a continuous mixer, shall not exceed that which will permit complete mixing of all the material.

To compute the mixing time in a continuous mixer, the weight of its contents at operating level is divided by the weight of the mixture delivered per second by the mixer:

$$\text{Mixing Time, seconds} = \frac{\text{Pugmill dead capacity, lb (kg)}}{\text{Output, lb (kg) per second}}$$

The pugmill for the continuous mixer shall be equipped with a surge hopper containing sufficient baffles and gates to prevent

segregation of material discharged into the truck and to allow for closing of the hopper between trucks without requiring shut down of the plant.

**(f) Placing and Compacting.** The subgrade surface, if dry, shall be moistened but not to the extent of producing a muddy condition at the time the base mixture is placed. Placing of the base course shall begin along the high point of the pavement on a crowned section or on the high side of a pavement sloping in one direction.

Proportioned and mixed materials shall be transported to the point of delivery in approved non-agitating equipment. Covers shall be provided for protection during transport.

The material shall be spread on the prepared underlying course to such depth that, when thoroughly compacted, it will conform to the grade and dimensions shown on the plans.

The materials shall be spread by a self-propelled spreading machine or similar method approved by the Engineer. Sufficient equipment shall be provided to obtain full width spreading of the base material. If, in the judgement of the Engineer, full width placement is not desirable, the base shall be constructed in partial widths. If the time elapsing between the placing of adjacent partial widths exceeds 30 minutes, a construction joint satisfactory to the Engineer shall be provided. Such joints shall be offset a minimum of 12" (300 mm) from a planned concrete pavement joint.

The equipment and methods employed in spreading the base material shall ensure accuracy and uniformity of depth and width. If conditions arise where such uniformity in the spreading cannot be obtained, the Engineer may require additional equipment or modification in the spreading procedure to obtain satisfactory results.

Immediately upon completion of the spreading operations, the base material shall be thoroughly compacted. Self-propelled rollers, in sufficient number, size, and type shall be provided to obtain the specified results. Care shall be exercised in routing construction equipment to avoid the formation of unnecessary ridges due to wheel tracks or tractor treads. If necessary, the base material after compaction shall be trimmed by means of a self-propelled motor grader to the grade and section shown on the plans. All material loosened in this operation shall be swept from the surface before any further rolling. Finishing operations shall continue until the surface

is true to the specified cross section and until the surface shows no variations of more than ¼" (6 mm) from a 10' (3 m) straightedge laid in any location parallel with, or at right angles to, the longitudinal axis of the pavement.

No equipment or traffic shall be permitted on the finished base course during the first 72 hours of the curing period, except for minor maneuvering to enable the Contractor to begin the next day's work, not to exceed 25' (8 m).

After the base course is 7 days old, one lane in each direction may be used as a haul road, at the Contractor's own risk. Any damaged areas resulting from this operation shall be removed and replaced at no cost to the Department. Loaded trucks will be permitted to back onto the base to unload.

**(g) Construction Joints.** At the end of each day's run a transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true transverse vertical face. These faces shall be protected by banking damp earth against them or by other approved suitable methods.

The protection provided for construction joints shall permit the placing, spreading, and compacting of base material without injury to the work previously placed.

When a longitudinal construction joint is required in partial width construction, side forms shall be used or the joint shall be formed by cutting back into the compacted material to form a vertical edge. Suitable curing shall be provided for any exposed longitudinal edge. Joints shall be offset from a planned longitudinal pavement joint a minimum of 12" (300 mm).

Care shall be exercised to ensure thorough compaction of the base material immediately adjacent to all construction joints.

**(h) Protection and Curing.** After the base course has been finished as specified herein, it shall be protected against drying for 7 days by the application of asphalt material. The curing methods shall begin as soon as possible, but no later than 24 hours after the completion of finishing operations. The finished base course shall be kept reasonably clean and continuously moist until the curing material is placed.

The asphalt material specified shall be uniformly applied to the moist surface of the completed base course at the rate of

approximately 0.2 gallon per square yard (0.75 L/sq m) using approved heating and distributing equipment. The exact rate and temperature of application to give complete coverage without excessive runoff will be specified by the Engineer.

Should it be necessary for construction equipment or other traffic to use the asphalt covered surface before the asphalt material has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use.

The curing material shall be maintained and applied as needed by the Contractor during the 7 day protection period so that all of the base course is covered effectively during this period.

Finished portions of base course that are used by equipment in constructing an adjoining section shall be protected in such a manner as to prevent equipment from marring or damaging the completed work.

When the air temperature may be expected to drop to the freezing point, sufficient protection from freezing shall be given the base course for 7 days after its construction and until it has hardened.

**(i) Cold Weather Protection.** During cold weather, when the air temperature may be expected to drop below 35° F (2° C), a sufficient supply of hay, straw, or other material suitable for cover shall be provided at the site. Any base that has been damaged by freezing shall be removed and replaced at no cost to the Department.

**(j) Tolerance in Base Thickness.** The base course shall be constructed according to the typical sections on the plans  $\pm 1/2$ " (12 mm) in thickness. Sections over  $1/2$ " (12 mm) deficient in thickness shall be removed and replaced at no cost to the Department. No payment will be made for materials placed in excess of planned thickness.

**308.05 Quality Control, Acceptance, and Adjustments in Payment.** **(a) General.** The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing. The Contractor's facilities shall be separate from any Field Laboratory and/or Field Office furnished under the Contract. The Contractor shall provide the Engineer with the opportunity to observe all quality control and acceptance sampling and testing. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician.

Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. Test reports shall be signed and copies made available to the Engineer.

**(b) Quality Control.** Quality control of the Cement Stabilized Crushed Stone Base Course in regards to gradation, density, and plasticity index shall be according to the Quality Control and Acceptance provisions contained in Section 306. The density, as determined by AASHTO T 310, Direct Transmission, shall not be less than 95% of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D. The Contractor shall conduct soundings to insure that the minimum specified depth is maintained.

**(c) Acceptance Testing.** Acceptance testing by the Contractor for thickness, gradation, and compressive strength will be based upon lots. The standard lot size for acceptance will be 4000 cubic yards (3000 cubic meters) of mix, with each standard lot divided into four sublots of 1000 cubic yards (750 cubic meters). The Engineer may establish partial lots at any time. The Engineer will determine the size of any partial lots established and the number and size(s) of the sublots, if any.

The minimum frequency of sampling and testing for thickness, gradation, and compressive strength shall be one test for each subplot. The Department will determine the location for each sample in the subplot by AHTD Test Method 465. For compressive strengths, the Contractor shall obtain one core from each subplot according to AASHTO T 24 and all core holes must be repaired by the Contractor using acceptable material approved by the Engineer. The Contractor shall perform compressive strength testing on the cores according to AASHTO T 22. The Contractor shall certify to the Engineer that the calibration of the concrete cylinder compression testing machine has been verified. This verification shall be performed in accordance with AASHTO T 22 and T 67 under any of the following conditions and documented in accordance with AASHTO T 67:

1. After an elapsed interval of 12 months, not to exceed 13 months since the previous calibration.
2. After original installation of the machine or following relocation of the machine.



3. Immediately after repairs or adjustments.
4. Whenever there is a reason to doubt the accuracy of the results, without regard to the time interval since the last verification.

Thickness determination shall be made from cores sampled for compressive strength tests. Acceptance of the aggregate gradation shall be according to the Quality Control and Acceptance provisions contained in Section 306.

In addition to the required acceptance tests, the Engineer may require the Contractor to test any location that, by visual observation, appears to be defective. The Department may perform any sampling or testing to verify the Contractor's testing equipment or procedures. The Contractor shall be required to make changes to the equipment and/or procedures if the Department is unable to verify the Contractor's test results.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

The Department will obtain and test a minimum of one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. The location of the lot sample will be determined by the Department using AHTD Test Method 465. Verification testing will be conducted in accordance with Subsection 106.11 and the *Manual of Field Sampling and Testing Procedures*.

Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. Acceptance sampling and testing shall be accomplished in a timely manner. The Contractor shall maintain records of all samples taken and the results of all tests performed. Signed copies of these records shall be furnished to the

Engineer on the next business day after the tests are performed. The item of work being tested shall not be considered complete or accepted until all test reports are submitted to the Engineer.

**(d) Acceptance and Adjustments in Payments.** Acceptance and adjustment will be by lot.

Acceptance of a standard lot shall be based on complying test results for thickness and gradation and the average compressive strength testing results meeting a minimum of 750 psi (5.2 MPa) in 7 days. The average result will include the subplot results of tests performed by the Contractor and the results of the lot test performed by the Department.

For a lot or subplot to be considered for acceptance and adjustments, each core shall achieve not less than 70% of the minimum compressive strength specified at 7 days. In the subplot containing the Department's lot test, if the result of either the Contractor's subplot test or the Department's lot test is below the minimum compressive strength specified, the two results will be averaged and the average of the two test results used to determine acceptance or rejection.

If the average compressive strength of the cores is less than the minimum compressive strength specified, adjustments will be made by reducing the contract price for the items of Aggregate in Cement Stabilized Crushed Stone Base Course, Cement in Cement Stabilized Crushed Stone Base Course, and Processing Cement Stabilized Crushed Stone Base Course on a lot basis according to Table 308-1. Continuous production of material not qualifying for full payment will not be allowed.

**TABLE 308-1**  
**Acceptance and Adjustments in Payments**

<b>Average 7 Day Compressive Strength</b>	<b>Pay</b>
750 psi (5.2 MPa )	100 %
750 to 675 psi (5.2 to 4.7 MPa)	90 %
675 to 600 psi (4.7 to 4.2 MPa)	80 %
600 to 525 psi (4.2 to 3.7 MPa)	70 %
less than 525 psi (3.7 MPa)	Remove and Replace

**(e) Unacceptable Base Course.** Any lot or subplot that is not accepted shall be removed and replaced by the Contractor at no cost to the Department. Payment for lots where removal and replacement is required will be withheld or recovered, and released after replacement has been acceptably completed. The quantity and measurement of the quantity used in replacement operations will not be considered.

**308.06 Method of Measurement.** (a) Processing Cement Stabilized Crushed Stone Base will be measured by the square yard (square meter) of the thickness specified. The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

(b) The mix proportions in pounds per square yard (kilograms per square meter) of aggregate and cement, as established by the laboratory design, will be used in conjunction with the square yard (square meter) measurement to determine the quantities of crushed stone and cement.

Quality Control and Acceptance sampling and testing of Cement Stabilized Crushed Stone Base Course will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items in this Section.

Water and asphalt will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Processing Cement Stabilized Base Course.

**308.07 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Processing Cement Stabilized Crushed Stone Base Course will be paid for at the contract unit price bid per square yard (square meter) for Processing Cement Stabilized Crushed Stone Base Course.

(b) Portland Cement and/or fly ash will be paid for at the contract unit price bid per ton (metric ton) for Cement in Cement Stabilized Crushed Stone Base Course.

(c) Aggregate will be paid for at the contract unit price bid per ton (metric ton) for Aggregate in Cement Stabilized Crushed Stone Base Course.

The contract unit prices mentioned above will be full compensation for furnishing, hauling, and placing materials; for performing quality control and acceptance sampling and testing; for pulverizing, watering, mixing, compacting, finishing, and curing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Processing Cement Stabilized Crushed Stone Base Course	Square Yard (Square Meter)
Cement in Cement Stabilized Crushed Stone Base Course	Ton (Metric Ton)
Aggregate in Cement Stabilized Crushed Stone Base Course	Ton (Metric Ton)

## **SECTION 309**

### **PORTLAND CEMENT CONCRETE BASE**

**309.01 Description.** This item shall consist of constructing a course of Portland cement concrete base, with or without reinforcement as specified, on a prepared surface according to these specifications, in reasonably close conformity with the established lines, grades, and typical cross sections shown on the plans or established by the Engineer.

**309.02 Proportions.** The proportions of materials shall comply with Section 501 for paving concrete or Section 802 for Class A or Class S concrete. The Contractor shall prepare a mix design according to Subsection 501.03 or Subsection 802.05 as appropriate.

**309.03 Materials.** The material requirements shall be according to Section 501. Fly ash, if used, shall be according to Section 501.

**309.04 Construction Requirements.** Construction requirements shall comply with Section 501 with the following exceptions:

(a) No joints shall be required in Portland Cement Concrete Base other than construction joints.

(b) The surface shall be given a Class 1, Ordinary Surface finish.

(c) Surface evenness testing of Subsection 501.05(m) shall not be required. However, surface tolerances shall be ¼" (6 mm) in 10' (3 m).

(d) The pavement shall not be opened to traffic until a minimum compressive strength of 2100 psi (15 MPa) is obtained.

**309.05 Tolerance in Base Thickness.** The tolerance in base thickness shall be according to Subsections 501.10 and 501.14. No thickness cores will be taken on sections less than 30' (10 m) in length or less than full lane width.

**309.06 Quality Control and Acceptance.** Quality control and acceptance sampling and testing shall be according to Subsection 501.04, except that compressive strength will be determined by cylinders obtained according to AASHTO T 23 and that coring will not be required to determine pavement thickness. Thickness will be determined by sounding after the fresh concrete has been struck off.

**309.07 Method of Measurement.** (a) Portland Cement Concrete Base will be measured by the square yard (square meter) and adjusted according to Subsections 501.04, 501.10 and 501.14.

(b) Reinforcing steel, when specified, will be measured according to Section 502.

**309.08 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Portland Cement Concrete Base will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Base of the thickness specified, which price shall be full compensation for preparing the subgrade and shaping the shoulders, unless otherwise specified; for furnishing, transporting, and placing materials; for preparing and processing materials; for mixing, spreading, vibrating, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) Reinforcing steel, when specified, will be paid for according to Section 502.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Base (__" [___mm] Uniform Thickness)	Square Yard (Square Meter)

## SECTION 310

### OPEN GRADED PORTLAND CEMENT CONCRETE BASE COURSE

**310.01 Description.** This item shall consist of a permeable base course of coarse aggregate, Portland cement and water mixed in a central plant and spread and compacted on a prepared and previously accepted base course according to these specifications and in conformity with the lines, grades, compacted thickness, and typical section shown on the plans or as directed by the Engineer.

**310.02 Composition. Cement Content.** The Portland cement content shall be 150 lbs per cubic yard (89 kg per cu m) of open graded base course. The water-cement ratio shall be a maximum of 0.45.

**310.03 Materials.** The material requirements shall be according to Subsection 501.02 except that aggregate shall be crushed stone and conform to the following gradation limits:

SIEVE	PERCENT PASSING BY WEIGHT
1" (25.00 mm)	100
3/4" (19.0 mm)	90-100
3/8" (9.5 mm)	20-55
#4 (4.75 mm)	0-10
#8 (2.36 mm)	0-5

**310.04 Construction Requirements.** The methods employed in performing the work and the equipment, tools, and plant machinery used in executing the work shall conform to the requirements of Section 501 except as amended herein:

(a) **Joints.** No joints shall be required in open graded Portland cement concrete base course other than construction joints.

**(b) Finish.** The surface shall be given a uniform screeded finish.

**(c) Curing.** The completed open graded base shall be cured by sprinkling the surface with a fine spray of water every 2 hours for a period of 8 hours. Curing shall start the morning after the open graded base has been placed.

**(d) Surface Tests.** Immediately behind the screed, the Contractor shall test the surface with a 10' (3 m) straightedge operated parallel to the centerline. The straightedge shall be held in contact with the surface in successive positions parallel to the pavement centerline and for the full width of the slab. Testing shall progress longitudinally in successive stages of not more than one-half the length of the straightedge. Depressions in excess of ¼" (6 mm) shall be filled with fresh mix and struck off. High areas in excess of ¼" (6 mm) shall be cut down. Straightedge testing and surface correction shall continue until the entire surface conforms to the required grade and section.

Care shall be exercised, at all times, to prevent deterioration of the permeability of the Open Graded Portland Cement Concrete Base Course by contamination of fines. Open Graded Portland Cement Concrete Base Course which, in the opinion of the Engineer, has been contaminated shall be corrected at no cost to the Department. Corrections shall be made by a method approved by the Engineer. Grinding or sawing of the base shall not be allowed.

**(e) Weight Limitations.** No traffic or Contractor's equipment shall be permitted on the open graded Portland cement concrete base course. The work of placing the subsequent layer shall not begin until the base course has been placed on the shoulders, after which only the paver will be permitted on the open graded Portland cement concrete base course. Placing the subsequent layer shall be accomplished by unloading materials from the haul trucks at the shoulder and then directly conveying them to the paver. The Contractor may propose alternates to the Engineer for the paving method but no haul trucks of any type shall be permitted on the open graded Portland cement concrete base course. Any damage to the open graded base shall be repaired promptly by the Contractor at no cost to the Department, as directed by the Engineer.

**(f) Base Thickness.** If the base thickness is not in conformity with the plans and specifications, the paving operations will cease

until the problem is corrected and the deficient areas brought into conformity with the plans and specifications.

**310.05 Quality Control and Acceptance. (a) Quality Control.**

The Contractor shall be responsible for quality control of materials during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of materials used to produce the specified concrete base.

The Contractor shall be responsible for determining gradation and moisture content of aggregates used in the concrete base mixture according to the Quality Control and Acceptance provisions contained in Section 306. The Contractor shall determine the specific locations for samples for quality control. When individual gradations fall outside the specified limits, the Contractor shall immediately make adjustments to bring the aggregates within specified limits.

There will be no minimum frequency for quality control sampling and testing.

The Contractor shall produce a mix conforming to the composition requirements in Subsection 310.02. If a mix is obviously defective, paving operations shall cease and not resume until proper adjustments have been made.

**(b) Acceptance Testing.** Acceptance testing for gradation by the Contractor will be based on lots. The size of standard lots will be 2500 square yards (2000 square meters). Partial lots, of any size, may be established by the Engineer at any time. Test methods for acceptance shall be the same as specified for quality control testing. The item of work being tested shall not be considered complete or accepted until passing test reports are submitted to the Engineer.

The Contractor shall take one test in each lot or partial lot at a location randomly selected by the Engineer under AHTD Test Method 465.

All acceptance testing performed by the Contractor is subject to observation by Department personnel. All test reports shall be signed and submitted to the Engineer by the next business day after the tests are performed.

The Contractor's acceptance sampling and testing procedures, equipments, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent



assurance sampling and testing will be conducted at the frequencies specified in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

The Department will obtain and test a minimum of one sample, taken at the frequency established in the Department's *Manual of Field Sampling and Testing Procedures*, for verification testing in accordance with Subsection 106.11.

**310.06 Method of Measurement.** Open Graded Portland Cement Concrete Base Course will be measured by the square yard (square meter).

**310.07 Basis of Payment.** Open Graded Portland Cement Concrete Base Course completed and accepted and measured as provided above will be full compensation for furnishing, hauling, and placing materials; for performing quality control sampling and testing; for mixing, spreading, finishing, straightedging, correcting surface and thickness irregularities, and curing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Open Graded Portland Cement Concrete Base	Square Yard (Square Meter)

**DIVISION 400**  
**ASPHALT PAVEMENTS**

**SECTION 401**  
**PRIME AND TACK COATS AND EMULSIFIED**  
**ASPHALT IN BASE COURSE**

**401.01 Description.** This item shall consist of a single application of asphalt material and blotter material, if required, applied to the completed and approved subgrade, to the base course, or on the existing asphalt or concrete surface according to these specifications and in reasonably close conformity with the lines shown on the plans or as directed.

**401.02 Materials.** Materials shall conform with the requirements provided under Section 403. A medium curing cut-back asphalt will be used for prime coat and a rapid curing cut-back or an emulsified asphalt will be used for tack coat. Emulsified asphalt conforming to grades SS-1, SS-1h, CSS-1, or CSS-1h shall be used for emulsified asphalt in base course. Dependent upon the texture of the base and the season of the year that work is being performed, the Engineer will select the particular grade of the type of asphalt material that will be used.

**401.03 Construction Requirements.** The methods employed in performing the work, and all equipment, tools, and machinery used in handling materials and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory, shall be changed and improved as required. All equipment, tools, and machinery used shall be maintained in a satisfactory working condition and shall meet the requirements of Section 403.

The surfaces of all structures shall be protected by some satisfactory method to prevent their being disfigured by the application of asphalt material. Objectionable asphalt discoloration, caused by the Contractor's operations, shall be removed from all roadway and bridge structures at no cost to the Department.

**(a) Cleaning.** If needed, the surface to be treated with prime or tack coat shall be cleaned of dust, dirt, and loose or foreign material by sweeping with mechanical brooms immediately preceding the application of the prime or tack coat. Care shall be taken to clean

but not loosen or dislodge the embedded aggregate in base courses. Patches of asphalt, dirt, or other material that do not form an integral part of the surface to be treated shall be removed. When directed, the surface shall be sprinkled with water and given an additional sweeping.

The cleaning operations shall be carried only far enough in advance of the application of the asphalt material to ensure the surface being properly prepared at the time of application. When the existing surface is an old concrete pavement, excess joint and crack filler shall be removed from the surface.

**(b) Application of Prime Coat.** After the surface to be treated has been prepared as outlined above, the asphalt material for the prime coat shall be sprayed uniformly over the surface by means of an approved mechanical pressure distributor at the rate of application indicated on the plans, or as directed.

Surplus asphalt material collected in surface depressions shall be removed.

Following the application of the prime coat, the road will be closed to traffic, if practicable, for a period of time sufficient to allow the proper curing of asphalt coating. Prime coat shall be allowed to cure a minimum of 3 days before any successive application of asphalt material. However, the minimum three day curing time may be waived when, in the opinion of the Engineer, the prime has sufficiently cured to allow placement of successive courses. No material for a succeeding course shall be placed on a primed base course until the prime coat has cured sufficiently to prevent damage by hauling operations. When shown on the plans or directed by the Engineer, the prime coat shall be applied in half widths in order to allow free passage of public traffic at all times.

Prime coat shall not be applied when the air temperature is below 45° F (7° C), nor shall it be applied to a surface having excess moisture, nor when general weather conditions, in the opinion of the Engineer, are not suitable. Special precautions shall be observed to ensure a uniform distribution of the asphalt material. The distributor shall be so adjusted and operated as to distribute evenly the material being applied. Deposits of asphalt material upon the road surface in excess of the quantity specified, caused by stopping or starting the distributor, by overflow, leakage, or otherwise, shall be removed.

The asphalt material shall be applied at the temperature specified in Section 403. The distributor shall be operated at a pressure of not less than 30 psi (200 kPa) nor more than 70 psi (500 kPa). The Contractor shall provide the necessary facilities for determining the temperature of the asphalt material in the heating equipment and in the distributor, for determining the rate of application, and for securing uniformity of distribution at longitudinal and transverse joints.

If the primed surface becomes damaged, such areas shall be cleaned or patched and re-treated at no cost to the Department.

At the Contractor's option, Emulsified Asphalt in Base Course, constructed according to the provisions of Subsections 401.02 and 401.03(d), may be substituted in lieu of Prime Coat. Payment for this substitution will be made as Prime Coat.

**(c) Application of Tack Coat.** When an asphalt course is to be laid on an asphalt or concrete surface, a tack coat shall be applied prior to placing the course. The tack coat shall be applied by means of a pressure distributor in the same manner as outlined above for the application of prime coat. When emulsified asphalt is used it shall be diluted with water as directed. The asphalt material shall be applied at the temperature specified in Section 403. The rate of application shall be from 0.03 gallon to 0.10 gallon per square yard (0.1 L/sq m to 0.5 L/sq m) as designated by the Engineer. The tack coat shall be applied sufficiently in advance of the asphalt course to allow the proper curing of the asphalt material but shall not be applied so far in advance as to lose its adhesiveness as a result of being covered with dust or foreign material. If the tack coat becomes damaged or covered with foreign material, such areas shall be cleaned as necessary and re-treated at no cost to the Department.

**(d) Application of Emulsified Asphalt in Base Course.** Construction of the base course shall be according to the provisions of Division 300 for the applicable type of base course.

Emulsified asphalt shall be incorporated into the top 2" (50 mm) of the base course in a manner that will produce a uniform distribution of the asphalt at the plan designated rate. To facilitate uniform application and distribution, the emulsified asphalt may be added to water at a rate dictated by job conditions.

When an existing base course is to be treated, the top 2" (50 mm) of the existing material shall be scarified, treated as described above, and spread and compacted.

At the Contractor's option, prime coat, constructed according to the provisions of Subsections 401.02 and 401.03(b), may be substituted in lieu of Emulsified Asphalt in Base Course on shoulders, driveways, turnouts, islands, detours, temporary roadways, and parking or small, irregular areas. Payment for this substitution will be made as Emulsified Asphalt in Base Course.

**401.04 Blotter Course. (a) General.** When directed, the fresh prime coat shall be covered by a blotter course in order to permit immediate use of the road by traffic without undue damage to the work or inconvenience to the traveling public.

**(b) Material.** The material for the blotter course may be an approved, clean, sandy material from a local source or may be a commercially processed sand. Material used shall be free from lumps, roots, sticks, or other foreign matter.

**(c) Construction Requirements.** Before the primed surface is opened to traffic, the blotter course shall be distributed evenly over the primed surface in such quantity as may be necessary to blot the surplus asphalt and prevent it from picking up under traffic. The surface shall then be dragged with an approved type of drag broom, supplemented as necessary by hand brooming, so as to distribute the material evenly.

**401.05 Method of Measurement.** Asphalt material will be measured by the gallon (liter).

Blotter course material, applied at the direction of the Engineer, will be measured either by the cubic yard (cubic meter) in vehicles or by the ton (metric ton).

**401.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per gallon (liter) for Prime Coat, Tack Coat, or Emulsified Asphalt in Base Course and per cubic yard (cubic meter) or ton (metric ton) for Blotter Course Material, which price shall be full compensation for furnishing, preparing, hauling, diluting, and applying asphalt material and blotter course material, when required; for cleaning or scarifying and compacting the surface; and for all

labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Prime Coat	Gallon (Liter)
Tack Coat	Gallon (Liter)
Emulsified Asphalt in Base Course	Gallon (Liter)
Blotter Course Material	Cubic Yard (Cubic Meter) or Ton (Metric Ton)

## **SECTION 402 ASPHALT SURFACE TREATMENT**

**402.01 Description.** This item shall consist of the application of one or more seal coats, as specified, according to these specifications and in reasonably close conformity with the lines shown on the plans or as directed.

When requested by the Contractor and approved by the Engineer, Asphalt Concrete Hot Mix Surface Course (1/2" [12.5 mm]) or (3/8" [9.5 mm]), conforming to Section 407, may be used in lieu of an asphalt surface treatment and will be considered to be equivalent construction when furnished according to the following minimum substitution rate:

<b>Material</b>	<b>Shoulders</b>		<b>Roadways</b>
	<b>Single AST</b>	<b>Double AST</b>	<b>Double AST</b>
ACHM Surface Course (1/2" [12.5 mm]) or (3/8" [9.5 mm])	100 lbs./S.Y. (60 kg/sq m)	165 lbs./S.Y. (90 kg/sq m)	165 lbs./S.Y. (90 kg/sq m)

**402.02 Materials.** All materials for asphalt surface treatment shall conform to the applicable requirements of Section 403. All materials for equivalent construction shall conform to the applicable requirements of Sections 407, 409, and 410.

The asphalt material shall be either a medium or rapid curing cut-back asphalt, an emulsified asphalt, or asphalt binder. If the type and grade are not specified in the Contract, the Contractor may choose the type and the Engineer will specify the grade.

**402.03 Construction Requirements. (a) General.** The methods employed in performing the work, and all equipment, tools, and machinery used in handling material and executing any part of the work shall be subject to the approval of the Engineer before the work is started and whenever found unsatisfactory shall be changed and improved as required. Equipment, tools, and machinery used must be maintained in a satisfactory condition, and must conform to the requirements provided in Section 403, or in Sections 409, and 410, for equivalent construction.

The surfaces of all structures shall be protected by some satisfactory method to prevent their being disfigured by the application of asphalt material. Objectionable asphalt discoloration, caused by the Contractor's operations, shall be removed from all roadway and bridge structures at no cost to the Department.

Asphalt material shall not be applied on a surface having excess moisture or when weather conditions are unsuitable. The Contractor shall monitor local weather conditions to avoid placing material on the road ahead of adverse weather that could subsequently damage the material. In the event materials are damaged by adverse weather, they shall be replaced or repaired at no additional cost to the Department.

Special precautions shall be taken to ensure that the equipment is operated in a manner that distributes the asphalt and aggregate evenly and uniformly. Deposits of asphalt and aggregate material upon the road surface in excess of the quantity specified, caused by stopping or starting the distributing machine, overflow, leakage, or other mechanical or human errors, shall be removed.

Prior to performing the actual work, all equipment shall be adjusted and calibrated according to Section 403 and applicable manufacturer's requirements.

The surface section shall be constructed in half widths for each application when public traffic is to be maintained. When traffic is not being maintained over the roadway, full width applications may be made when sufficient aggregate spreading and rolling equipment is provided for complete simultaneous coverage.

**(b) Sweeping and Cleaning.** Before the asphalt material is applied, the surface shall be thoroughly cleaned and swept with a rotary power broom to remove all dust, dirt, mud, and loose or foreign material. A blower may be used to assist in the cleaning operation. The sweeping and cleaning operations shall be carried only far enough in advance of the application of the asphalt material to ensure that the surface is maintained in the proper condition at the time of application.

**(c) Application of Asphalt Material.** After the surface to be treated has been prepared as specified above, the asphalt material for the surface treatment shall be sprayed uniformly over the surface by means of an approved mechanical pressure distributor, meeting the requirements of Section 403, to the lines and at the rate of application designated by the Engineer. The asphalt material shall be applied at the temperature specified in Section 403. The Contractor shall ensure uniformity of distribution at junctions of distributor loads by use of building paper or other approved methods.

After asphalt material is applied, no equipment or traffic will be permitted on the surface until the aggregate is applied and rolled.

**(d) Application of Mineral Aggregate.** The mineral aggregate shall not contain excessive free moisture and shall be spread immediately following the application of the asphalt material. Operations shall not proceed or continue when the asphalt material is allowed to chill, set up, dry, or otherwise impair retention of the mineral aggregate. The mineral aggregate shall be spread with a mechanical spreader meeting the requirements of Section 403. The mineral aggregate shall be distributed over the asphalt material to the lines and at the rate of application as directed by the Engineer. The use of an approved chip box to distribute the mineral aggregate will be permitted on detour construction and other areas approved by the Engineer where the use of a mechanical spreader is impractical. Spreading shall be accomplished in such manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and freshly applied asphalt material. Portions of the surface not covered by mechanical spreaders shall be hand spotted so that the entire surface will be uniformly covered. Light hand brooming may be necessary to distribute excess aggregate.

**(e) Rolling and Brooming.** A minimum of two rollers, one pneumatic and one steel wheel, along with one rotary power broom



shall be used with each aggregate spreader being used. A combination steel wheel/pneumatic roller will be allowed as a substitute for the steel wheel roller.

Rolling shall begin immediately behind the spreader. Each surface treatment shall be completely rolled a minimum of three times.

After the final set of asphalt has occurred and no more than 48 hours after application, the surface shall be lightly broomed to remove excess aggregate. Generally, the brooming shall be confined to the cooler hours of the day and shall be conducted so as not to displace embedded material.

**(f) Second and Successive Applications.** If the work involves two or more applications of asphalt material and mineral aggregate, the rates of application for this material will be those specified on the plans or as designated by the Engineer and the method of construction will be the same as for the first application. Each application shall be placed only after the preceding application has been satisfactorily completed and cured.

A minimum of 48 hours for emulsions and asphalt binders and 72 hours for cut-backs shall elapse between the first and any succeeding application, however, a minimum of 24 hours is required before applying the succeeding application on detours or other temporary work. Further, the asphalt shall be firmly set and the aggregate firmly embedded so as not to be displaced by brooming. Before application, the surface shall be thoroughly swept with a rotary power broom so that no dust or loose aggregate is left that might cause a plane of cleavage.

**402.04 Traffic Control.** During the application of the asphalt material and aggregate, and during the rolling operation, traffic will not be allowed on the new surface. When traffic must use the lane adjacent to the lane under construction, the Contractor shall regulate the flow of vehicles past the surfacing operation at a speed not to exceed 25 miles per hour (40 km/h). The Engineer may require the use of a pilot vehicle.

Until the asphalt has set and the cover aggregate is firmly embedded, traffic shall not exceed 25 miles per hour (40 km/h). The vehicle speeds shall be controlled by the use of one or a combination of barricades, flaggers, signs, or pilot vehicles that will minimize the loss of cover aggregate. The method used for speed control shall be

approved by the Engineer and will be subject to change or modification should the selected method of control prove unsatisfactory.

The Contractor shall route the aggregate haul trucks to and from the work area so that they will not have to turn on the freshly placed surface treatment.

**402.05 Temperature and Seasonal Limitations.** Asphalt material shall not be applied when the surface temperature is below 60° F (15° C). In addition, asphalt surface treatments shall not be applied outside the following seasonal limitations:

Traveled Lanes	April 15 to September 30
Shoulders	April 1 to October 31

No deviation from the above limitations will be allowed except by written permission from the Engineer.

**402.06 Method of Measurement.** (a) Mineral aggregate in surface treatments will be measured either by the cubic yard (cubic meter) or by the ton (metric ton).

(b) Asphalt in surface treatments will be measured by the gallon (liter).

(c) When the actual rate of application of ACHM Surface Course (1/2" [12.5 mm]) or (3/8" [9.5 mm]) is placed within the limits shown on the plans or as directed by the Engineer at the rate shown in Subsection 402.01, or greater, it will be considered as the equivalent plan rate of Mineral Aggregate and Asphalt Material contained in each square yard (square meter) of Asphalt Surface Treatment.

Should the Contractor inadvertently apply a lesser rate of application, the quantities placed at the lesser rate will be adjusted by the following factors:

Rate of Application				Adjustment Factor
lbs./S.Y.		kg/sq m		
165	110	90	60	
165	110	90	60	1.00
158-164	106-109	86-89	57-59	0.96
152-157	101-105	82-85	54-56	0.92
145-151	96-100	79-81	51-53	0.88
Less than 145	Less than 96	Less than 79	Less than 51	No pay or overlay at no cost to Dept.

**402.07 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) or per cubic yard (cubic meter) for Mineral Aggregate in Asphalt Surface Treatment.

In cases where the combined specific gravity of the material used for Mineral Aggregate in Asphalt Surface Treatment exceeds 2.80 and the method of measurement is by the ton (metric ton), the quantity of material will be adjusted for payment by multiplying the quantity of the material used by the specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt material will be paid for at the contract unit price bid per gallon (liter) for Asphalt in Surface Treatment, Polymer Modified Cationic Emulsified Asphalt (CRS-2P), or Latex Modified Cationic Emulsified Asphalt (CRS-2L).

The above contract unit price shall be full compensation for furnishing, loading, heating, hauling, placing, and applying materials; for cleaning, sweeping, brooming, and rolling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Mineral Aggregate in Asphalt Surface Treatment (Class___)	Cubic Yard (Cubic Meter) or Ton (Metric Ton)
Asphalt in Surface Treatment	Gallon (Liter)
Polymer Modified Cationic Emulsified Asphalt (CRS-2P)	Gallon (Liter)
Latex Modified Cationic Emulsified Asphalt (CRS-2L)	Gallon (Liter)

### **SECTION 403**

#### **MATERIALS AND EQUIPMENT FOR PRIME, TACK, AND ASPHALT SURFACE TREATMENTS**

**403.01 Mineral Aggregate.** The various classes of Mineral Aggregate shall conform to the grading requirements of Subsection 403.02. Composition shall be as follows:

**Class 1, Class 2, and Class 4** shall be crushed stone, crushed gravel, or crushed steel slag in which at least 90% by weight of the coarse particles have been produced from larger particles by crushing operations and shall contain no more than 5% novaculite.

**Class 3** shall be crushed or uncrushed gravel, crushed steel slag, or crushed stone.

**Class 5** shall be composed of material meeting the requirements of either Class 1, Class 2, or Class 3 at the option of the Contractor.

Crushed stone shall consist of tough durable fragments of rock of uniform quality, and shall not contain more than 5% soft particles (AHTD Test Method 302). When subjected to 5 cycles of the Sodium Sulfate Soundness Test (AASHTO T 104), it shall have a loss not to exceed 12% and shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 35.

Gravel shall consist of hard, durable aggregate and shall not contain more than 5% soft particles (AHTD Test Method 302) and shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 35.

Steel slag shall consist of hard, durable aggregate and shall not contain more than 5% soft particles (AHTD Test Method 302). When subjected to 5 cycles of the Sodium Sulfate Soundness Test (AASHTO T 104), it shall have a loss not to exceed 12% and shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 35.

Fine aggregate is that portion passing the #10 (2.00 mm) sieve, and shall consist of clean, sound, hard, and durable particles of natural sands, stone sand, and other inert substances of similar characteristics. Coarse aggregate is that portion retained on the #10 (2.00 mm) sieve.

All mineral aggregates shall be uniformly well graded from coarse to fine and free from lumps or foreign material. They shall also be free from adherent films of clay that will prevent thorough coating with asphalt material.

**403.02 Aggregate Gradation.** Requirements in the following table are given in percent passing by weight.

Class	Sieve, (mm)					
	3/4" (19.0)	1/2" (12.5)	3/8" (9.5)	#4 (4.75)	#10 (2.00)	#16 (1.18)
1	100	90-100	--	0-15	0-3	--
2	--	100	80-100	--	0-15	0-3
3	--	100	80-100	--	0-15	0-3
4	--	--	100	50-90	0-15	0-8
5	May be either Class 1, 2, or 3.					

Sieve analysis will be determined by AASHTO T 27.

The decantation loss as determined by AASHTO T 11 shall not exceed 1.5% for any class of mineral aggregate.

**403.03 Asphalt Materials.** Asphalt materials shall include cut-back asphalt, emulsified asphalt, and asphalt binder. Samples of asphalt material will be tested according to applicable AASHTO or ASTM methods.

**(a) Rapid Curing Cut-back Asphalt.** Rapid Curing Cut-back Asphalt shall conform to the requirements of AASHTO M 81.

**(b) Medium Curing Cut-back Asphalts.** Medium Curing Cut-back Asphalt of the grade designated shall conform to the requirements of AASHTO M 82.

**(c) Anionic Emulsified Asphalt.** Anionic Emulsified Asphalt shall conform to the requirements of AASHTO M 140.

**(d) Cationic Emulsified Asphalt.** Cationic Emulsified Asphalt shall conform to the requirements of AASHTO M 208. In addition, CRS-2 shall have: 1) A minimum Saybolt Furol Viscosity at 122° F (50° C) at the point of manufacture and/or origin of 200 seconds, and a maximum Saybolt Furol Viscosity of 500 seconds. The Saybolt Furol Viscosity at 122° F (50° C) on destination field samples shall be within the limits of 100-500 seconds. If the asphalt fails to comply at 122° F (50° C) test temperature, the test shall be repeated at 160° F (70° C) and shall be within the limits of 90-200 seconds; and 2) the minimum residue from distillation by weight shall be 68%.

**(e) Polymer/Latex Modified Cationic Emulsified Asphalt.** Polymer Modified (CRS-2P) and Latex Modified (CRS-2L) Cationic Emulsified Asphalt shall conform to the requirements of AASHTO M 316, except for the minimum Ductility at 25° C (77°

F). In addition, CRS-2P and CRS-2L shall have : 1) A minimum Saybolt Furol Viscosity at 122° F (50° C) at the point of manufacture and/or origin of 200 seconds, and a maximum Saybolt Furol Viscosity of 500 seconds. The Saybolt Furol Viscosity at 122° F (50° C) on destination field samples shall be within the limits of 100-500 seconds. If the asphalt fails to comply at 122° F (50° C) test temperature, the test shall be repeated at 160° F (70° C) and shall be within the limits of 90-200 seconds; 2) the minimum residue from evaporation by weight shall be 68%, and 3) the penetration on residue from evaporation test shall be a maximum of 250.

**(f) Asphalt Binder.** Asphalt binder furnished shall conform to the requirements of AASHTO M 320 Table 1, except the Direct Tension requirement is deleted.

**403.04 Application Temperatures.** Asphalt material shall be applied at a temperature that provides proper and uniform distribution and within practical limits avoiding higher temperatures than necessary. Satisfactory application usually should be obtained within the recommended ranges shown below. No material shall be heated above the maximum allowable temperatures shown:

Type and Grade	Recommended Range		Maximum Allowable	
	°F	°C	°F	°C
RC-70	80-150	27-66	175	80
RC-250	100-175	38-80	200	93
RC-800	160-225	71-107	250	121
RC-3000	200-275	93-135	290	143
MC-30, MC-70	80-150	27-66	175	80
MC-250	100-200	38-93	230	110
MC-800	185-260	85-127	275	135
MC-3000	225-275	107-135	290	143
RS-1, RS-2	125-185	52-85	185	85

Type and Grade	Recommended Range		Maximum Allowable	
	°F	°C	°F	°C
MS-2	70-160	21-71	160	71
SS-1, SS-1h	70-160	21-71	160	71
CRS-1, CRS-2, CRS-2P, CRS-2L	125-185	52-85	185	85
CMS-2h, CMS-2	70-160	21-71	160	71
CSS-1, CSS-1h	70-160	21-71	160	71
All Asphalt Binders	275-325	135-163	350	177

Note: Heating of asphalt materials (except emulsions) constitutes a fire hazard to various degrees. Proper precautions should be used in all cases and especially with rapid curing cut-backs, as the maximum allowable temperature may exceed the flash point.

**403.05 Heating Equipment.** Equipment for heating asphalt material in tank cars or storage tanks shall have adequate capacity to heat the material by steam coils, electricity, or other means such that no flame shall come in contact with the heating tank.

The heating equipment shall be provided with an accurate thermometer to indicate the temperature of the asphalt material in the unit to which heat is being applied. Heating equipment that agitates the material will be prohibited if, in the opinion of the Engineer, it injures or in any way changes the characteristics of the material. The introduction of free steam directly into asphalt material will not be permitted.

**403.06 Pressure Distributors.** Each pressure distributor used for applying asphalt material shall be equipped with the following listed appliances or devices:

1) Tachometer devices registering traveling speed in feet per minute (meters per minute) or feet per second (meters per second).

2) A gauge, indicating pump pressure or output in gallons per minute (liters per minute) or gallons per second (liters per second) passing through the nozzles.

3) Thermometer well and accurate thermometer to indicate the temperature in degrees Fahrenheit (Celsius) of the asphalt material in the distributor.

4) Spray bars shall be of adjustable length and height and the distributor shall produce a 50% lap of the sprays from adjacent nozzles.

5) A power unit and pump system that will supply a uniform pressure through the entire length of the spray bar to provide equal output from all nozzles.

6) Calibrated metal measuring stick, marked in increments of not more than 10 gallons (50 L).

7) Easily removable dome cover.

8) Wind guard on ends of spray bars.

Calibration of the distributor will be checked by the Engineer before being used on the work. Distributors previously calibrated as described above by the Department or by another state Department of Transportation or the manufacturer, and certified in writing, will be accepted. Distributors will be kept free from sludge or other residue and at any time there is evidence of inaccuracy they will be subject to re-calibration. The Contractor shall provide, at no cost to the Department, all necessary equipment, materials, and assistance for any required calibration.

**403.07 Aggregate Spreaders.** The mechanical spreader for mineral aggregate shall be self-propelled and capable of accurately and uniformly spreading the material.

Calibration of the spreader will be checked by the Engineer prior to the actual work, and as often as necessary, to assure that the openings are properly set to feed the aggregate at the designated application rate.

**403.08 Rollers. (a) General.** Rollers shall be equipped with approved devices to prevent adhesion of the surfacing material to the wheels. Rollers shall be maintained in good mechanical condition and operated to produce a surface course with satisfactory aggregate orientation and interlock. Rollers shall be equipped with a self-contained power unit adequate to maintain dependable forward and reverse working speeds. Rollers shall have a system for cleaning the tires for the full width of each tire.



**(b) Pneumatic Rollers.** Pneumatic rollers shall be mounted on 7 or more wheels, a minimum of 3 leading wheels and 4 drive wheels. The wheels shall be mounted at right angles to the axles, shall maintain this position through the full revolution, and shall afford a continuous and complete rolling width of not less than 60 inches (1.5 m). The tires shall have a smooth tread. All tires on an individual roller unit shall be of equal size and diameter and shall be so arranged that the gap between the tires of one axle is covered by the tires of the other axle. Tires shall be uniformly inflated so that the air pressure of the several tires shall not vary more than 5 psi (35 kPa).

Pneumatic rollers shall be capable of exerting a minimum ground contact pressure of 45 psi (310 kPa). The Contractor shall furnish to the Engineer charts or tabulations showing the contact area and contact pressure for the full range of tire inflation pressures and for the full range of tire loadings for each type and size compactor tire furnished. The tires shall be inflated and the roller loaded with ballast, as required, to obtain the average ground contact pressure necessary to obtain proper compaction.

**(c) Steel Wheel Rollers.** Steel wheel or combination steel wheel/pneumatic rollers may be either three wheel or tandem type, shall weigh not less than 200 pounds per inch (35 kg/10 mm) width of roller, and shall have a complete rolling width of not less than 36" (1 m).

## **SECTION 404 DESIGN AND QUALITY CONTROL OF ASPHALT MIXTURES**

**404.01 Design of Asphalt Mixtures. (a) General.** The Contractor shall furnish one mix design for each of the particular asphalt mixtures listed on the plans or in the Contract. The mix design shall be performed by a laboratory that is on the Department's QPL of approved asphalt mix design laboratories and shall include the following:

- Type of mix (e.g., ACHM Base, Binder, and Surface Course).
- Design values for asphalt binder content, air voids, voids in mineral aggregate, gradation, and wheel tracking test.

- Source of each material to be used in production of the mix.
- Designation of the asphalt plant to be used for production of the mix.
- Name(s) of individual(s) who performed the sampling, testing, and preparation of the mix design and the name of the laboratory used.
- Optimum laboratory mixing and compacting temperatures.
- Temperature viscosity curves for the asphalt binder to be used in the mix.
- A one gallon sample of performance grade asphalt binder to be used in the mix.
- Copies of all test results and mix design work papers.
- Nine (9) blended aggregate samples.
- A Certification by the Contractor that the mix design was prepared according to the specifications and that the materials to be used are from sources approved by the Engineer.

The mix design shall be submitted to the Engineer of Materials for review. After completion of the review, the Engineer of Materials will accept or reject, in writing, the mix design. A mix design will be accepted only for a specific type of mix, materials sources, and the plant to be used. A change in any materials source will require a different mix design. Mix designs will be approved for a period of five years from the original approval date provided satisfactory results are obtained during production and placement. The Engineer of Materials will accept a maximum of three (3) mix designs for a particular type mix, materials source, and plant combination at any time. Mix designs submitted in excess of three will not be considered until the number of accepted mix designs is reduced by declaring one or more of them invalid. All mix designs accepted by the Engineer of Materials become the property of the Department.

The Contractor shall notify the Resident Engineer in writing of the accepted mix design proposed for use on a specific project and provide copies of the mix design to the Resident Engineer. The Resident Engineer will approve an accepted mix design for use on each project. Only one mix design for each type of mix will be active (approved for use on highway projects) at any one plant at any time. A maximum of two other accepted mix designs for each type of mix will be considered inactive. If a change of mix design is

desired, the Contractor shall notify the Resident Engineer and request permission to change the mix design. Arbitrary changes of the active mix design will not be approved.

The Engineer will not perform any pre-bid testing of materials. It will be the Contractor's responsibility to obtain material sources approved by the Engineer unless sources are designated on the plans or in the Contract. Additives shall be selected from those on the Qualified Products List. If asphalt binder or aggregate sources proposed for use are not on the Qualified Products List, at least 10 business days must be allowed for sampling and testing before beginning the mix review process. At least five (5) business days shall be allowed for the review of the mix design.

**(b) Design Requirements.** Each mix design shall be prepared by laboratory analysis according to the requirements of the specifications. Each mix design will establish a mix gradation for the aggregates (based on the weight of material passing specified screen sizes), an optimum asphalt binder content (expressed as a percentage of the total mix weight), an optimum laboratory mixing temperature, and an optimum laboratory compaction temperature. Optimum laboratory mixing and compaction temperatures shall be established based on temperature-viscosity curves of the asphalt binder to be used in the mix. The optimum asphalt content is the asphalt binder content at 4% Air Voids (AV) for PG 76-22 mixes and 4.5% Air Voids (AV) for PG 64-22 and PG 70-22 mixes. The mix design will be designed in accordance with the volumetric mix design procedures contained in AASHTO M 323, its referenced standards, and the exceptions below:

- PG 64-22 and PG 70-22 mixes will be designed using 4.5% air voids;
- the fine aggregate angularity will be determined in accordance with AASHTO T 304 using the aggregate blend specific gravity of the minus No. 8 (2.36 mm) sieve through plus No. 100 (0.15 mm) sieve material;
- if any part of an ACHM Binder Course or an ACHM Base Course is within four inches (100 mm) of the pavement surface, the binder or base course lift shall comply with the angularity requirements for the top four inches (100 mm) of pavement;

- the gyratory compactor used in design, quality control, and acceptance testing must be a type evaluated by a Superpave Center and must meet the testing protocols for gyratory compactors. Gyratory compactors shall be calibrated in accordance with AASHTO T 312 and the manufacturer's recommendations. Documentation of calibration shall be made available to the Engineer upon request.
- the Voids in Mineral Aggregate (VMA) ranges will be as shown in Tables 405-1, 406-1, 407-1, or 407-2, as appropriate;
- the minimum requirement for one fractured aggregate face will be 98% and 80% for two fractured faces;
- wheel tracking test results will be determined using AHTD Test Method 480.
- water sensitivity will be determined using AHTD Test Method 455A. Copies of AHTD Test Methods are available from the Department.

The maximum number of gyrations ( $N_{max}$ ) will be shown on the plans.

Asphalt binder shall comply with the requirements of AASHTO M 320 Table 1, except the Direct Tension requirements are deleted, and shall be from sources that have executed a certification agreement with the Department. PG 70-22 and PG 76-22 asphalt binders shall be production straight run binders that are modified by using either a SB, SBS or SBR to achieve the specified grade. PG 70-22 and PG 76-22 asphalt binders shall meet a minimum elongation recovery of 40% and 50%, respectively, when tested on the original binder at 77° F ( $\pm 1^\circ$  F) [ $25^\circ$  C ( $\pm 0.5^\circ$  C)], in accordance with AASHTO T 301. Additives shall be approved by the Engineer. If an anti-strip additive is needed, a heat stable liquid anti-strip additive from the Qualified Products List shall be added at the rate of 0.5% or 0.75% by weight of the asphalt binder as determined by laboratory analysis. The maximum theoretical density computed from the specific gravity as determined by the Rice method (AASHTO T 209) shall be included in the mix designs. The Contractor shall compute the effective specific gravity. A correction factor, accounting for the difference in the VMA(actual) determined by bulk specific gravity and the VMA(effective) determined by the effective specific gravity, shall be shown on the mix design. The mix design for each type of asphalt mix shall meet the design

criteria for asphalt binder content, Air Voids (AV), Voids in Mineral Aggregate (VMA), fines to asphalt ratio, aggregate gradation, water sensitivity, and wheel tracking test.

The Contractor certified mix design shall provide for the design requirements for asphalt binder content, AV, VMA, fines to asphalt ratio, aggregate gradation, and water sensitivity specified for the particular mix.

The mix design gradation must fall within the master gradation limits for the specified type of mix.

If an acceptable pavement is not produced and it is determined that the accepted mix design is at fault, paving operations shall be stopped and the Contractor shall prepare a new mix design. The processing of proposed changes or new designs shall follow the same procedures as the initial mix designs.

**404.02 Mixture Requirements.** Asphalt mixtures will be designed and tested to meet the requirements specified in Sections 405, 406, and 407.

**404.03 Mixture Substitutions.** Substitutions of specified courses will be allowed only on shoulders, leveling, and incidental or temporary construction as follows:

- 1) ACHM Base Course (1-1/2" [37.5 mm]) may be replaced with:
  - ACHM Binder Course (1" [25 mm])
  - ACHM Surface Course (1/2" [12.5 mm])
  - ACHM Surface Course (3/8" [9.5 mm])
- 2) ACHM Binder Course (1" [25 mm]) may be replaced with:
  - ACHM Surface Course (1/2" [12.5 mm])
  - ACHM Surface Course (3/8" [9.5 mm])
- 3) ACHM Surface Course (1/2" [12.5 mm]) may be replaced with:
  - ACHM Surface Course (3/8" [9.5 mm])

Mixture substitution will be at the planned rate for the material for which the substitution is being made and shall use the specified asphalt binder grade. Measurement for payment of all components of the mix will be based on the accepted mix design for the type specified on the plans or on the accepted mix design for the type used, whichever results in the lower cost per ton (metric ton) of mix to the Department. If no accepted mix design for the type specified on the plans is available, the mixture composition for payment will be based on the composition shown on the plans as the basis of estimate for the plan type or on the accepted mix design for the mix

actually used, whichever results in the lower cost per ton (metric ton) of mix to the Department.

**404.04 Quality Control of Asphalt Mixtures.** The Contractor shall perform all applicable quality control sampling and testing of the asphalt mixtures used on the project.

The Contractor is responsible for product quality control during handling, blending, mixing, storing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to produce the accepted mix design within the tolerances specified for the mix. Adjustments to the accepted mix design to conform to actual production values without re-design of the mixture shall be based on production of the mixture at a target value of 4.0% Air Voids (AV) for PG 76-22 mixes and 4.5% Air Voids (AV) for PG 64-22 and PG 70-22 in specimens and an asphalt binder content not less than that specified in the accepted mix design. The VMA shall be within the specified limits for the adjustment to be acceptable.

The accepted mix design shall be field verified by the Contractor at the start of mix production or after an interruption of more than 90 calendar days. The asphalt mixture shall be verified by testing mix that has been produced through the plant using the aggregate proportions shown on the accepted mix design.

The mix will be considered to be verified if test values for air voids, asphalt binder content, and VMA are within the compliance limits shown in Table 410-1, and when the accepted mix design has been produced within the gradation tolerances according to Subsection 404.04.

After verification of the initial design, the Contractor may elect to make adjustments in aggregate proportions to vary the accepted mix design gradations and bring the mix properties near the center of the compliance limits. If these adjustments are made and the plant produced mix has the desired properties, the Contractor may request that a field mix design be accepted by the Engineer. If this is acceptable to the Engineer, the Contractor will be notified in writing.

If other changes to the accepted mix design are desirable, the Contractor must first produce another laboratory mix design, submit it to the Engineer for review and acceptance, and follow the verification procedures that are described above.

The Contractor shall perform all applicable quality control sampling and testing required to ensure that the completed asphalt pavement complies with all requirements of the specifications. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*.

Quality control sampling and testing shall be accomplished in a timely manner. Sampling and testing shall be planned and conducted so that a representative sample is obtained and tested. The Contractor shall determine the specific locations for samples and frequency of sampling for quality control, except the minimum frequency which is listed below for aggregate gradation shall be used. In addition, the Contractor shall be required to perform acceptance sampling and testing at specific times and/or locations specified by the Engineer according to Subsection 410.09. The Contractor may use the results of these required tests in their quality control program.

If the accepted mix design is not being produced as defined by the accepted mix design, and if the mix cannot be adjusted within the tolerances of the accepted mix design to achieve the specified mix properties, production shall be discontinued. A new mix design shall be developed and submitted for review and acceptance. Sieve tolerances shall be as tabulated below.

<b>Mix Design Tolerances</b>		
<b>Sieve Size</b>	<b>(mm)</b>	<b>Tolerance (%)</b>
1"	(25.0)	±7.0
3/4"	(19.0)	±7.0
1/2"	(12.5)	±7.0
#4	(4.75)	±7.0
#8	(2.36)	±7.0
#16	(1.18)	±4.0
#30	(0.60)	±4.0
#50	(0.30)	±4.0
#100	(0.15)	±4.0

Sampling shall be performed according to AASHTO T 168 and AHTD 465, except that the number and locations for sampling shall

be as specified in this Subsection and in Subsection 410.09. Test methods shall be as shown below:

<b>Property</b>	<b>Test Method(s) (NOTE 1)</b>
Aggregate Gradation	AASHTO T 30, AHTD 460, or AASHTO T 308 1 per 750 metric tons (750 tons) minimum
Asphalt Binder Content (NOTE 4)	AHTD 449/449A or AASHTO T 308
Stability	AASHTO T 245
Air Voids (AV) (NOTE 2)	AASHTO T 269
Voids in Mineral Aggregate (VMA)	AHTD 464
Density - Maximum Theoretical	AASHTO T 209
Density (Field)	AASHTO T 166 or AHTD 461
Water Sensitivity (NOTE 3)	AHTD 455A
Wheel Tracking Test	AHTD 480

**NOTE 1:** Where alternate test methods are shown, the method used shall be at the Contractor's option. All testing for quality control and acceptance shall be performed on samples of the plant mixed product. Field densities and samples to investigate segregation shall be taken from the roadway after compaction; all other samples shall be taken from trucks at the plant.

**NOTE 2:** Test for AV on samples prepared by gyratory compactor according to the volumetric mix design procedures in AASHTO M 323.

**NOTE 3:** The Water Sensitivity shall be determined at least once during the first three days of production of each type mix; during the first three days of production of any new mix design; and/or during the first three days of production after an interruption of 90 calendar days or more. If the water sensitivity falls more than 10 percentage points below that specified for the type mix, production shall cease and a new mix design will be required.

**NOTE 4:** Department test results for asphalt binder content will be determined by AHTD 449/449A (nuclear asphalt content gauge) exclusively. In the event of disagreement between the test results from a nuclear gauge and test results from an ignition oven, the



nuclear gauge results shall take precedence over the ignition oven results.

Sampling and testing for acceptance and adjustment of payment will be performed as specified in Subsection 410.09.

The Contractor shall furnish a building for the use of the Department's plant inspector according to Subsection 409.03(h). This building shall be separate and independent of the Contractor's facilities and equipment for performing quality control sampling and testing. The "separate and independent" requirement may be met by space in a building that is also used by the Contractor or supplier, provided that the space otherwise meets all requirements of Subsection 409.03(h); is physically separated from the rest of the building by a solid wall; and has an outside entrance with all keys placed in the custody of the Engineer.

The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures. The Contractor's quality control personnel may observe the AHTD project personnel during acceptance sampling and testing for the purpose of comparing sampling and testing procedures.

The Contractor shall maintain a daily plot of all test results, and make the plots available to the Engineer. Upon completion of work on the item these plots shall be furnished to the Resident Engineer for inclusion in the project files. The Resident Engineer will make acceptance test results available to the Contractor's personnel.

If the test results show that the material is outside the mix design limits, is widely varying, or is consistently marginal, corrective action shall be taken. Corrective actions taken shall be based on the Contractor's quality control test results. The Department's asphalt plant inspector will be notified of all proposed corrective actions before their implementation. Each individual aggregate cold feed may be adjusted no more than an amount that is sufficient to produce the specified AV and VMA and that is within the tolerances for the accepted mix design. If excessive changes are required, production will be suspended and a new mix design shall be developed according to the applicable specifications.

Use of nuclear asphalt content gauges is regulated by the Radiation Control and Emergency Management Programs of the Arkansas State Department of Health. If the Contractor elects to use a nuclear gauge in his quality control program, he shall be

responsible for meeting and following all licensing and use requirements.

**404.05 Method of Measurement and Basis of Payment.** Design and Quality Control of Asphalt Mixtures will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various types of asphalt concrete hot mix used on the project.

## SECTION 405

### ASPHALT CONCRETE HOT MIX BASE COURSE

**405.01 Description.** This item shall consist of a base course constructed on an accepted course according to these specifications and in substantial conformity with the lines, grades, and typical cross section shown on the plans.

**405.02 Vacant**

**405.03 Materials.** The materials used shall comply with Section 409 and this subsection. The materials shall be proportioned to meet the design requirements for asphalt concrete base course as shown in Table 405-1.

The design and quality control of ACHM base course mix shall be according to Section 404.

**Table 405-1**

Design Requirements for Asphalt Concrete Hot Mix Base Course  
(1-1/2" [37.5 mm])

Sieve (mm)	Control Points
	Percent Passing (%)
2" (50.0)	100
1½" (37.5)	90 - 100
1" (25.0)	90 max.
No. 4 (4.75)	-
No. 8 (2.36)	15 - 41
No. 16 (1.18)	-
No. 30 (0.60)	-
No. 50 (0.30)	-
No. 200 (0.075)	0 - 6

**Table 405-1** continued

Asphalt Binder Content	Design Value	
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)	
% VMA	11.5 – 13.0	
Minimum Water	80.0	
Sensitivity Ratio	As Required	
% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test	<u>Design Gyration</u>	<u>Maximum Rut</u>
(8000 cycles, 100 psi,	75 & 115	0.315 in. (8.000 mm)
64°C)	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

\*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

**405.04 Equipment.** Equipment used in this construction shall comply with Section 409.

**405.05 Construction Requirements and Acceptance.** Construction requirements and acceptance shall conform to the requirements of Section 410. The required density shall be 92% to 96% of the maximum theoretical density. The required density for ACHM Base Course placed in trench areas less than 6' (1.8 m) in width at levels below the existing pavement surface shall be 90% to 96%.

**405.06 Method of Measurement.** (a) Mineral aggregate will be measured by the ton (metric ton).

(b) Asphalt binder will be measured by the ton (metric ton).

Quantities of mineral aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weights will be used in lieu of truck scales to determine the total weight of the composite mixture.

**405.07 Basis of Payment. Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in ACHM Base Course. Mineral filler will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Mineral Aggregate.

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG \_\_\_\_ ) in ACHM Base Course (1½" [37.5 mm]). Anti-strip additives will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Asphalt Binder.

The contract unit prices mentioned above shall be full compensation for furnishing materials; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Mineral Aggregate in ACHM Base Course (1-1/2" [37.5 mm])	Ton (Metric Ton)
Asphalt Binder (PG ____ ) in ACHM Base Course (1-1/2" [37.5 mm])	Ton (Metric Ton)

## SECTION 406 ASPHALT CONCRETE HOT MIX BINDER COURSE

**406.01 Description.** This item shall consist of an asphalt concrete binder course constructed on an accepted course according

to these specifications and in reasonably close conformity with the lines, grades, and typical cross sections shown on the plans.

**406.02 Materials.** The materials used shall comply with Section 409 and this subsection. The materials shall be proportioned to meet the design requirements for asphalt concrete binder course mixtures as shown in Table 406-1.

The design and quality control of ACHM binder course mix shall be according to Section 404.

**406.03 Equipment.** The equipment used in this construction shall comply with Section 409.

**406.04 Construction Requirements and Acceptance.** Construction requirements and acceptance shall conform to the provisions of Section 410. When Binder is placed on shoulders constructed under Section 216 or on reconstructed base course under Section 305, the minimum density shall be 90% of the maximum theoretical density. The required density for ACHM Binder Course placed in trench areas less than 6' (1.8 m) in width at levels below the existing pavement surface shall be 90% to 96%.

**Table 406-1**

Design Requirements for Asphalt Concrete Hot Mix Binder Course  
(1" [25 mm])

	Control Points
Sieve (mm)	Percent Passing (%)
1½" (37.5)	100
1" (25.0)	90 - 100
¾" (19.0)	90 max.
No. 4 (4.75)	-
No. 8 (2.36)	19 - 45
No. 16 (1.18)	-
No. 30 (0.60)	-
No. 50 (0.30)	-
No. 200 (0.075)	1 - 7
Asphalt Binder Content	Design Value
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)
% VMA	12.5 – 14.0
Minimum Water Sensitivity Ratio	80

% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test (8000 cycles, 100 psi, 64°C)	<u>Design Gyration</u>	<u>Maximum Rut</u>
	75 & 115	0.315 in. (8.000 mm)
	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

\*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

**406.05 Method of Measurement.** (a) Mineral aggregate will be measured by the ton (metric ton).

(b) Asphalt binder will be measured by the ton (metric ton).

Quantities of aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weights will be used in lieu of truck scales to determine the total weight of the composite mixture.

**406.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in ACHM Binder Course (1" [25 mm]). Mineral filler will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Mineral Aggregate.

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG \_\_\_\_\_) in ACHM Binder Course (1" [25 mm]). Anti-strip additives will not be paid

for separately, but full compensation therefor will be considered included in the contract unit price bid for Asphalt Binder.

The contract unit prices mentioned above shall be full compensation for furnishing materials; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Mineral Aggregate in ACHM Binder Course (1" [25 mm])	Ton (Metric Ton)
Asphalt Binder (PG _____) in ACHM Binder Course (1" [25 mm])	Ton (Metric Ton)

**SECTION 407**  
**ASPHALT CONCRETE HOT MIX SURFACE**  
**COURSE**

**407.01 Description.** This item shall consist of an asphalt concrete surface course constructed on an accepted course according to these specifications and in reasonably close conformity with the lines, grades, and typical cross sections shown on the plans.

**407.02 Materials.** The materials used shall comply with Section 409 and this subsection. The materials shall be proportioned to meet the design requirements for asphalt concrete surface course mixtures as shown in Table 407-1 or Table 407-2, as appropriate.

The design and quality control of ACHM surface course mix shall be according to Section 404.

**407.03 Equipment.** The equipment used in this construction shall comply with Section 409.

**407.04 Construction Requirements and Acceptance.** Construction requirements and acceptance shall comply with Section 410. When Surface is placed on shoulders constructed under Section 216 or on reconstructed base course under Section 305, the minimum density shall be 90% of the maximum theoretical density. The required density for ACHM Surface Course

placed in trench areas less than 6' (1.8 m) in width at levels below the existing pavement surface shall be 90% to 96%.

**Table 407-1**

Design Requirements for Asphalt Concrete Hot Mix Surface Course  
(1/2" [12.5 mm])

Sieve (mm)	Control Points	
	Percent Passing (%)	
3/4" (19.0)	100	
1/2" (12.5)	90 - 100	
3/8" (9.5)	90 max.	
No. 8 (2.36)	28 - 58	
No. 16 (1.18)	-	
No. 30 (0.60)	-	
No. 50 (0.30)	-	
No. 200 (0.075)	2 - 10	
Asphalt Binder Content	Design Value	
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)	
% VMA	14.0 – 16.0	
Minimum Water Sensitivity Ratio	80.0	
% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test (8000 cycles, 100 psi, 64°C)	<u>Design Gyration</u>	<u>Maximum Rut</u>
	75 & 115	0.315 in. (8.000 mm)
	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

\*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.



**Table 407-2**

Design Requirements for Asphalt Concrete Hot Mix Surface Course  
(3/8" [9.5 mm])

Sieve (mm)	Control Points	
	Percent Passing (%)	
1/2" (12.5)	100	
3/8" (9.5)	90 - 100	
No. 4 (4.75)	90 max.	
No. 8 (2.36)	32 - 67	
No. 16 (1.18)	-	
No. 30 (0.60)	-	
No. 50 (0.30)	-	
No. 200 (0.075)	2 - 10	
Asphalt Binder Content	Design Value	
% Air Voids	4.0 (PG 76-22 mixes) ; 4.5 (PG 64-22 & PG 70-22 mixes)	
% VMA	15.0 – 17.0	
Minimum Water Sensitivity Ratio	80.0	
% Anti-strip	As Required	
Fines to Asphalt Ratio*	0.6 – 1.6	
Wheel Tracking Test (8000 cycles, 100 psi, 64°C)	<u>Design Gyration</u>	<u>Maximum Rut</u>
	75 & 115	0.315 in. (8.000 mm.)
	160	0.197 in. (5.000 mm)
	205	0.197 in. (5.000 mm)

\*Fines to asphalt ratio shall be defined as the percent materials passing the No. 200 (0.075 mm) sieve (expressed as a percent of total aggregate weight) divided by the effective asphalt binder content.

**407.05 Method of Measurement.** (a) Mineral aggregate will be measured by the ton (metric ton).

(b) Asphalt binder will be measured by the ton (metric ton).

Quantities of aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and

mixing control system, the printed batch weights will be used in lieu of truck scales to determine the total weight of the composite mixture.

**407.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in ACHM Surface Course (\_\_\_\_\_). Mineral filler will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Mineral Aggregate.

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG \_\_\_\_\_) in ACHM Surface Course (\_\_\_\_\_). Anti-strip additives will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Asphalt Binder.

The contract unit prices mentioned above shall be full compensation for furnishing materials; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Mineral Aggregate in ACHM Surface Course (1/2" [12.5 mm])	Ton (Metric Ton)
Asphalt Binder (PG _____) in ACHM Surface Course (1/2" [12.5 mm])	Ton (Metric Ton)
Mineral Aggregate in ACHM Surface Course (3/8" [9.5 mm])	Ton (Metric Ton)
Asphalt Binder (PG _____) in ACHM Surface Course (3/8" [9.5 mm])	Ton (Metric Ton)

## SECTION 408 VACANT

## SECTION 409

MATERIALS AND EQUIPMENT FOR ASPHALT  
CONCRETE PLANT MIX COURSES

**409.01 Mineral Aggregates.** Mineral aggregate for Asphalt Concrete Hot Mix Base Course, Asphalt Concrete Hot Mix Binder Course, Asphalt Concrete Hot Mix Surface Course, and Asphalt Concrete Cold Plant Mix shall consist of combinations of coarse aggregate, fine aggregate and mineral filler as provided for in the respective mix designs. Mineral aggregate shall consist of clean, hard, durable fragments of aggregate of uniform quality, free from an excess of soft particles, deleterious material and adherent films of clay. Eighty-five percent of the mineral aggregate shall be produced from larger particles by mechanical crushing operations.

Coarse aggregate shall comply with Table 409-1.

Table 409-1  
Coarse Aggregate Properties

Coarse Aggregate Type	Crushed Gravel; Crushed Stone; Steel Slag
Size	Plus No. 8 (2.36 mm)
Fractured Faces	
One Face	98 % min.
Two Faces	80 % min.
LA Abrasion (AASHTO T 96)	40 % max.
Sodium Sulfate Soundness <sup>Note 1</sup> (AASHTO T 104, 5 cycle)	12% max.
Flat, Elongated Particle	10 % max.
Wearing Surface Aggregate	
Limestone	60 % max.
Other <sup>Note 2</sup>	40 % min.
Gravel	60 % max.
Other <sup>Note 3</sup>	40 % min.

NOTE 1: Sodium Sulfate Soundness does not apply to Crushed Gravel.

NOTE 2: Crushed sandstone, crushed siliceous gravel, syenite, novaculite, crushed steel slag, or mineral aggregate which has an insoluble residue not less than 85% when tested in a 1:1 solution of hydrochloric acid and water according to ASTM D3042 shall be used as the remaining coarse mineral aggregate.

NOTE 3: Crushed steel slag, crushed sandstone, syenite, novaculite, or other crushed quarry stone which has an insoluble residue not less than 85% when tested in a 1:1 solution of hydrochloric acid and water according to ASTM D3042 shall be used as the remaining coarse mineral aggregate.

The fine aggregate shall comply with Table 409-2.

Table 409-2  
Fine Aggregate Properties

Fine Aggregate Type <sup>Note 1</sup>	Manufactured Sand; Natural Sand
Size	Minus No. 8 (2.36 mm)
Fine Aggregate Angularity <sup>Note 2 &amp; 3</sup>	As specified in AASHTO M 323
Sand Equivalent	As specified in AASHTO M 323
Natural Sand Content	15% max.
Coal and/or Lignite <sup>Note 4</sup>	2% max.

NOTE 1: Manufactured sand shall be angular particles that have been produced from larger particles by mechanical crushing operations.

NOTE 2: Test to be performed according to AASHTO T 304 using the aggregate blend specific gravity of the minus No. 8 (2.36 mm) sieve through plus No. 100 (0.15 mm) sieve material.

NOTE 3: If any part of an ACHM Binder Course or an ACHM Base Course is used within 4 inches (100 mm) of the pavement surface, the binder or base course lift shall comply with the angularity requirements for the top 4 inches (100 mm) of pavement.

NOTE 4: The amount of coal and lignite shall be determined according to AASHTO T 113.

**409.02 Asphalt Binder.** Asphalt binder shall be according to AASHTO M 320 Table 1, except the Direct Tension requirement is deleted.

If required, the asphalt binder shall contain a heat-stable anti-stripping additive. The additive shall be approved by the Engineer. It shall be added at the rate of 0.5% to 0.75% by weight of asphalt binder as determined by laboratory analysis and laboratory mix design procedures. The anti-stripping additive shall be added by an in-line blending process just before introduction of the asphalt binder to the mixer.

**409.03 Mixing Plants. (a) General.** The plant used in the production of the mixture shall be of the separate weigh batch type, the continuous mixing type, or the drum mixing type. The separate weigh batch type and the continuous mixing type may be operated without screens.

**(b) Requirements of All Plants.**

**(1) Uniformity.** The plant shall be so designed, coordinated, and operated as to produce mixtures within the job mix tolerances fixed by these specifications.

**(2) Storage Tanks for Asphalt Binder.** Storage tanks shall be equipped to heat the asphalt binder, under effective and positive control at all times, to the temperature requirements set forth in the specifications. Heating shall be accomplished by steam or oil coils, electricity, or other means such that no flame comes into contact with the heating tank.

A circulating system for the asphalt binder shall be provided of adequate size to ensure proper and continuous circulation during the entire operating period.

Pipe lines and fittings shall be steam or oil jacketed or otherwise properly insulated to prevent heat loss.

Provisions shall be made for sampling storage tanks.

The asphalt storage system shall be provided with signal devices and controls that will warn of low levels if the asphalt storage level is lowered to the point of exposing the feed end of the asphalt suction line.

**(3) Mineral Filler and Dust Return.** Dry storage shall be provided for mineral filler, when required, and provision shall be made for accurate proportioning.

If the asphalt plant is equipped with a baghouse dust collector, the fines, if elected to be reintroduced to the mixture, shall be added to the mixture at the approximate rate at which collected. In addition baghouse fines may be stored in a silo for use in mixes. If baghouse fines from a silo are incorporated into a mix, the baghouse fines shall be added at the rate that is shown on the mix design. Direct return from the baghouse to the hot elevator will be permitted only when it can be demonstrated that the flow can be controlled at a uniform rate. Intermittent feeding of baghouse fines into the mixture will not be permitted.

**(4) Cold Feed Bins and Cold Feeder for Dryer.** A minimum of 3 cold feed bins shall be used with weigh batch and continuous mixing type plants, and a minimum of 4 cold feed bins shall be used with drum mixing type plants, weigh batch type plants without screens, and continuous mixing type plants without screens. The bins shall be of sufficient size to store the amount of aggregate that is required for continuous plant operations. The unit shall have a mechanical feeder control mounted under the cold feed bins capable of controlling cold aggregate feeds at the rates shown on the job mix design.

A scalper screen of the dimensions necessary to remove oversize aggregates shall be provided.

**(5) Dryer.** The plant shall include a dryer or dryers that will continuously agitate the aggregate during the heating and drying process. The dryer shall be capable of heating and drying the aggregate to the moisture and temperature requirements without leaving any visible unburned fuel or carbon residue on the aggregate when discharged from the dryer.

**(6) Asphalt Control Unit.** Satisfactory means, either by weighing, metering, or the taking of volumetric measurements, shall be provided to obtain the proper amount of asphalt binder in the mixture within the tolerance specified for the job mix.

Suitable means shall be provided, either by steam jacketing or other insulation, for maintaining the specified temperature of asphalt binder in the system.

**(7) Thermometric Equipment.** An armored automatic recording thermometer covering a range from 200° F to 400° F (90° C to 205° C) shall be fixed in the asphalt binder feed line at a suitable location near the discharge valve at the mixer unit.

An armored recording thermometer shall be placed as to register and record automatically the temperature of the heated aggregates.

**(8) Pollution Control Equipment.** Asphalt mixing plants shall be so designed, equipped, and operated that the quality and quantity of pollutants emitted will conform to the requirements of applicable Federal, State, and local laws, ordinances, and regulations.

**(9) Storage Silos and Surge Bins.** Storage silos or surge bins may be used to store production mixture provided that it is not detrimental to the quality of the mixture placed on the roadway.

Open Graded Asphalt Base Course mixtures shall not be stored.

Mixtures that are determined by visual observation to be segregated will be rejected.

The system shall be capable of conveying the hot mix from the plant to the silo by means of a drag-slat conveyor system or other approved system. The conveyor may be enclosed and heated to prevent a drop in the mixture temperature; however, hot air shall not be blown on the mixture.

The atmosphere within the silo may be air or inert gas. The storage silo heating system shall be capable of maintaining the mixture temperature without localizing heating (hot spots). If inert gas is used, the inert gas system must be capable of purging the silo with an oxygen-free (inert) atmosphere and then sealing the silo to prevent loss of the inert gas.

Permissible storage times shall be as follows:

	<b>Storage Time (Hours)*</b>	
	<u>Maximum Aggregate Size</u>	
	<u>¾" (19.0 mm)</u>	<u>1½" (37.5 mm )</u>
Air in bin	36	18
Inert gas in bin	144	72

\*Note: Asphalt binder shall be treated with a silicone that is on the Department's QPL at the rate of 1 ounce/5000 gallons (1 g/668 L).

Longer storage times than those permitted above may be allowed based upon the results of tests on the mixture. All sampling and testing of the mixture shall be performed by an approved independent laboratory and certified correct. To qualify the silo or storage bin for longer storage times, the mixture must be sampled immediately after it is mixed and again after it has been stored at the requested longer time.

Penetration loss in storage shall not exceed 20 percent. Comparative tests shall be performed according to AASHTO T 49.

The minimum limits for Rolling Thin Film Oven (RTFO) residue when tested with a Dynamic Shear Rheometer (DSR) in accordance with AASHTO T 315, from samples of discharge from the surge or storage bin, shall be as follows:

<u>GRADES</u>	<u>MINIMUM</u>
PG 64-22	0.3 psi @ 147°F (2.2 kPa @ 64°C)
PG 70-22	0.3 psi @ 158°F (2.2 kPa @ 70°C)
PG 76-22	0.3 psi @ 169°F (2.2 kPa @ 76°C)

Once a silo or storage bin has qualified for longer storage times for particular types of mixes, the requested longer storage times may be used on other jobs without additional testing. Testing of mixture for permitting longer storage time will be at no cost to the Department.

If changes or alterations to a qualified surge or storage system are made, the Engineer shall be notified of the modifications. Any departure or alteration will require reevaluation.

The storage silo or surge bin unloading gates shall not cause segregation or be detrimental to the mixture in any way.

**(10) Safety Requirements.** Adequate and safe access to all parts of the plant shall be provided for plant inspection. Moving parts shall be shielded. A clean, free from drippings, and unobstructed passage shall be maintained at all times in and around the truck loading space



**(11) Anti-strip Additive Measuring System.** An anti-strip additive measuring system shall be placed in the anti-strip additive line prior to introduction into the asphalt binder loading line. The meter shall be capable of handling the anti-strip additive at temperatures up to 162° F (72° C) and shall be capable of withstanding the corrosiveness of the anti-strip additive. Meters having working internal components exposed to the additive shall not be composed of aluminum, brass, bronze, or copper. Permanent provisions shall be made for checking the accuracy of the meter. The meter shall be designed so that the cumulative amount of anti-strip additive can be accurately determined.

The anti-strip additive pipe line shall be insulated.

**(12) Scales.** All approved plant and truck scales shall be furnished by the Contractor according to Subsection 109.01(f).

**(c) Additional Requirements for Batch Plants.**

**(1) Hot Bins.** The plants shall include hot bins of sufficient capacity to supply the mixer when it is operating at full capacity. Hot Bins shall be divided into at least three compartments unless otherwise specified.

Each compartment shall be provided with an overflow pipe that shall be of such size and at such location as to prevent any backing up of material into other bins.

**(2) Proportioning Equipment.** Mineral aggregate shall be proportioned by weight.

The weighing unit shall consist of one hopper or weigh box large enough to hold one batch without running over or without requiring manual placement.

The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they will not be easily thrown out of alignment or adjustment.

The gate shall close tightly when the hopper is empty so that no material will be allowed to leak into a batch in the mixer during the process of weighing the next batch.

**(3) Scales.** Scales for weigh box or hopper shall be of the digital or springless dial type and shall be of standard make and design.

The capacity of the dial shall not exceed twice the full capacity of the mixer. The dials shall be of compounding type having full complements of index pointers. Scales shall be equipped with a tare beam.

Weight indicators shall be plainly visible and easily read by the operator.

Pointers so placed as to give excessive parallax errors shall not be used.

Scale indicators placed at locations other than the mixer platform shall be operated by a satisfactory electronic system. A mechanical arrangement such as cables and pulleys for operating the scale indicators will not be permitted.

Asphalt shall be measured by weight in a heated bucket suspended from a springless dial scale. Scales for weighing asphalt shall conform to the specifications for the scales for aggregate, and shall read to the nearest pound (kilogram).

In lieu of plant and truck scales, the Contractor may provide an approved automatic printer system that will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weight ticket for each load.

**(4) Mixer Unit.** The plant shall include a batch mixer of an approved twin pugmill type and capable of producing a uniform mixture within the job mix tolerances.

The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate. It shall lock the asphalt bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of asphalt material. The wet mixing period is the interval of time between the start of introduction of asphalt material and the opening of the mixer gate.

The time control shall be capable of being set at intervals of not more than 5 seconds.

**(d) Additional Requirements for Continuous Mixing Plants.**

**(1) Hot Bins.** If hot bins are included as part of the design of the plant, they shall be of sufficient capacity to supply the mixer when it is operating at full capacity. Hot Bins shall be divided into at least three compartments unless otherwise specified.

Each compartment shall be provided with an overflow pipe that shall be of such size and at such location as to prevent any backing up of material into other bins.

**(2) Mixer Unit.** The plant shall include a continuous mixer of an approved twin pugmill type or rotary drum mixer and capable of producing a uniform mixture within the job mix tolerances

Unless otherwise required, determination of mixing time shall be by weight method under the following formula:

$$\text{Mixing Time, seconds} = \frac{\text{Pugmill dead capacity, lb (kg)}}{\text{Pugmill output, lb (kg) per second}}$$

The weights shall be determined for the job by tests made by the Engineer.

**(e) Additional Requirements for Drum Mixer Plants.** The system shall provide a positive weight measurement of the cold aggregate feed by use of belt scales or other devices that will allow regulation of feed gates and permit correction for variations in load.

The asphalt feed control shall be interlocked with the total aggregate weight measuring device in such manner as to automatically vary the asphalt feed rate as required to maintain proper asphalt content in the mixture.

**(f) Additional Requirements for All Plants Without Screens. Cold Feed Control.** The cold feed control shall be considered acceptable when the results of tests conducted on these cold feed samples indicate that the individual aggregates have been combined within the allowable tolerances for the job mixture limits.

**(g) Additional Requirements for Batch Plants Without Screens.** The discharge into the weigh hopper shall be made from 1 bin only, which shall discharge into the center of the weigh hopper. The amount of material stored in the bin at any one time shall be such that sloughing or segregation is minimized.

**(h) Plant Inspection.** The Engineer shall have access to all parts of the plant.

The Contractor shall provide and maintain a laboratory facility for the exclusive use of the Engineer. This facility shall be located at the plant site. The dimensions and other requirements specified herein are minimums. The facility may be built by the Contractor for the specific purposes stated. It is not intended, however, to preclude the use of commercially built trailers or prefabricated buildings that may deviate in minor dimension or detail from the requirements listed but may in some features exceed these requirements and in all major respects be entirely suitable for the purpose intended. The Contractor may furnish, in lieu of a separate building, a facility having sufficient space in a building, parts of which are used for other purposes, provided that the facility furnished meets all other requirements of this subsection; is physically separated from the remainder of the building; and has an outside entrance with unrestricted access allowed and reserved for the exclusive use of the Engineer. Adequate space shall be provided for parking of at least three Department vehicles in the vicinity of the facility. The Engineer will determine the suitability of any facility furnished.

General requirements for the laboratory facility are:

- 208 square feet (20 sq m) floor space, with a width of 8' (2.5 m) or greater and a ceiling height of 7' (2 m).
- Floored, weatherproof, and reasonably dustproof.
- At least two glazed windows capable of being opened and locked only from the inside.
- At least one door with a substantial lock and all keys placed in the possession of the Engineer.
- Windows and doors shall be screened.
- Adequate electric lights and power outlets suitable for the purposes intended. At least one power outlet shall provide 220 VAC.
- Adequate heating in cold weather and air conditioning in hot weather. Heating, cooling, and utility service shall be provided at no cost to the Department.
- Suitable toilet facilities in reasonably close proximity to the facility.

## Detailed requirements:

- A work counter approximately 30" (750 mm) high built-in along one wall and across one end. Total length of the work counter shall be approximately 20' (6 m).
- A single sink, approximately 20" (500 mm) square, with outside drain, suitable for washing samples, installed in the end section of the work counter.
- A water supply providing a minimum of 50 gallons (200 liters) storage capacity (or connected to a public or private water system), discharging through a faucet above the sink.
- Adequate shelves and/or cabinets for storage of testing equipment.
- A storage area for storing nuclear equipment, complete with a substantial lock and all keys to this area placed in the possession of the Engineer.
- A desk or table approximately 24" x 36" (600 mm x 900 mm), with at least two drawers, each approximately 13" x 13" x 18" (330 mm x 330 mm x 450 mm) for storing records.
- At least three chairs.
- At least one Type C fire extinguisher (10-pound size minimum).
- An exhaust fan shall be installed over the equipment clean up area. The exhaust fan shall be rheostatically controlled and capable of exhausting in one minute a volume of air equal to the volume of the entire laboratory. The exhaust fan shall be maintained operational.
- A local access touchtone telephone line (with access to toll free telephone numbers but otherwise blocked for outgoing long distance calls), with a landline modular jack and touchtone telephone, shall be provided in the laboratory facility for use by Department personnel. The local landline telephone service will be furnished at no cost to the Department.

The field laboratory for asphalt mixing plants will not be paid for directly, but will be considered a part of the asphalt mixing plant.

**409.04 Equipment. (a) Mechanical Spreading and Finishing Equipment.** Mechanical spreading and finishing equipment shall consist of a self-powered paver, capable of spreading and finishing the mixture true to line, grade, and cross section. The paver shall be capable of laying a uniform mixture to the full width being laid.

The paver shall be equipped with mechanical devices such as equalizing runners, straightedge runners, evener arms, or other compensating devices to adjust the grade and confine the edges of the mixture to true lines. The paver shall be equipped with hoppers and distributing screws adequate to place the mixture evenly ahead of the screed for the full width being laid.

Pavers used for shoulders and similar construction shall be capable of uniformly spreading and finishing courses of asphalt material to the full width being laid. The paver shall be equipped with a receiving hopper and distribution system to place the mixture uniformly across the entire width of the screed.

The term "screed" shall include any strike-off device, operated by cutting, crowding, or other practical action that effectively places and spreads the mixture without tearing, shoving, gouging, or segregating. Screeds shall be adjustable to crown and grade and shall have an indicating level attached.

The paver shall be equipped with an automatic screed control system for the control of grade and slope. The sensor for grade control may be operated from a reference stringline, from a ski-type grade reference system, or by any other appropriate method that will produce the desired results.

Final approval of spreading and finishing equipment will be based upon satisfactory performance during actual construction. If equipment becomes unsatisfactory, it shall be replaced before proceeding with the work.

**(b) Materials Transfer Device (MTD) / Materials Transfer Vehicle (MTV).** A Materials Transfer Device or Materials Transfer Vehicle (MTD/MTV) shall be used on all State, US, and Interstate highways for the placement of all ACHM courses. ACHM quantities exempt from this requirement are projects or phases of work with less than 1000 tons of hot mix, leveling, parking lots, driveways and turnouts, temporary pavements (such as detours and crossovers), and ACHM placement in trench widening areas less than 11' (3.3 m) in width. At the Engineer's discretion, isolated

portions of a project may be exempted from use of the MTD/MTV if the weight or operation of the MTD/MTV is detrimental to the roadway. Exemptions will not be made prior to the beginning of paving operations and initial use of the MTD/MTV. The MTD/MTV may not be removed from the project during the paving operations over the exempted location; rather it must be on-site and available to resume work once the paving operation moves out of the isolated area.

The ACHM mixture shall be transferred mechanically to the paver by means of a MTD/MTV. The material shall be continuously remixed or rebled either internally in the transfer vehicle, in a paver hopper insert, or in the paver's hopper. Remixing/reblending shall be accomplished by the use of remixing augers, paddles or screens capable of continuously blending the hot mix asphalt.

The MTD/MTV, haul units, and paver shall work together to provide a continuous, uniform, segregation free flow of material. The number of haul units, speed of the paver, plant production rate, and speed of the MTD/MTV shall be coordinated to avoid stop and go operations. The wings of the paver receiving hopper shall not be raised (dumped) at any time during the paving operation.

If a MTD/MTV or remixing/reblending unit malfunctions during lay-down operations, the Contractor may continue hot mix lay-down operations until any hot mix asphalt in transit or stored in a silo (up to a maximum of 500 tons [500 metric tons]) has been laid and until such time as there is sufficient hot mix placed to maintain traffic in a safe manner. Lay-down operations shall cease thereafter, until such time as the equipment is operational.

The Engineer will evaluate the performance of the MTD/MTV and remixing/reblending equipment by measuring the temperature profile of the mat immediately behind the screed of the paver during placement of the rolling pattern test strip. The ACHM to be placed for the temperature profile test shall be held in the haul truck(s) for at least 45 minutes, measured from the time of loading to the time of discharging into the MTD/MTV. If the bed of the haul truck is covered, the cover will be removed once arriving at the test strip location. The temperature profile measurements shall be taken of the surface of the mat at six 50 ft. (13 m) intervals during test strip construction using a non-contact thermometer. Each temperature profile shall consist of three surface temperature measurements

taken transversely across the mat in a straight line at a distance of 1 foot to 3 feet (0.3 m to 1 m) from the screed while the paver is operating. The three temperature measurements in each profile shall be taken approximately one foot (0.3 m) from each edge and one in the middle of the mat. The difference between the maximum and minimum temperature of each individual profile shall not be more than 10°F (6° C).

If any two temperature measurement profiles within the test strip do not comply with the 10°F (6° C) temperature differential requirement, the paving operation shall be halted and adjustments made to the MTD/MTV or remixing/reblending equipment to ensure that the hot-mix placed by the paver is within the above temperature requirements. Once adjustments are made, the Engineer will repeat this procedure to verify that the mix placed by the paver is within specifications.

Additional surface temperature profile measurements may be taken transversely across the mat at any time during the project to determine if the MTD/MTV and remixing/reblending equipment are working properly. During this verification testing, if two consecutive temperature measurement profiles do not comply with the 10°F (6° C) temperature differential requirement, the paving operation shall be halted and adjustments made to the MTD/MTV or remixing/reblending equipment to ensure that the hot-mix placed by the paver is within the above temperature requirements.

(c) **Rollers.** Rollers shall be of the size and type to produce the density required and a surface that is smooth and free from check cracking. Rollers shall have a system for moistening the full width of each tire or drum and devices for cleaning the tires or drums. Petroleum products shall not be used on the surfaces of the roller that will be in contact with the pavement.

## **SECTION 410 CONSTRUCTION REQUIREMENTS AND ACCEPTANCE OF ASPHALT CONCRETE PLANT MIX COURSES**

**410.01 Description.** The methods employed in performing the work shall be at the Contractor's option. The plant and equipment shall comply with the requirements of Section 409. When the



production and/or placement of the material does not comply with the specifications, the Contractor shall make the changes necessary to bring the work into compliance.

**410.02 Pre-Placement Conference.** Unless waived by the Engineer, prior to the start of paving operations the Contractor shall conduct a Pre-Placement Conference involving the Contractor's personnel and the Department's personnel. The Contractor's proposed plant, delivery, laydown, compaction, and equipment shall be discussed and, if deemed necessary by the Department, all the equipment inspected. The accepted mix designs and materials to be used shall be discussed. The proposed mixing and compaction temperatures, sampling and testing plan, haul route, rolling pattern, and other pertinent information shall be discussed. The Pre-Placement Conference and all items discussed shall be documented by the Contractor and furnished to the Resident Engineer within ten calendar days after the Pre-Placement Conference.

**410.03 Preparation of Mixture.** The aggregates, mineral filler, and asphalt binder shall be measured separately and accurately mixed in the proper proportions according to the mix design. The aggregates shall be thoroughly coated and the mixture shall not show an excess or deficiency of asphalt binder, injury or damage due to burning or overheating, or an improper combination of aggregates. The continuous production of ACHM shall be within plus or minus 25° F (14° C) of the mixing temperature shown on the approved mix design. Momentary temperature spikes shall be kept to a minimum.

**410.04 Preparation of Subgrade.** Unless the course is to be placed on an existing base or pavement, the subgrade shall be prepared in conformity with the provisions of Section 212, and shall conform to the typical cross section as shown on the plans, and primed if specified. Additional material obtained from preparing the subgrade shall be bladed to the shoulders and evenly spread, with excess material being distributed evenly on the slopes.

**410.05 Preparation of Existing Base or Surface.** Newly constructed base or surface courses shall be prepared as set forth in the specification item covering such courses.

Before placing asphalt base, binder, or surface courses, all required corrections of the existing pavement or old base, such as filling pot holes, sags, ruts, and depressions, or alterations of the

existing pavement crown, shall be made. Such corrections shall be accomplished by placing asphalt binder or surface course mixtures at the location and in a manner as directed by the Engineer. Asphalt material used for wedging or leveling courses, or for filling holes, may be placed by hand, blade grader, or mechanical spreader methods. The mixture shall be featheredged to a smooth and even surface around the edges of these areas. Before placing asphalt material, the base or existing surface shall be primed or tacked as applicable.

Unless otherwise specified, no direct payment will be made for cleaning the surface of existing pavement.

Before arrival of the mixture on the work, the prepared surface, primed or tack coated as specified, shall be cleaned of all loose and foreign materials. The mixture shall not be placed on a surface that shows evidence of free moisture.

Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin coating of rapid curing cutback asphalt or emulsified asphalt. No direct compensation will be made for this work.

For foreign material, or when the time lapse between courses is more than 72 hours, the earlier course shall be cleaned and given a tack coat before placing the succeeding course. When directed, the tack coat shall be applied and paid for under Section 401. If directed by the Engineer, a tack coat shall be used even though the elapsed time has been less than 72 hours.

**410.06 Transporting.** The mixture shall be transported from the mixing plant to the work in vehicles with clean tight beds.

No loads shall be sent so late in the day as to interfere with spreading and compacting the mixture during daylight hours unless adequate artificial lighting is provided.

Sufficient haul vehicles and plant production rate shall be maintained for the project to provide a continuous operation on the roadway.

Only non-petroleum release agents listed on the QPL shall be used in haul trucks.

**410.07 Spreading and Finishing.** The mixture from all types of plants shall be delivered to the paver at no more than 25° F (14° C)

above the mixing temperature shown on the approved mix design. In no case shall binder or surface course be placed at a temperature less than 250° F (125° C).

The mixture shall be placed on an approved surface, spread, and struck off to the line, grade, and elevation established. The mixture shall be placed only on a base that shows no evidence of free moisture, and only when weather conditions are suitable. The Engineer may, however, permit work of this character to continue when overtaken by sudden rains to utilize materials that may be in transit from the plant at the time, provided the mixture is within the temperature limits specified and provided the finished pavement otherwise meets specification requirements. Water shall not be applied to the ACHM courses to speed cooling of the mat.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6" (150 mm), however, in general, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two lanes in width, or at lane lines if the roadway is more than two lanes in width. On roadways with a center turn lane, the Contractor may, at his option, elect to place a joint at the crown (i.e., middle of the center turn lane) of the roadway and eliminate the joints on the lane lines of that lane. The slight excess of asphalt at a longitudinal joint, generated by overlapping during placement of an adjacent mat to a previous mat, shall not be scattered across the mat. This material shall be stacked over the joint. The first pass of the steel wheel roller shall be entirely on the new mat, with the edge of the drum 6" (150 mm) away from the longitudinal joint. The second pass of the steel wheel roller shall be made with 6" to 8" (150 mm to 200 mm) of the drum overhanging onto the older mat.

General casting back of material or hand raking material onto the surface will not be permitted. Hand spreading will be permitted only in areas inaccessible to the paver.

On roads under traffic, the mixture shall be spread and finished in full lane widths where practicable. The paver shall alternate between the lanes with such frequency that the adjacent lane shall be laid no later than the next working day after the first lane is laid. A transition area from the new pavement down to the existing pavement will be constructed at the beginning and ending of each day's paving operation. The length of the transition will be based on the thickness of the ACHM course being placed:

Roadway Type	Short Term Temporary (In-place for less than 7 calendar days)	Temporary (In place for over 7 days)	Permanent
Interstates & divided highways with speed limits > 55 mph	4 ft. (1.2 m) length for each 1" (25 mm) of thickness	10 ft. (3.0 m) length for each 1" (25 mm) of thickness	100 ft. (30.5 m) length for each 1" (25 mm) of thickness
Other highways with speed limits ≤ 55 mph	3 ft. (0.9 m) length for each 1" (25 mm) of thickness	5 ft. (1.5 m) length for each 1" (25 mm) of thickness	50 ft. (15.2 m) length for each 1" (25 mm) of thickness

The paver shall uniformly distribute and compact the mixture in front of the screed for the full width being paved. The finished surface shall be smooth and of uniform texture.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

When laying mixtures, the paver shall be operated at forward speeds consistent with satisfactory laying of the mixture. The speed of the paver shall be matched with the plant production rate and number of hauling units. Stop and go operation of the paver shall be held to a minimum.

The edge of the Binder or Surface Course shall be established by a string or chalk line for a distance of not less than 500' (150 m) ahead of the spreading operation.

**410.08 Rolling and Density Requirements and Joints.** At the beginning of placement of each mix design, the Contractor shall establish an optimum rolling pattern for the mix being placed. A strip of approximately 500' (150 m) of the mat being placed shall be used to establish the rolling pattern. A sufficient number of coverages of the entire mat by the rollers proposed to be used by the

Contractor during production paving operations shall be made to achieve the maximum density possible. The Engineer will observe the Contractor's use of a nuclear density gauge to verify that the maximum densities possible are obtained.

The established rolling pattern shall be used for compacting all mix placed. If a change in the accepted mix design occurs, or if the compaction method or equipment is changed, or if unacceptable results are obtained, a new optimum rolling pattern shall be established.

If for any reason a rolling pattern cannot be established to produce the specified density, a new mix design will be required. The Contractor shall establish an optimum rolling pattern that will produce the maximum density using the new mix design. Continuous production of the mix shall not begin until an optimum rolling pattern that produces the specified density within the allowable range has been established.

Rolling shall start longitudinally at the low edge and proceed toward the higher portion of the mat. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Alternate passes of the roller shall be terminated at least 3' (1 m) from any preceding stop. Rolling on superelevated curves shall progress from the low side. Rollers shall not be stopped perpendicular to the centerline of the traveled way.

The speed of the roller shall be slow enough to avoid displacement of the hot mixture, and shall in no case be more than 3 mph (5 km/h). The roller shall be operated in such a manner that no displacement of the mat will occur. Rolling shall proceed continuously until all roller marks are eliminated and the required density attained. To prevent adhesion of the asphalt mixture to the rollers, the rollers shall be kept moist for the full width of the rollers, but an excess of water will not be permitted.

Upon completion of the rolling operations, the surface shall be smooth and of uniform texture.

If the asphalt binder content varies from the value used to calculate the specific gravity, the maximum theoretical density will be adjusted accordingly. If the Contractor elects to verify the specific gravity or to establish a different specific gravity, he shall perform the test under AASHTO T 209 on production mix and

furnish the results to the Engineer. The Contractor and the Engineer will use the specific gravity that best represents the material that is being sampled for acceptance of the pavement. If either quality control or acceptance density tests indicate that the established maximum theoretical density may be in error, the Engineer may require that the specific gravity be redetermined from production mix. If production has been interrupted for 90 calendar days or the mix design has changed a new maximum theoretical density shall be established.

Rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. A brush coat of asphalt material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously placed material.

**410.09 Acceptance of the Pavement and Adjustments in Payment. (a) General.** The accepted mix design shall be verified by the Contractor at the start of mix production for that design or after an interruption of more than 90 calendar days. A maximum of 200 tons (200 metric tons) of material may be placed on the roadway during the verification process. If the mix produced does not verify the mix design, the material placed on the roadway shall be declared a partial lot and a new mix design submitted. Verification shall consist of test results showing that the values for air voids, VMA, and asphalt binder content are within the compliance limits. If necessary, adjustments will be made to the plant to produce mix within the specified property limits. All mixes produced shall be within the gradation tolerances of the accepted mix design according to Section 404.04. The adjusted mix shall become the new accepted mix design.

Acceptance and adjustment in payment will be by lot. The standard lot size for acceptance and adjustment in payment will be 3000 tons (3000 metric tons), with each standard lot divided into four sublots of 750 tons (750 metric tons) each. The Engineer may establish a partial lot at any time. The Engineer will determine the size of any partial lots established and the number and size(s) of the sublots, if any. Although there are no specified limits for the size of such partial lots, they normally will be not less than 300 tons (300 metric tons) nor more than 3300 tons (3300 metric tons). Field density tests shall be performed on the compacted mat on the

roadway as soon as possible, preferably not later than the day after placement.

The Contractor shall obtain and test one sample taken at random from each subplot. The Department will determine the location for each sample in the subplot by AHTD Test Method 465. The Department's inspector shall be provided an opportunity to witness all Contractor sampling and testing. The test reports of all Contractor acceptance tests shall be provided to the Engineer by the end of the first working day following production of the material.

The Department will obtain and test a minimum of one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. Verification testing will be conducted in accordance with Subsection 106.11 and the Department's *Manual of Field Sampling and Testing Procedures*. The location of the lot sample will be determined by the Department using AHTD Test Method 465. If core samples are used for field density testing, they shall be obtained by the Contractor at locations selected by the Engineer and at no cost to the Department. The samples shall be obtained using a diamond blade pavement saw or a diamond bit core drill to remove a sample of compacted pavement for the full depth of the course(s). The holes made in taking the sample shall be repaired by the Contractor at no cost to the Department.

The following procedures shall apply for field density testing when ACHM mixes are used as a leveling course or as a bond breaker between a base material and Portland Cement Concrete Pavement:

- If the entire subplot quantity is placed for leveling or as a bond breaker and the thickness of all of the leveling/bond breaker in that subplot is less than three times the nominal maximum aggregate size, no field density sample or test will be required. The subplot will be excluded from the calculation of the average field density for the acceptance of the lot in Subsection 410.09(a).
- If the entire subplot quantity is placed for leveling or as a bond breaker and portions of the leveling/bond breaker have a thickness greater than three times the nominal maximum aggregate size, a field density sample shall be obtained by the Contractor at a location determined by the Department using AHTD Test Method 465; however the sampling area will be

restricted to the area in which the thickness of the leveling course/bond breaker is greater than three times the nominal maximum aggregate size.

- If only a portion of the subplot quantity is placed for leveling or as a bond breaker, the Contractor shall obtain a field density sample at a location determined by the Department using AHTD Test Method 465; however the sampling area will be restricted to the portion of the subplot where the material used as leveling or as a bond breaker has a thickness greater than three times the nominal aggregate size and to the area where the material was not used for leveling or as a bond breaker.

When field density testing for a subplot is waived by one of the above conditions, the ACHM mix used as a leveling course or as a bond breaker shall be compacted utilizing the optimum rolling pattern to achieve the maximum density required, as required by Subsection 410.08.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

The Department will perform all tests for acceptance and adjustment in payment on material used to replace unacceptable material removed by the Contractor. The number of tests and the location(s) for sampling will be determined by the Engineer using the same procedures used for the original material. The results of these tests will be used for acceptance and adjustment in payment for the lot or subplot, as applicable.

Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. All sampling and testing for acceptance and adjustment in payment shall be performed using the test methods specified in Subsection 404.04 for quality control



sampling and testing. This includes performing a maximum theoretical specific gravity test (AASHTO T 209) for each acceptance and adjustment in payment test. The VMA (effective) as determined by the effective specific gravity shall be calculated. The VMA (actual) shall be determined by reducing the VMA (effective) by the correction factor shown on the mix design. Samples for all properties except density and the investigation of segregation shall be obtained from trucks at the plant. Samples shall be maintained at or near the optimum mixing temperature until the testing procedure begins. Specimens for air voids shall be compacted at or near the optimum compaction temperature. In no case shall the sample be allowed to cool below the compaction range specified by the accepted mix design.

**(b) Acceptance of the Pavement.** Acceptance of ACHM courses will be based on the following criteria:

- The results of tests for the properties listed in Table 410-1,
- Pavement smoothness, and
- Segregation.

**(1) Properties in Table 410-1.** Acceptance with respect to the properties listed in Table 410-1 will be by lot. Acceptance of a standard lot will be based on the average of the five (5) tests performed on the lot. Acceptance of a partial lot will be based on the average of the actual number of tests made on that partial lot. Acceptance of a subplot will be based on the results of the test(s) performed on samples from that subplot.

The term "mix design value" refers to the value shown in the accepted mix design.

When the average of the test results for a lot fall within the range shown in Table 410-1 as "Compliance Limits", the lot will be accepted with no price reduction for those properties. If the average of the test results for a lot for any single property listed in the table falls within the limits shown as "Price Reduction Limits", the material may be left in place at a reduced price as specified in Subsection 410.09(d). If the average of the test results for a lot for any single property listed in the table falls outside the limits shown as "Lot Rejection Limits", the entire lot shall be removed and replaced at no cost to the Department. Sampling and testing of the replacement material will be according to Subsection 410.09(a).

For any single property except density, if the result of the single test in a subplot falls outside the limits shown as "Sublot Rejection Limits", that subplot shall be removed and replaced at no cost to the Department. In the subplot containing the Department's lot test, if the result of either the Contractor's subplot test or the Department's lot test fall outside the subplot rejection limits, the two tests will be averaged and the average of the two test results used to determine acceptance or rejection of the subplot. The average of the two test results will also be used as a single value to compute the average for the lot for acceptance and adjustment.

For density, if a test for a subplot is more than 2.0 percentage points above or below the specification limits for the type of mix, that subplot will be further evaluated as follows:

Two additional density tests will be performed by the Department on a statistically random basis within that subplot, except that only one additional test will be performed if the subplot contains both a Contractor subplot test and a Department lot test. If the average of the three tests is within 2.0 percentage points above or below the compliance limits, the subplot will be accepted. The average of the three test results will be used as a single value to compute the average for acceptance and adjustment of the lot.

If the average is outside the subplot rejection limits, the subplot shall be removed and replaced at no cost to the Department. In that case, the result of a density test performed on the replacement material will be used to calculate the average for acceptance and adjustment of the lot.

**(2) Pavement Smoothness.** The finished surface, when checked with a 10' (3 m) straight-edge parallel to the centerline, shall show no variation more than 3/16" (5 mm) for binder courses and not more than 1/8" (3 mm) for surface courses when the profile grade line is shown on the plans. If the profile grade line is not shown on the plans, the variations shall be not more than 1/4" (6 mm) for binder courses and not more than 3/16" (5 mm) for surface courses. When surface tests indicate surface tolerances do not meet these requirements, corrections to the pavement and changes to the paving operations shall be made before beginning the next day's operations.

All transverse joints shall be straightedged immediately following rolling of the joint. Paving will not continue until the transverse joint meets the applicable surface tolerances shown above.

The Engineer will test the finished surface of each course on main lanes and ramps with a rolling straightedge immediately following the final rolling as conditions permit. All testing will be made in a longitudinal direction and at least one pass shall be made for the full length of each lane.

Areas not meeting the above surface test requirements for all except the final surface course may be corrected by skin patching, featheredging, or other methods that would provide the required smoothness.

Areas not meeting the above surface test requirements for the final surface course shall be corrected in such a manner as to maintain a quality pavement having the same uniform texture and appearance as the adjoining surface. Skin patching will not be permitted. Featheredging will be permitted only at the beginning and the end of the job. When the corrective action involves removing and replacing a section of the final surface, the minimum area to be removed shall be 50 linear feet (15 m) of length for the full width of the course placed. Replacement of the final surface shall be accomplished using a paver.

Grinding will be allowed, if necessary, to correct surface tolerance deficiencies. The grinding equipment shall be power driven and specifically designed to smooth and uniformly texture the pavement by means of diamond blades.

All corrective work and material necessary to correct surface tolerance deficiencies for binder or surface courses shall be at no cost to the Department.

**(3) Segregation.** Segregation in asphalt concrete hot mix paving is the non-uniform distribution of aggregate that results in non-uniform surface texture. If a pattern of segregation develops, or if segregation occurs over a large area (3 square yards [3 sq m] or more), paving shall cease until the problem has been corrected.

**TABLE 410-1  
COMPLIANCE, PRICE REDUCTION AND REJECTION LIMITS FOR ACHM COURSES**

<b>Property</b>	<b>Compliance Limits</b>	<b>Price Reduction Limits</b>	<b>Lot Rejection Limits</b>	<b>Sublot Rejection Limits</b>
Asphalt Binder Content (ALL MIXES)	±0.3 from mix design value	more than ±0.3, to ±0.6 from mix design value	more than ±0.6 from mix design value	±0.8 from mix design value
Air Voids (AV) (ALL MIXES)	3.0% to 5.0%	2.5% to 3.0% 5.0% to 5.5%	2.4% or less; 5.6% or more	1.9% or less; 6.1% or more
Voids in Mineral Aggregate (VMA)*				
ACHM Base Course (1 ½" [37.5 mm])	11.0% to 13.0%	10.5% to 10.9%; 13.1% to 13.5%	10.4% or less; 13.6% or more	9.9% or less; 14.1% or more
ACHM Binder Course (1" [25 mm])	12.0% to 14.0%	11.5% to 11.9%; 14.1% to 14.5%	11.4% or less; 14.6% or more	10.9% or less; 15.1% or more
ACHM Surface Course (1/2" [12.5 mm])	13.5% to 16.0%	13.0% to 13.4%; 16.1% to 16.5%	12.9% or less; 16.6% or more	12.4% or less; 17.1% or more
ACHM Surface Course (3/8" [9.5 mm])	14.5% to 17.0%	14.0% to 14.4%; 17.1% to 17.5%	13.9% or less; 17.6% or more	13.4% or less; 18.1% or more
Density (% of theoretical) BASES, BINDER, AND SURFACES	92.0% to 96.0%	91.0% to 91.9%; 96.1% to 97.0%	90.9% or less 97.1% or more	89.9% or less** 98.1% or more
Density (% of theoretical) for ACHM Courses where minimum specified is 90.0%	90.0% to 96.0%	89.0% to 89.9% 96.1% to 97.0%	88.9% or less 97.1% or more	87.9% or less**; 98.1% or more

\* The values for VMA(actual) shall be determined by calculating the VMA(effective) and reducing it by the correction factor shown on the mix design.

\*\*Subject to further evaluation, see text.

Visual inspection of the compacted pavement will be made to determine the extent of any segregation. In addition to the visual inspection, objectionable areas may be tested. Samples will be obtained from the areas identified as objectionable by the Engineer. Gradation, density, and asphalt binder content of the samples will be determined according to the test methods in Section 404.04. The test values obtained shall be within the tolerances for gradation in Section 404.04 and within the compliance limits for asphalt binder content and density in Section 410. If any of the test results do not meet the requirements, the area/areas will be considered non-complying. If the non-complying material is deemed reasonably acceptable according to Subsection 105.04, it may be left in place at a reduced cost to the Department.

In the event the material is found unacceptable relative to segregation and it is determined that the material must be removed, the area(s) of segregation shall be removed full depth of the course paved. Replacement of the material by dumping and spreading by hand or motor grader will be permitted on base and binder courses for areas less than 50 linear feet (15 m) in length. Replacement of larger areas of base and binder and replacement of any surface course will be accomplished with a paver. On surface course, the minimum area to be removed shall be 50 linear feet (15 m) of the full width of the mat paved.

(4) Pavement that is determined to be non-complying for any reason other than the properties listed in Table 410-1 will be evaluated under Subsection 105.04. The Engineer will determine whether the non-complying pavement must be corrected, removed and replaced, or may be left in place at a reduced cost to the Department. Price reductions determined under Subsection 105.04 will be in addition to the price reductions, if any, determined under Subsection 410.09(d). If the total price reduction is determined to be greater than 50% for any lot, that lot will not be accepted. When two consecutive lots or any three out of five lots fail to qualify for full payment for any reason, work will be stopped until corrective action is taken.

**(c) Unacceptable Pavement.** Any lot or subplot of any ACHM course that is not accepted for any reason shall be removed and replaced by the Contractor at no cost to the Department. Payment for sections where removal and replacement is required will be

withheld or recovered, and released after replacement has been acceptably completed. The quantity for payment will be the original quantity and measurement of the quantity used in replacement operations will not be considered.

**(d) Adjustments.** Adjustments will be made by reducing the contract price of the lot according to the schedules below. Price reductions will be computed from the schedules below for each property, and reductions for each property added together to obtain the total price reduction for the lot. The total price reduction will be applied to all components of the course for the entire quantity of the lot. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction. When the number of deviations for any property shown exceeds the maximum specified, or when the total price reduction for a lot is greater than 50%, that lot will not be accepted. Continuous production of material not qualifying for full payment will not be allowed.

**(1)** For Asphalt Binder Content, the contract price of the entire lot will be reduced by 12% for each deviation outside the compliance limits, up to a maximum of 3 deviations. One deviation is 0.1 percentage point.

**(2)** For Air Voids, the contract price of the entire lot will be reduced by 10% for each deviation outside the compliance limits, up to a maximum of 5 deviations. One deviation is 0.1 percentage point.

**(3)** For VMA, the contract price of the entire lot will be reduced by 10% for each deviation outside the compliance limits, up to a maximum of 5 deviations. One deviation is 0.1 percentage point.

**(4)** For Density, the contract price of the entire lot will be reduced by 4% for each deviation outside the compliance limits up to a maximum of 10 deviations. One deviation is 0.1 percentage point.

**410.10 Incentives.** It is the intent of this specification to produce a pavement that is durable and consistently exceeds the minimum test values established in these specifications. To that end, incentives will be included in the pay schedule for ACHM Binder Course and/or ACHM Surface Course. Incentive pay will be according to the following guidelines.

When the entire quantity of either the ACHM Binder Course or ACHM Surface Course (including any sublots used for leveling) meets the following criteria, an incentive of the percentage designated will be applied to the dollar amount for all the components of the designated mix. For the purpose of incentives, the only tests to be considered shall be the average test results for each lot. Incentive payments will be accomplished by Change Order and will be shown on the final estimate as a separate item increase. An accumulated maximum 6.0% incentive payment is available as follows:

(a) An incentive payment of 3.0% will be added if:

- the asphalt binder content is within  $\pm 0.2$  percentage point of the mix design value, and
- the total variation, low to high, in air voids is no more than 0.6%, with none outside of the compliance limits, and
- all densities fall between 92.0%\* and 96.0%, and
- there are no areas of segregation outside of the compliance limits as verified by testing according to Subsection 410.09(b)(3)

\*When the minimum specification density is 90.0%, this value is changed to 90.0%.

(b) An additional incentive payment of 2.0% will be added if the requirements of (a) above are met and if the VMA are within the compliance limits.

(c) If the Contractor elects, an additional incentive payment of 1.0% of the total ACHM Surface Course quantities used on the project will be added if:

- the pavement smoothness incentive criteria are met, and
- there are no corrective patches\*, and
- the requirements of both (a) and (b) above are met.

\*Note: Any repaved section of 1000' (300 m) or greater in length for a full lane width will not be considered a patch.

To achieve the smoothness incentive payment, the Contractor shall furnish and operate a California-style profilograph meeting the specifications of ASTM E 1274 or an automated lightweight profilometer complying with ASTM E 950, Class I and calibrated to the California-style profilograph scale, and:

(1) The finished surface shall have a maximum profile index of 3"/mile ( $\pm 0.1$ " blanking band) per 0.1 mile section (50 mm/km [ $\pm 2.5$  mm blanking band] per 200 m section), or portion thereof, for the entire project. Individual sections will not be considered for the incentive.

In addition to the above requirements for profile indices, on the final surface course, no areas representing high or low points having a deviation greater than 0.3" in 25' (7.5 mm in 7.5 m) as determined by the profilograph shall be present.

(2) The Contractor shall take all profiles required by this subsection under the observation of the Engineer. All data obtained from the profiling operations will be furnished to the Engineer to be considered for any incentive payment.

The Engineer will verify the calibration of the profilograph equipment as frequently as necessary to assure proper operation.

The profile will be taken near the center of each main traffic lane using a California-style profilograph or lightweight profilometer. For daily operations, the profile shall begin 10' (3.25 m) back onto the previous day's run and shall be continuous to within 10' (3.25 m) of an existing structure or existing pavement, or the end of the pavement. The profile may also be determined upon completion of the project by a trace that shall run continuously to within 10' (3.25 m) of an existing structure or existing pavement, or the end of the pavement. In either case, the incentive payment will be determined at the completion of the project and when all profile traces have been submitted to the Engineer for the project files.

Scheduling and testing will be coordinated with the Engineer. The Contractor shall provide all traffic control associated with the surface testing operations.

**410.11 Widening and Overlay Operations.** When pavement construction results in vertical differentials at the lane lines or at the edge of the traveled lanes, the Contractor shall comply with the requirements of Subsection 603.02(d).

When asphalt hot mix material is to be placed in a trench for widening an existing pavement and the trench is inaccessible to normal rolling operations, compaction both of the subgrade and of



the asphalt material shall be accomplished by means of a trench roller or by other approved methods.

**410.12 Seasonal and Temperature Limitations.** Hot mix asphalt materials shall not be mixed or placed when the surface temperature is below 40° F (5° C), or when there is frost in the base or subgrade, or at any other time when weather conditions are unsuitable for the type of material being placed.

Placement of ACHM Base Course and ACHM Binder Course shall be scheduled to minimize exposure to inclement weather. The amount of ACHM Base and/or Binder exposed at any time between December 1 and March 14 shall be limited to the area that can be covered with binder and/or surface course in one (1) day's normal production. Placing additional ACHM Base or Binder will not be allowed until the exposed course has been covered with binder and/or surface course. The succeeding course shall be placed as soon as weather and ground conditions allow.

## SECTION 411

### ASPHALT CONCRETE COLD PLANT MIX

**411.01 Description.** This item shall consist of an asphalt concrete cold plant mix, composed of a mixture of mineral aggregate and asphalt, according to these specifications.

**411.02 Materials.** The asphalt concrete cold plant mix shall be furnished from sources listed on the Department's Qualified Products List. Materials used in the mix shall conform to the following:

(a) **Asphalt.** The Engineer will specify the type and grade of asphalt to be used.

The asphalt shall be an MC-250, MC-800, MC-3000, a, or an inverted emulsion type asphalt.

Medium curing asphalt shall comply with the requirements of Subsection 403.03.

Inverted emulsion type asphalt shall comply with the following requirements:

<b>Inverted Emulsions</b>		
<b>Characteristics</b>	<b>Minimum</b>	<b>Maximum</b>
-Flash Point, Tag Open Cup °F	200	-
-Viscosity (SF), sec at 140°F (AASHTO T 59)	100	-
-Stone Coating <sup>A</sup>		
Coating, %	90	-
Asphalt Run-off, %	-	0
-Test on Residue from Distillation 500°F (AASHTO T59) Residue		
by Distillation, % by Mass	80	-
Oil distillate, % by Volume	2	-
-Test on Residue from Cutback Distillation (AASHTO T 78)		
Absolute Viscosity, P (AASHTO T 202)		
	30	800
Solubility, % (AASHTO T44)	97.5	-

**A-Stone Coating Test (at 140°F)**

Weigh 200 grams of dry aggregate (at the gradation of the mix design) into a beaker.

Weigh 4 grams of distilled water into the beaker containing the dry aggregate and mix for 30 seconds.

Dose dry aggregate with inverted emulsion at optimum AC% and add to the beaker containing the damp aggregate and mix vigorously for 120 seconds.

Dump contents in beaker onto a metal pan or suitable surface and visually check coating of aggregate. There shall be no evidence of asphalt run-off.

**(b) Mineral Aggregate.** Mineral aggregate shall conform to the requirements of Section 409.

**411.03 Mix Design.** The Contractor shall furnish a mix design performed by an asphalt design laboratory shown on the Department's QPL. The design will be performed in accordance with Section 404, AHTD Test Method 470 and the requirements of Table 411-1.

**TABLE 411-1**  
**DESIGN REQUIREMENTS FOR ASPHALT CONCRETE**  
**COLD PLANT MIX**

SIEVE, mm	PERCENT PASSING	MAXIMUM MIX TOLERANCE (%)
½" (12.5)	100	
#4 (4.75)	60-80	±7
#8 (2.36)	43-63	±5
#50 (0.300)	15-28	±4
#200 (0.075)	4-10	±2
Asphalt Binder		
Content	3.5%-6.5%	±0.4

**411.04 Production Methods.** The methods used in producing the mix and the equipment and plant machinery used shall be subject to the approval of the Engineer and shall conform, insofar as practicable, to the requirements of Section 409.

**(a) Preparation of Asphalt.** Medium curing cut-back shall be heated to a temperature not exceeding 250° F (120° C). Seasonal type asphalt shall be heated to a temperature not exceeding 175° F (80° C).

**(b) Preparation of Mineral Aggregate.** The coarse and fine aggregate shall be dried and heated at the mixing plant so that when delivered to the mixer, it shall be at as low a temperature as is consistent with proper mixing and in no case shall exceed 250° F (120° C) when using a medium curing cut-back or 175° F (80° C) when using a seasonal type asphalt.

**(c) Preparation of Mixture.** Mixture preparation shall conform to the applicable portions of Subsection 410.03.

**411.05 Quality Control and Acceptance.** **(a) Quality Control.** All acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall perform all quality control sampling and testing in accordance with Subsection 404.04 except that the only properties determined shall be for gradation and asphalt content. Either one of the following two

methods shall be used for determination of gradation and asphalt content compliance:

- Asphalt content determined by extraction tests (AHTD 450) and sieve analysis (AASHTO T 30) of the extracted aggregate; or
- Asphalt content determined by a nuclear asphalt content gauge (AHTD 449/449A) and the sieve analysis (AASHTO T 30) of the aggregate sample obtained by washing (AHTD 460).

The Contractor shall provide an opportunity for the Engineer to observe all sampling and testing (including those for acceptance), provide an opportunity to review all test results, and shall furnish a building with facilities for the use of the Department's inspector according to Subsection 409.03(h).

**(b) Acceptance.** All acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The accepted mix design shall be field verified by the Contractor at the start of mix production or after an interruption of more than 90 calendar days. Verification shall consist of test results showing that the values for gradation and asphalt content are within the tolerances shown on the mix design.

Acceptance and adjustment will be in accordance with Subsection 410.09(a) except that there will be no sublots and the standard lot size will be 750 tons (750 metric tons). The Department will only perform verification testing as needed and acceptance and adjustment will be based on the Contractor's test results. All sampling and testing for acceptance and adjustment shall be performed using the test methods specified in Subsection 411.05(a) for quality control sampling and testing. Acceptance will be based on the adherence to the gradation and asphalt content tolerances as shown on job mix design.

When the results of either the quality control or acceptance tests indicate the mixture is outside the specified tolerances, further evaluation of the mixture will be made to determine its acceptability.

**411.06 Construction Requirements.** Construction methods in addition to the general requirements of these specifications shall conform, insofar as applicable, to Section 410.

**411.07 Method of Measurement.** Asphalt Concrete Cold Plant Mix will be measured by the ton (metric ton) of mix.

When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weight will be used in lieu of truck scale weights.

**411.08 Basis of Payment.** Work completed and accepted and measured as provided above, will be paid for at the unit price bid per ton (metric ton) for Asphalt Concrete Cold Plant Mix, which price shall be full compensation for furnishing materials; for heating and mixing; for furnishing acceptable mix designs; for performing quality control and acceptance sampling and testing; for hauling, stockpiling, placing, rolling, and finishing, as applicable; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Asphalt Concrete Cold Plant Mix	Ton (Metric Ton)

## SECTION 412 COLD MILLING ASPHALT PAVEMENT

**412.01 Description.** This item shall consist of cold milling the asphalt pavement at the location(s) designated on the plans or by the Engineer and removing the resulting material from the highway right-of-way. Unless otherwise provided, the reclaimed pavement shall become the property of the Contractor. The pavement remaining after milling shall provide a surface suitable for maintaining traffic.

**412.02 Equipment.** The Contractor shall provide self-propelled equipment with sufficient power, traction, and stability to maintain an accurate depth of cut and slope. The equipment shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing from the existing pavement by means of a ski or matching shoe or from an independent grade control and shall have an automatic system for controlling cross

slope at a given rate. The milling machine shall have an effective means for preventing dust resulting from the operation from escaping into the air.

Provision shall be made, either integrally with the milling machine or by the use of additional equipment, to remove the material being cut from the surface of the roadway.

**412.03 Construction Requirements.** The existing pavement shall be cold milled to the depth shown on the plans. The number of passes and the depth of each pass required to obtain the total depth to be removed will be determined by the Contractor, unless specified in the plans. The transverse joint left at the end of each day's run shall be tapered to provide a smooth ride. When cold milling asphalt pavement results in vertical differentials at the lane lines or at the edge of the traveled lanes, the Contractor shall comply with the requirements of Subsection 603.02(d). At the end of a day's run, vertical differentials will only be permitted at the centerline or lane lines. The equipment shall be operated at a rate of travel that will provide a surface meeting the applicable surface requirements.

**412.04 Method of Measurement.** Cold Milling Asphalt Pavement will be measured by the square yard (square meter) of pavement milled to the depth specified.

**412.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Cold Milling Asphalt Pavement, which price shall be full compensation for all work as prescribed herein, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Cold Milling Asphalt Pavement	Square Yard (Square Meter)

**SECTION 413 VACANT**

**SECTION 414**  
**ASPHALT CONCRETE PATCHING FOR**  
**MAINTENANCE OF TRAFFIC**

**414.01 Description.** This item shall consist of an asphalt concrete material composed of mineral aggregate and asphalt binder for use in patching to maintain traffic.

**414.02 Materials and Composition.** Materials and equipment shall conform to the requirements of ACHM Surface Course, Section 407, or Asphalt Concrete Cold Plant Mix, Section 411.

**414.03 Construction Requirements.** Construction requirements shall conform, insofar as possible, to Section 415.

**414.04 Method of Measurement.** Asphalt Concrete Patching for Maintenance of Traffic will be measured by the ton (metric ton) of mix.

**414.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Concrete Patching for Maintenance of Traffic, which price shall be full compensation for furnishing materials; for heating, mixing, hauling, placing, and compacting; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Asphalt Concrete Patching for Maintenance of Traffic	Ton (Metric Ton)

**SECTION 415**  
**ASPHALT CONCRETE HOT MIX PATCHING OF**  
**EXISTING ROADWAY**

**415.01 Description.** This item shall consist of patching the existing roadway using an asphalt concrete material composed of mineral aggregate and asphalt binder.

**415.02 Materials and Composition.** Materials shall conform to the requirements of Section 401, Tack Coat and Section 406, ACHM Binder Course or Section 407, ACHM Surface Course.

**415.03 Construction Requirements.** Unstable areas in existing roadways and shoulders, designated by the Engineer to be repaired, shall be removed to provide firm vertical sides and a firm, stable, bottom generally parallel with the existing surface. All loose or foreign material shall be removed from the hole.

A tack coat of emulsified asphalt shall be applied to the sides of the hole. Asphalt Concrete Hot Mix Binder or Surface Course shall be placed in the hole in uniform layers, not to exceed 4" (100 mm) loose measurement. Compaction, satisfactory to the Engineer, shall be accomplished with a mechanical tamper or other approved methods. The finished surface shall be smooth and level with the surrounding surface.

**415.04 Method of Measurement.** Asphalt Concrete Hot Mix Patching of Existing Roadway will be measured by the ton (metric ton) of mix.

**415.05 Basis of Payment.** Work completed and accepted and measured as provided above, will be paid for at the contract unit price bid per ton (metric ton) for ACHM Patching of Existing Roadway, which price shall be full compensation for excavation of the existing roadway; for removal and disposal of excavated material; for compacting and tacking the excavated area; for furnishing materials; for heating, mixing, hauling, placing, and compacting the materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
ACHM Patching of Existing Roadway	Ton (Metric Ton)

**SECTION 416  
RECYCLED ASPHALT PAVEMENT**

**416.01 Description.** This item shall consist of an asphalt concrete base, binder, or surface course mixed at a central plant and constructed on the completed and approved subgrade, base, or surface course in conformance with the lines, grades, and dimensions shown on the plans, and according to the provisions of these specifications.



Unless otherwise provided, these provisions allow the Contractor to utilize recycling of reclaimed asphalt pavement material in any type mixture specified in Sections 405, 406, 407, and 417. The recycled mixture shall meet all of the requirements of the mixture type specified on the plans.

**416.02 Materials and Equipment.** Materials and equipment shall meet the requirements of Section 409 except as modified herein.

**416.03 Materials and Composition.** If the Contractor elects to use reclaimed asphalt pavement in the job mixture, the mixture shall contain a minimum of 70% virgin material. The grade of asphalt will be determined at the mix design stage. An approved softening agent may be required in conjunction with a new asphalt. The softening agent with accompanying specifications shall be submitted and approved prior to use. The Contractor shall supply a temperature viscosity curve for the blend of reclaimed and virgin asphalts. A temperature viscosity curve will not be required for the blend of virgin and Recycled Asphalt Pavement (RAP) material when the binder used is a PG 64-22 grade and the design incorporates less than 15% RAP. Overall blend angularity will be determined by extracting the aggregate from the RAP material and combining the extracted aggregate with the virgin mineral aggregate.

The design and quality control of Reclaimed Asphalt Pavement mix shall be according to the provisions of Section 404.

The acceptance of a reclaimed pavement stockpile for recycling will be determined on the uniformity of the stockpiled material, the results of tests on the reclaimed material, and the satisfactory design of a mixture meeting all the specification requirements. When significant differences in the properties of reclaimed pavements exist, separate stockpiles shall be required.

The maximum size of the reclaimed material shall be 3" (75 mm) when introduced into the mixer.

**416.04 Equipment.** The equipment used in this construction shall conform to Section 409. When the recycling process is utilized, a central mixing plant complying with Section 409 and modified to process recycled material shall be used. The plant modifications shall be according to the manufacturer's recommendations. The plant used shall be designed, equipped, and operated in such a manner that will comply with Section 409.

**416.05 Construction Requirements.** Construction requirements shall comply with Section 410.

**416.06 Method of Measurement and Basis of Payment.** Method of Measurement and Basis of Payment shall be according to Sections 405, 406, 407, or 417, as applicable. If the Contractor elects to use reclaimed material in the mix, the percentages of asphalt binder and mineral aggregate to be paid for will be determined from the accepted mix design. The residual asphalt in the reclaimed material will be paid for at the contract unit price bid for Asphalt Binder in ACHM. The mineral aggregate in the reclaimed material will be paid for at the contract unit price bid for Mineral Aggregate in ACHM.

Softening agent will not be measured for payment, but will be considered included in the contract unit prices bid for the other items in the mix.

## **SECTION 417 OPEN GRADED ASPHALT BASE COURSE**

**417.01 Description.** This item shall consist of a base course composed of a consolidated mixture of crushed stone and asphalt binder and shall be constructed on the existing pavement according to these specifications and in substantial conformity with the lines, grades, and typical cross sections shown on the plans.

**417.02 General.** The base course shall be composed of a mixture of mineral aggregate and asphalt proportioned to meet the requirements for design of Open Graded Asphalt Base Course mixtures as shown in Table 417-1.

**TABLE 417-1**

<b>REQUIREMENTS FOR OPEN GRADED ASPHALT BASE COURSE</b>				
<b>Sieve, (mm)</b>	<b>Percent Passing</b>			
	<b>Type 1</b>	<b>Type 2</b>	<b>Type 3</b>	<b>Type 4</b>
3" (75.0)	100	--	--	--
2½" (63.0)	95-100	--	--	--
2" (50.0)	--	100	--	--
1½" (37.5)	30-70 [±7]	75-90 [±7]	--	--
1" (25.0)	--	--	--	100
¾" (19.0)	0-15 [±7]	50-70 [±7]	100	90-100
½" (12.5)	--	--	90-100	--
⅜" (9.5)	0-2	--	--	20-55 [± 5]
#4 (4.75)	--	8-20 [± 5]	0-15 [± 5]	0-10
#8 (2.36)	--	--	0-3	0-5
#100 (0.150)	--	0-5	--	
<b>Asphalt Content</b>	1.5 - 4.0	1.5 - 4.0	1.5 - 4.0	2.5 - 3.0

NOTE: The number in brackets is the allowable tolerance from the mix design value.

The design of Open Graded Asphalt Base Course Types 1, 2, 3, and 4 shall be according to AHTD Test Method 481. The mix design shall be performed by the Department.

The mix design for Type 4 shall include an effective asphalt content, as determined by AHTD Test Method 481, within the range of 2.5%-3.0% by weight of total mix.

**417.03 Materials.** The materials and equipment used in this construction, in addition to the general requirements of these specifications, shall conform to the provisions of Section 409.

**417.04 Equipment.** The equipment used shall conform to the requirements of Section 409, except as amended herein.

**417.05 Construction Requirements.** Construction requirements shall conform to the requirements of Section 410, except that Subsection 410.03 is amended to include the requirements of Subsection 417.05(a), that the temperature requirements of 410.07 are amended as per Subsection 417.05(b), and that 410.08 is deleted.

**(a) Preparation of Mixture.** The temperature of the aggregate before adding the asphalt binder shall be not less than 275° F (135° C) nor more than 325° F (163° C).

The continuous production of Open Graded Asphalt Base Course shall be within plus or minus 25° F (14° C) of the mixing temperature shown on the approved mix design. Momentary temperature spikes shall be kept to a minimum.

**(b) Spreading and Finishing.** The mixture shall be placed within 2 hours after production. The mixture shall not be mixed or placed when the surface temperature is below 40° F (4° C). The mixture, after being spread, shall be compacted in one layer according to one of the following methods selected by the Contractor:

(1) The mixture shall be delivered to the paver at no more than 25° F (14° C) above the mixing temperature shown on the approved mix design, as measured in the hopper of the paving machine. Compaction shall be accomplished with one complete coverage with a steel-wheeled, 2-axle tandem roller weighing 3.0 - 5.0 tons (2.7 - 4.5 metric tons). A coverage is a forward pass and a back pass over the same portion of the open graded asphalt base course. Compaction shall begin as soon as the mixture has cooled sufficiently to support the weight of the rolling equipment without undue displacement.

(2) Compaction shall be accomplished with one complete coverage with a steel-wheeled, 2-axle tandem roller weighing 7.0 - 11.0 tons (6.4 - 10.0 metric tons). Compaction shall begin when the temperature of the mixture is not more than 180° F (82° C) and shall be completed before the mixture has cooled below 100° F (38° C).

Vibratory rollers meeting the above requirements may be used provided the vibratory unit is turned off.

**(c) Rolling and Density Requirements.** The mixture shall be consolidated, to the satisfaction of the Engineer, while in a plastic condition and as soon after being spread as it will bear the weight of the rollers without undue displacement.

**(d) Surface Tests.** The finished surface of the open graded asphalt base course, when checked with a 10' (3 m) straightedge operated parallel to the centerline, shall show no variation more than ½" (12 mm) when the profile grade is shown on the plans. When surface tests indicate surface tolerances do not meet this requirement, corrections to the pavement and/or changes in the paving operations shall be made before beginning the next day's

operations. The open graded asphalt base course shall be corrected with open graded asphalt base course mixture meeting these specifications, or if permitted by the Engineer the high spots may be removed to within the specified tolerances by any method that does not produce contamination of the base with fines nor damage to the base course remaining in place. Grinding will not be allowed.

Hardened open graded asphalt base course with a surface tolerance more than 1/2" (12 mm) below the grade indicated by the surface tests shall be corrected with open graded asphalt base course mixture meeting these specifications. All corrective work and material necessary to correct surface tolerances shall be at no cost to the Department.

Care shall be exercised to prevent contamination of the base course with fines. Open graded asphalt base course that in the opinion of the Engineer has been contaminated with fines shall be corrected at no cost to the Department.

**(e) Weight Limitations.** No traffic or Contractor's equipment except the paver will be permitted on the hardened open graded asphalt base course. The work of placing the subsequent layer shall not begin until the base has been placed on the shoulders flush with the open graded asphalt base course. Placing the subsequent layer shall be accomplished by unloading the material from the haul trucks at the shoulder and conveying the material to the paver. The Contractor may propose alternates to the Engineer for the paving method, but no haul trucks of any type shall be permitted on the open graded asphalt base course. Any damage to the base shall be repaired promptly by the Contractor at no cost to the Department and as directed by the Engineer.

**417.06 Quality Control, Acceptance, and Adjustments. (a) Quality Control.** The quality control for all types of Open Graded Asphalt Base Course shall be according to Subsection 404.04 except that the only properties determined shall be for gradation and asphalt binder content.

**(b)Acceptance of the Pavement.** Acceptance and adjustment will be by the lot as specified in Subsection 410.09(a).

**(1) Asphalt Binder Content.** Acceptance of the pavement mixture will be according to the applicable parts of Subsection 410.09(b) except that references to Table 410-1 will be interpreted to be Table 417-2.

**(2) Gradation.** Acceptance of the pavement mixture will be according to the criteria that is listed in Table 417-2.

**(c) Unacceptable Pavement.** The removal and replacement of unacceptable pavement will be according to Subsection 410.09(c).

**(d) Adjustments.** Adjustments will be made according to Subsection 410.09(d) and the following:

**(1)** For aggregate gradation, the contract price of the entire lot will be reduced by 5.0% for each deviation outside of the compliance limits from the mix design value up to a maximum of 8 deviations. One deviation is 1%.

**(e)** Pavement that is determined to be non-complying for any reason other than asphalt content or aggregate gradation will be evaluated according to Subsection 105.04. The Engineer will determine whether the non-complying pavement must be corrected or removed and replaced or may be left in place at a reduced cost to the State. Cost reductions according to the provisions of Subsection 105.04 will be in addition to the cost reductions, if any, determined for asphalt content, and aggregate gradation. If the total cost reduction is determined to be greater than 50% for any lot, that lot will not be accepted.

When two consecutive lots or any three out of five lots fails to qualify for full payment with a price adjustment for any reason, work will be stopped until corrective action is taken.

**417.07 Method of Measurement.** **(a)** Mineral aggregate will be measured by the ton (metric ton). Mineral filler will not be measured or paid for separately but will be considered included in the contract unit price bid for mineral aggregate.

**(b)** Asphalt binder will be measured by the ton (metric ton). Anti-strip additives will not be measured or paid for separately but will be considered included in the contract unit price bid for asphalt binder.

Quantities of aggregate and asphalt binder will be determined by weighing the composite mixture on truck scales, determining the weight of asphalt binder by the accepted mix design, and deducting this weight from the total weight of the composite mixture to obtain the weight of the mineral aggregate. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weights will be used in lieu

of truck scales to determine the total weight of the composite mixture.

**417.08 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Mineral Aggregate will be paid for at the contract unit price bid per ton (metric ton) for Mineral Aggregate in Open Graded Asphalt Base Course (Ty\_\_).

In cases where the combined specific gravity of the mineral aggregate exceeds 2.80, the quantity of mineral aggregate will be adjusted for payment by multiplying the quantity of mineral aggregate used by a specific gravity of 2.80 and dividing by the higher specific gravity.

(b) Asphalt Binder will be paid for at the contract unit price bid per ton (metric ton) for Asphalt Binder (PG \_\_) in Open Graded Asphalt Base Course (Ty\_\_).

The contract unit prices mentioned above shall be full compensation for furnishing materials; for performing quality control and acceptance sampling and testing; for heating, mixing, hauling, placing, rolling, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

**Pay Item Pay Unit**

Mineral Aggregate in Open Graded  
Asphalt Base Course (Ty\_\_) Ton (Metric Ton)

Asphalt Binder (PG \_\_) in Open Graded  
Asphalt Base Course (Ty\_\_) Ton (Metric Ton)

**TABLE 417-2  
COMPLIANCE, PRICE REDUCTION, AND REJECTION LIMITS FOR  
OPEN GRADED ASPHALT BASE COURSES**

Property	Compliance Limits (from mix design value)	Price Reduction Limits (from mix design value)	Lot Rejection Limits (from mix design value)	Sublot rejection Limits (from mix design value)
Asphalt Binder Content	± 0.3	more than ± 0.3, to ± 0.6	more than ± 0.6	more than ± 0.8
Aggregate Gradation				
Type 1				
1½" (37.5 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
¾" (19.0 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
Type 2				
1½" (37.5 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
¾" (19.0 mm)	± 7%	more than ± 7%, to ± 15%	more than ± 15%	more than ± 25%
#4 (4.75 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
Type 3				
#4 (4.75 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%
Type 4				
¾" (9.5 mm)	± 5%	more than ± 5%, to ± 13%	more than ± 13%	more than ± 23%



## SECTION 418 SLURRY SEAL

**418.01 Description.** This work shall consist of the application of a mixture of emulsified asphalt, mineral aggregate, mineral filler, water and other additives, properly proportioned, mixed, and spread on the surface according to this specification, and as directed by the Engineer.

**418.02 Materials. (a) Asphalt Material.** The asphalt emulsion used shall include cationic emulsified asphalt or polymer modified cationic emulsified asphalt. The cationic emulsified asphalt shall be a CQC-1h meeting the requirements of AASHTO M 208, except that the cement mixing test requirement is excluded. The polymer modified emulsified asphalt shall be CQS - 1h that has been modified to meet the following requirements by addition of polymers:

	<b>Min.</b>	<b>Max.</b>
Viscosity, Saybolt Furol at 77° F (25° C), Sec.:	20	100
Storage stability test, one day		1%
Particle Charge test:	Positive	
Sieve test, percent:		0.1
Distillation*:		
Oil distillate, by vol. of emulsion, %:		0.5
Residue from distillation:		62.0
Polymer Solids, percent	3.0	
Penetration, 77° F (25° C), 100 g, 5 sec.:	55	90
Ductility, 77° F (25° C), 5 cm/min., cm:	70	
Solubility in trichloroethylene: **	97%	
Softening point, R. & B., ° F	135° (57° C)	

\* The standard distillation procedure shall be modified as follows: The temperature on the lower thermometer shall be brought slowly to 349° F ± 11° F (176° C ± 6° C) and maintained at this point for 20 minutes. Complete the total distillation in 60 ± 5 minutes from the application of heat.

\*\* Base Asphalt Binder

Prior to beginning work the emulsion supplier shall furnish the Department samples of the base asphalt and polymer used in the finished emulsion.

The emulsified asphalt and the modified emulsified asphalt shall be so formulated that when the paving mixture is applied with the relative humidity at not more than 50% and ambient air temperature of at least 77° F (25° C), it will cure sufficiently that rolling traffic can be allowed to use the surface in two hours (one hour for polymer modified slurry seal) with no damage to the surface.

**(b) Mineral Aggregate.** The aggregate shall be crushed steel slag, crushed gravel or crushed stone meeting the requirements of Section 409. Limestone aggregates shall not be used as mineral aggregate. The aggregate shall meet the following gradation requirements:

<u>Sieve Size, (mm)</u>	<u>Type II Percent Passing (by weight)</u>	<u>Type III</u>
3/8" (9.5)	100	100
#4 (4.75)	90 - 100	70 - 90
#8 (2.36)	65 - 90	45 - 70
#16 (1.18)	45 - 70	28 - 50
#30 (0.600)	30 - 50	19 - 34
#50 (0.300)	18 - 30	12 - 25
#100 (0.150)	10 - 21	7 - 18
#200 (0.075)	5 - 15	5 - 15
Los Angeles Test		
(AASHTO T 96)	35 max.	35 max.
Sand Equivalent Test		
(AASHTO T 176)	45 min.	60 min.

**(c) Mineral Filler.** Mineral filler, if used, shall be Portland Cement or hydrated lime which meets the requirements of AASHTO M 17.

Portland cement shall be a commercial quality, non-air-entraining cement and shall not be considered as mineral filler for the purpose of satisfying the gradation requirement of the aggregate.

**(d) Water.** Water shall be potable and free of harmful soluble salts.

(e) **Other Additives.** Additives supplied by the emulsion manufacturer may be added to the emulsion mix or to any of the component materials to provide control of the set time in the field.

**418.03 Design and Quality Control of Mixture.** The design of the Slurry Seal shall be the responsibility of the Contractor and shall meet or exceed the criteria set forth by the International Slurry Seal Association's A-105 and A-143. Quality control of the mix shall be according to Section 404.04 to the Standard Specifications.

**Composition of Mixture.** The mix design and materials and methods must receive the approval of the Engineer prior to use on the project. The proportions to be used shall be within the following limits:

Residual Asphalt: 6.5% - 13.5% for slurry seals and 5.5% - 9.5% for polymer modified slurry seals by weight of dry aggregate.

Mineral Filler: 0.5% - 2.0 % by dry weight of aggregate.

Polymer Modifier: When specified to provide the required properties.

Field Control Additive: As required to provide the specified properties.

Water: As required to provide the proper consistency.

**418.04 Equipment.** All equipment used for materials handling and mixing and placing of mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective with a potential for affecting the quality of the paving mixture will be rejected by the Engineer and must be replaced or repaired before its use or continued use.

The material shall be mixed by a self-propelled mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, additives, and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, and water to maintain an adequate supply to the proportioning controls. The machine shall be equipped with self-loading devices which provide for the loading of all

materials while continuing to lay slurry seal, thereby minimizing construction joints.

Individual volume or weight controls for proportioning each material to be included in the mixture shall be provided. Each material control device shall be calibrated and properly marked. Calibration shall be performed prior to starting the project and in the presence of the Engineer. Documentation shall be included for each individual calibration of material at the various settings, which can be related to the machine's metering devices. The machine will be equipped with a metering device for the mineral filler which indicates the quantity used. No machine will be allowed to work on the project until the calibration has been completed and/or accepted. Calibration shall be verified by the Contractor using AHTD Test Method 466 under observation by the Engineer.

The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.

The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box.

The mixing machine shall be equipped with an approved fines feeder and liquid additives feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler.

**418.05 Stockpiling and Storage. (a) Aggregate Storage.** If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. The grading of aggregates supplied to the mixing plant shall be uniform. Suitable equipment of acceptable size shall be furnished by the contractor to work the stockpiles and prevent segregation of the aggregates. If a polymer modified slurry seal is specified, a scale system shall be supplied by the Contractor to weigh the aggregate. The scale shall provide printed tickets for each truck loaded.

**(b) Storage and Heating of Asphalt Materials.** The asphalt material storage shall be ample to meet the requirements of the plant. Asphalt emulsion shall not be heated to a temperature in excess of 160° F (71° C). All equipment used in the storage and handling of asphalt material shall be kept in a clean condition at all

times and shall be operated in such manner that there will be no contamination by foreign matter.

**418.06 Construction Methods. (a) General.** It shall be the responsibility of the Contractor to produce, transport, and place the specified paving mixture according to these specifications and as approved by the Engineer.

**(b) Seasonal Limitations.** No slurry seal shall be placed after October 15 or before May 1 without prior approval by the Engineer. Slurry seal shall not be applied if either the pavement or ambient temperature is 55° F (13° C) or less.

**(c) Surface Preparation.** The area to be sealed shall be thoroughly cleaned of all vegetation, loose aggregate and soil. Utility entrances within the area to be sealed shall be protected from the slurry seal by the use of plastic coverings or other methods. All utility entrances shall be uncovered before the surface is reopened to traffic. Water used to pre-wet the surface ahead of and outside the spreader box shall be applied at a rate which will dampen the entire surface without any free flowing water ahead of the spreader box.

**(d) Traffic Control.** It shall be contractor's responsibility to provide adequate traffic control measures, such as barricades, cones, advance warning signs, flagmen, etc., to protect the uncured slurry seal from all types of traffic and to provide traffic safety in the construction area. These measures shall be employed in a safe manner and must not be used until approved by the Engineer.

Opening the roadway surface to traffic does not constitute acceptance of the work. Any damage to the uncured slurry seal material will be the responsibility of the Contractor and the damaged surface shall be repaired to the satisfaction of the Engineer. Interim pavement marking shall be provided according to Subsection 604.03(f).

**(e) Spreading Equipment.** The paving mixture shall be spread uniformly by means of a mechanical type squeegee box attached to the mixer and equipped with paddles to agitate and spread the materials throughout the box. A front seal shall be provided to ensure no loss of the mixture at the road contact surface. The rear seal shall act as a final strike off and shall be a uniform skid resistant application of aggregate and asphalt on the surface. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved while producing a free flow of

material to the rear strike-off. A secondary strike-off shall be used to provide uniformity. The seam where two spreads join shall be neat and uniform in appearance.

**(f) Rut Filling.** When ruts exceed 1/2" (12 mm) in depth on projects that specify polymer modified slurry seal, a separate leveling course shall be placed to fill the ruts. The leveling course shall be placed utilizing a rut filling vee-box. The ruts shall be reprofiled as to allow a crown of 1/4" (6 mm) for every 1" (25 mm) of rut depth. Traffic shall be allowed to compact the filled ruts for 24 hours prior to the placement of the full width seal course.

**(g) Workmanship.** No excessive buildup, uncovered areas or unsightly appearance will be permitted at longitudinal or transverse joints.

Longitudinal joints shall be placed at lane lines. Excessive overlap will not be permitted. Care shall be taken to ensure straight lines along the roadway centerline, lane lines, shoulder, or curb lines. Lines at intersections shall be kept straight to provide a good appearance.

Care shall be exercised in areas that require hand work so that the finished surface is uniform in texture, density, and of overall appearance comparable to that produced by the spreader box.

Areas of non-uniform texture, density, or appearance will be patched as directed. Patching shall be done using the same process and equipment that originally surfaced the area. Handworking of patches will not be permitted, except as authorized by the Engineer.

The Contractor shall supervise and direct the work, using their best skill and attention. The work shall be directed using any means as is the custom of the trade to complete the work in an acceptable manner.

**(h) Acceptance of the Slurry Seal and Adjustments.**

**(1) General.** Acceptance and adjustment will be based on the test results for asphalt content and gradation listed in Table 418-1 by the lot, which will be defined as 120,000 square yards (100,000 square meters), and the subplot, which will be defined as 30,000 square yards (25,000 square meters), with no less than one test per project. Asphalt content shall be determined using AHTD Test Methods 449/449A, AHTD Test Method 450 or 451, or AHTD Test Method 467 as directed by the Engineer.

Gradation shall be determined using either AHTD Test Method 460 or 467 as directed by the Engineer. The Department shall determine the location for each sample in the subplot by AHTD Test Method 465.

The Department will obtain and test one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. The location of the lot sample will be determined by the Department using AHTD Test Method 465.

**(a) Acceptance of the Pavement.** Acceptance of a standard lot for asphalt content and gradation listed in Table 418-1 will be based on the average of the five (5) tests performed on the lot. Acceptance of a partial lot will be based on the average of the actual number of tests made on that partial lot. Acceptance of a subplot will be based on the results of the test(s) performed on samples from that subplot.

In Table 418-1, the term "specification limit(s)" refers to those limits and/or values shown in the tables of design values for the various types of mix. The term "mix design value" refers to the value shown in the accepted mix design.

When the average of the test results for a lot fall within the range shown in Table 418-1 as "Compliance Limits", the lot will be accepted with no price reduction for those properties. If the average of the test results for a lot for any single property listed in the table falls within the limits shown as "Price Reduction Limits", the material may be left in place at a reduced price as specified in Subsection 418.06(h)(1)(c) below. If the average of the test results for a lot for any single property listed in the table falls outside the limits shown as "Lot Rejection Limits", the entire lot shall be removed and replaced at no cost to the Department. Sampling and testing of the replacement material will be according to the same sampling and testing requirements specified above.

For any single property, if the result of the single test in a subplot falls outside the limits shown as "Sublot Rejection Limits", that subplot shall be removed and replaced at no cost to the Department. In the subplot containing the Department's lot test, if the result of either the Contractor's subplot test or the Department's lot test fall outside the subplot rejection limits, the

two tests will be averaged and the average of the two test results used to determine acceptance or rejection. The average of the two test results will also be used as a single value to compute the average for the lot for acceptance and adjustment.

**(b) Unacceptable Pavement.** Any lot or section of any slurry seal course that is not accepted for any reason shall be removed and replaced by the Contractor at no cost to the Department. Payment for sections where removal and replacement is required will be withheld or recovered, and released after replacement has been acceptably completed. The quantity for payment will be the original quantity and measurement of the quantity used in replacement operations will not be considered.

**(c) Adjustments.** Adjustments will be made by reducing the contract price of the lot according to the schedules below. Price reductions will be computed from the schedules below for each property, and reductions for each property added together to obtain the total price reduction for the lot. The total price reduction will be applied to all components of the course for the entire quantity of the lot. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction. When the number of deviations for any property shown exceeds the maximum specified, or when the total price reduction for a lot is greater than 50%, that lot will not be accepted. Continuous production of material not qualifying for full payment will not be allowed.

**(1)** For Asphalt Binder Content, the contract price of the entire lot will be reduced by 12% for each deviation outside the compliance limits, up to a maximum of 3 deviations. One deviation is 0.1 percentage point.

**(2)** For aggregate gradation, the contract price of the entire lot will be reduced by 5.0% for each deviation outside of the compliance limits from the mix design value up to a maximum of 8 deviations. One deviation is 1%.

**418.07 Method of Measurement.** Slurry Seal will be measured by the square yard (square meter). Aggregate in Slurry Seal (Polymer Modified), which shall include the aggregate and mineral



filler, will be measured by the ton (metric ton). Asphalt in Slurry Seal (Polymer Modified), which shall include the polymer modifier, will be measured by the gallon (liter).

**418.08 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Slurry Seal will be paid for at the contract unit price bid per square yard (square meter) for Slurry Seal.

(b) Mineral aggregate and mineral filler in Slurry Seal (Polymer Modified) will be paid for at the contract unit price bid per ton (metric ton) for Aggregate in Slurry Seal (Polymer Modified).

(c) Asphalt emulsion in Slurry Seal (Polymer Modified) will be paid for at the contract unit price bid per gallon (liter) for Asphalt in Slurry Seal (Polymer Modified).

Field control additives will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Slurry Seal or Slurry Seal (Polymer Modified).

The contract unit prices mentioned above shall be full compensation for furnishing materials; for designing the mixture, including trial mixtures required; for performing quality control and acceptance sampling and testing; for preparation of the surface; for heating, mixing, hauling, placing, and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Water used in preparing the surface will not be measured or paid for separately.

Tack coat, if used, will be measured and paid for in accordance with Section 401.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Slurry Seal	Square Yard (Square Meter)
Aggregate in Slurry Seal (Polymer Modified)	Ton (Metric Ton)
Asphalt in Slurry Seal (Polymer Modified)	Gallon (Liter)

**TABLE 418-1**  
**COMPLIANCE, PRICE REDUCTION, AND REJECTION LIMITS FOR SLURRY SEALS**

<b>Property</b>	<b>Compliance Limits (from mix design value)</b>	<b>Price Reduction Limits (from mix design value)</b>	<b>Lot Rejection Limits (from mix design value)</b>	<b>Sublot Rejection Limits (from mix design value)</b>
Asphalt Binder Content	$\pm 0.3$	more than $\pm 0.3$ , to $\pm 0.6$	more than $\pm 0.6$	more than $\pm 0.8$
Aggregate Gradation				
Sieve Sizes				
#4 (4.75 mm)	$\pm 5\%$	more than $\pm 5\%$ , to $\pm 13\%$	more than $\pm 13\%$	more than $\pm 23\%$
#8 (2.36 mm)	$\pm 5\%$	more than $\pm 5\%$ , to $\pm 13\%$	more than $\pm 13\%$	more than $\pm 23\%$
#16 (1.18 mm)	$\pm 5\%$	more than $\pm 5\%$ , to $\pm 13\%$	more than $\pm 13\%$	more than $\pm 23\%$
#30 (0.6 mm)	$\pm 5\%$	more than $\pm 5\%$ , to $\pm 13\%$	more than $\pm 13\%$	more than $\pm 23\%$
#50 (0.30 mm)	$\pm 4\%$	more than $\pm 4\%$ , to $\pm 12\%$	more than $\pm 12\%$	more than $\pm 22\%$
#100 (0.15 mm)	$\pm 3\%$	more than $\pm 3\%$ , to $\pm 11\%$	more than $\pm 11\%$	more than $\pm 21\%$
#200 (0.075 mm)	$\pm 2\%$	more than $\pm 2\%$ , to $\pm 10\%$	more than $\pm 10\%$	more than $\pm 20\%$

**DIVISION 500  
RIGID PAVEMENT**

**SECTION 501  
PORTLAND CEMENT CONCRETE PAVEMENT**

**501.01 Description.** This item shall consist of constructing a pavement composed of portland cement concrete, with or without reinforcement as specified, constructed on a prepared subgrade or base course according to these specifications and conforming to the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

Design and Quality Control of Portland Cement Concrete Pavement will consist of the Contractor furnishing acceptable mix designs and performing all applicable quality control sampling and testing for Portland cement concrete pavement according to these provisions.

**501.02 Materials.** The materials used shall comply with the requirements as set out herein. No materials shall be used containing foreign matter, frost, or lumps or crusts of hardened substances.

(a) **Cement.** Unless otherwise specified, Portland cement conforming to the requirements of AASHTO M 85, Type I shall be furnished. One of the following blended cements may be used in lieu of Type I:

- Portland-Pozzolan Cement, AASHTO M 240, Type IP (20% maximum)
- Slag-Modified Portland Cement, AASHTO M 240, Type IS (25% maximum)

Fly ash or slag cement shall not be substituted for blended cements. Cement, blended cement, fly ash, and slag cement shall be from sources that are listed on the Department's Qualified Products List and that have executed a certification agreement with the Department.

The total alkalis in the Portland cement ( $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ ) shall not exceed 0.60%. The total alkalis in the cementitious material (Portland cement, fly ash or slag cement) shall not exceed 5 lb/cu yd (3 kg/cu m). In lieu of using low alkali cement as specified, the contractor may choose alternative testing of the proposed aggregates and cementitious materials as follows:

Option 1 – Test the fine and coarse aggregate sources in accordance with AASHTO T 303. If the 14 day expansion  $\leq 0.10\%$ , the requirement for low-alkali cement is waived. If the 14 day expansion is greater than 0.10%, further testing per Option 2 below is required using slag cement or fly ash.

Option 2 – Test using the specific job materials and selected replacement level of supplemental cementitious materials (slag cement or fly ash) proposed for the project according to AASHTO T 303. If the 14 day expansion is  $\leq 0.10\%$ , the requirement for low-alkali cement is waived. If the 14 day expansion is greater than 0.10%, additional testing with a different cement, different supplemental cementitious material, and/or different replacement level is required.

Cement shall be furnished in bulk. The mixing or alternate use of cement from different manufacturing plants will not be permitted. The source of cement shall not be changed without the written approval of the Engineer. The use of cement salvaged from spillage will not be allowed. Cement placed in storage shall be suitably protected. Loss in quality occurring during the storage period will be cause for rejection. If the cement furnished produces erratic results under the field conditions incident to the placing of the concrete, or in regard to the strength of the finished product, or in the time of the initial or final set, the Contractor shall, without notice from the Engineer, cease the use of that source of cement.

**(b) Fine Aggregate.** The fine aggregate shall consist of clean, hard, durable particles of natural sand or other approved inert material with similar characteristics.

When determined necessary by visual observation, the amount of deleterious substances will be tested by laboratory methods and shall not exceed the following limits:

	<b>Maximum Permissible Percentage by Weight</b>
Removed by decantation (AASHTO T 11)	2.00
Clay lumps (AHTD Test Method 302)	0.50
Coal and lignite (AASHTO T 113)	0.25
Soft and flaky particles (AHTD Test Method 302)	2.00

All fine aggregate shall be free from injurious amount of organic impurities. Aggregates shall be subjected to testing according to AASHTO T 21. Should AASHTO T 21 produce results that indicate that the sand may possibly contain injurious or damaging organic compounds, mortar strength test specimens shall be tested according to AASHTO T 71 such that the fine aggregate has a compressive strength of 95% of the standard sand samples at 7 days.

Fine aggregate shall comply with the following grading requirements when tested according to AASHTO T 27:

<b>Sieve, (mm)</b>	<b>Percent Passing</b>
3/8" (9.5)	100
#4 (4.75)	95-100
#8 (2.36)	70-95
#16 (1.18)	45-85
#30 (0.600)	20-65
#50 (0.300)	5-30
#100 (0.150)	0-5

The fineness modulus of the fine aggregate shall not vary more than 20 points from the established value of the fine aggregate used in the mix design. In the event that the fineness modulus exceeds 20 points, a new mix design will be required.

**(c) Coarse Aggregate.** The coarse aggregate shall consist of crushed stone or gravel. A coarse aggregate consisting of a combination of crushed stone and gravel shall be used only when specifically approved by the Engineer.

Crushed stone shall consist of clean, hard, durable fragments of rock of uniform quality. The stone shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 40, and when subjected to 5 cycles of the Soundness Test (Sodium Sulfate, AASHTO T 104), shall have a loss not to exceed 12%.

Gravel shall consist of clean, hard, durable, uncoated aggregate, crushed or uncrushed, having a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 40.

When determined necessary by visual observation, the amount of deleterious substances will be tested by laboratory methods and shall not exceed the following limits:

	<b><u>Maximum Permissible Percentage by Weight</u></b>
Removed by decantation (AASHTO T 11)	1.00
Coal and Lignite (AASHTO T 113)	0.25
Clay lumps (AHTD Test Method 302)	0.25
Soft fragments (AHTD Test Method 302)	5.00
Total Deleterious substances	5.00

The maximum percentage by weight removed by decantation (AASHTO T 11) from crushed stone coarse aggregate may be increased to 1.5% provided the percent loss (AASHTO T 11) from the fine aggregate does not exceed 1%, or to 1.8% provided the percent loss from the fine aggregate does not exceed 0.5%.

The fineness modulus of the coarse aggregate shall not vary more than 20 points from the established value of the coarse aggregate used in the mix design. In the event that the fineness modulus exceeds 20 points, a new mix design will be required.

Coarse aggregate shall comply with the following grading requirements when tested according to AASHTO T 27:

Sieve, (mm)	% Passing	
	Standard Gradation AHTD	Alternative Gradation AASHTO M43 #57
1½" (37.5)	100	100
1" (25.0)	60-100	95-100
¾" (19.0)	35-75	-
½" (12.5)	-	25-60
⅜" (9.5)	10-30	-
#4 (4.75)	0-5	0-10
#8 (2.36)	-	0-5

**(d) Water.** Water used in mixing or curing shall be clean and free from injurious amounts of oil, salts, or other deleterious substances and shall not contain more than 1000 ppm of chlorides. Tests will be made according to AASHTO T 26.

Water from municipal supplies approved by the State Department of Health will not require testing but water from other sources shall be sampled and tested before use in concrete.

Where the source of water is relatively shallow, it shall be maintained at such depth and the intake so enclosed as to exclude silt, mud, grass, or other foreign materials.

**(e) Admixtures. (1) General.** Admixtures shall be used to improve certain characteristics of the concrete when specified on the plans or may be used when requested by the Contractor and approval is given by the Engineer. The Contractor's request shall be supported with the manufacturer's certified formulation of the proposed admixture and with sufficient evidence that the proposed admixture has given satisfactory results on other similar work. Chlorides shall not be added during the manufacturing process.

Either prior to or at any time during construction, the Engineer may require that the admixture selected by the Contractor be further tested to determine its effect upon the strength or properties of the

concrete. Permission to use the admixture may be withdrawn at any time by the Engineer when satisfactory results are not being obtained.

Admixtures which are used shall be listed on the Department's Qualified Products List or approved by the Engineer. Admixtures shall be compatible with each other, as advised by the manufacturer. The admixture dosage rate range recommended by the manufacturer shall be used. Should the dosage rate for any admixture not yield desirable characteristics in the concrete, the dosage shall be adjusted based on test results obtained by trial batches.

Admixtures shall be added to the mixing water by means of a mechanical dispenser that will accurately meter the additive throughout the mix water cycle.

**(2) Air Entraining Agent.** Air entraining agent shall comply with the requirements of AASHTO M 154 and be approved by the Engineer.

**(3) Retarding Agent.** In order to permit the retarding of the set and extend the finishing time of concrete, a retarding agent shall be used when specified on the plans or may be used when permission for its use is requested by the Contractor and approved by the Engineer. The retarding agent shall be a Type B or Type D admixture as defined in AASHTO M 194.

No compensation will be made for furnishing and incorporating the agent in the mix. No additional compensation will be made for furnishing, placing, finishing, and curing the concrete involved.

**(4) Other Admixtures.** The use of other admixtures will be considered by the Engineer on a case by case basis upon written request from the Contractor. If approved, the admixture used shall be furnished at no additional cost to the Department.

**(f) Cement Replacements. (1) Fly Ash.** Fly ash for use with Portland cement shall comply with the requirements of AASHTO M 295, Class C or Class F. Mixing of Class C and Class F fly ashes will not be permitted.



**(2) Slag Cement.** Slag cement shall comply with the requirements of AASHTO M 302, Grade 100 or higher.

**(g) Reinforcing Steel and Dowel Bars. (1) General.** Reinforcing steel, dowel bars, and other steel bars shall comply with Subsection 502.02. Epoxy coated dowel bars and tie bars shall be used.

The epoxy coated dowel bars and tie bars shall be coated according to the provisions of ASTM A775 using a coating material meeting Annex A1. The Contractor shall certify the epoxy coating in accordance with Subsection 804.02(d) and comply with the requirements of Subsection 804.04 for epoxy coated bars. Damage to epoxy coated bars shall be repaired according to the epoxy powder manufacturer's recommendations and Subsection 804.05. Shipping, handling, and protection of epoxy coated bars shall be in accordance with Subsection 804.05.

**(2) Dowel Bars.** No coating repairs will be required for uncoated cut or sheared ends of the dowel bars or at the locations where the wire basket has been welded to the dowel bar.

**(3) Tie Bars.** No coating repairs will be required for uncoated cut or sheared ends of tie bars. Tie bars that must be bent and later straightened to facilitate construction shall comply with AASHTO M 31, Grade 40 (Grade 300). Tie bars shall be bent back reasonably straight and any damage to the epoxy coating during the rebending shall be repaired in accordance with (1) above. Tie bars broken during the rebending shall be replaced by the Contractor at no cost to the Department. Installation of replacement tie bars shall use an approved non-shrink grout or a resin anchoring system listed on the Department's Qualified Products List. The diameter of the drilled holes and the installation procedures shall be as recommended by the grout manufacturer or the resin anchoring system manufacturer.

**(h) Joint Materials.**

**(1) Materials for filling and sealing expansion joints shall be as shown on the plans and shall comply with the following requirements, as applicable:**

a. Type 1: A joint filler that is a uniform mixture of sawdust and asphalt material in the proportion of one part asphalt to four parts sawdust, by volume. Asphalt material used shall be either MC-250 or SS-1 according to Subsection 403.03. When this material is specified, the joint shall be filled to within 1" (25 mm) of the pavement surface. The top 1" (25 mm) shall be sealed with a material complying with the requirements of ASTM D6690, Type I.

b. Type 2: A joint filler that is preformed, non-extruding, and resilient type, complying with AASHTO M 153 Type I (sponge rubber).

(2) The material for filling and sealing longitudinal, warping, contraction, and other specified joints shall be as shown on the plans and shall comply with the following requirements:

a. Backer rod filler for Types 3, 4, and 5 joints shall meet ASTM D 5249, Type 1 for Types 3, 4, and 5 joint sealers or Type 3 for Types 3 and 4 joint sealers and shall be approximately 1/8" (3 mm) larger in diameter than the width of the joint to be sealed. All components of the joint sealant system, including the backer rod, shall be compatible. No bond shall occur between the backup material and the sealant system for Types 3 and 4 joint sealer.

b. Type 3: A joint sealer that is a cold applied, single component, chemically curing silicone sealant that meets the requirements of ASTM D 5893. The formulation shall not require a primer for bond to concrete. The compound shall be compatible with concrete. The material shall be one that has been approved by the Engineer.

c. Type 4: A joint sealer that is a cold applied, single component, chemically curing silicone sealant that meets the requirements of ASTM D 5893. The formulation shall require a primer for bond to concrete. The compound shall

be compatible with concrete. The material shall be one that has been approved by the Engineer.

d. **Type 5:** A joint sealer that is a hot poured elastomeric joint sealant. The material shall comply with ASTM D3406. The appendix of that specification shall be considered a part of this specification.

f. **Type 6:** A joint sealer that is a hot poured elastic type complying with ASTM D 6690, Type 1.

**(i) Curing Materials.** Curing materials shall be one of the following types:

(1) Polyethylene-burlap mats complying with ASTM C171. Polyethylene-burlap mats shall consist of one 9 ounces per square yard (300 g/sq m) thickness of burlap, impregnated on one side with one opaque 4 mil (0.10 mm) thickness of polyethylene, and free from visible defects.

(2) Membrane curing compound complying with ASTM C309 for Type 1-D or Type 2.

(3) Polyethylene sheeting shall be 4 mil (0.10 mm) minimum thickness, uniform in appearance, and free from visible defects.

(4) Copolymer/synthetic blanket complying with the performance requirements of ASTM C171. Copolymer/synthetic blankets shall be a composite of a copolymer membrane material coated over a layer of absorbent nonwoven synthetic fabric weighing at least 6 ounces per square yard (200 g/sq m), uniform in appearance, and free from visible defects.

(5) Other approved sheeting materials complying with the performance requirements of ASTM C171.

**501.03. Mix Design. (a) General** The portland cement concrete pavement mix shall be composed of portland cement, water, air entraining agent, fine aggregate, and coarse aggregate of the gradation and quality specified in Subsection 501.02 and the proportions specified below.

The air content of the fresh concrete, as determined by AASHTO T 152, shall be  $6\% \pm 2\%$ . The air entrainment shall be accomplished by adding to the mixing water the proper amount of an air entraining agent in solution.

When air-entrained concrete is specified, the air-entraining agent and the retarding agent shall be so incorporated that the air content of the concrete shall fall within the percentage range stipulated in the specifications. When air-entrained concrete is not specified, the concrete to which the retarding agent has been added shall have an air content not greater than 3 percent.

The minimum cement content shall be 564 pounds (6 sacks) of cement per cubic yard (335 kg of cement per cubic meter) of concrete.

The water/cement ratio shall not exceed 0.45 pound per pound (5.1 gallons per bag)[ 0.45 kg/kg] (including the free moisture content of the aggregate). When fly ash or slag cement is used as a partial replacement for cement, the total weight of both cement and fly ash or slag cement shall be used to determine the water/cement ratio.

Fly ash may be used as a partial replacement for Type I cement, not exceeding 20% by weight. Substitution shall be made at the rate of one pound (kilogram) of fly ash for each pound (kilogram) of cement replaced. Mixtures with fly ash shall meet the same requirements as mixtures without fly ash. Fly ash will not be allowed as a substitute for high early strength or blended cements.

Slag cement may be used as a partial replacement for Type I cement, not exceeding 25% by weight. Substitution shall be made at a rate of one kilogram (pound) of slag cement for each pound (kilogram) of cement replaced. Slag cement will not be allowed as a substitute for high early strength or blended cements. Ternary mixes (cement, fly ash, and slag cement) are not allowed.

The minimum 28 day compressive strength shall be 4000 psi (28.0 MPa) when tested according to AASHTO T 22. Test

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specimens will be made and cured according to AASHTO T 23 or T 126 as applicable.

The mixed concrete shall have a uniform consistency with a slump, as determined by AASHTO T 119, of not more than 2" (50 mm).

A Type A water reducing concrete admixture or mid-range water reducing concrete admixture may be used with the approval of the Engineer. All admixtures shall comply with Subsection 501.02.

Fine and coarse aggregate shall be added only in such proportion that satisfactory plasticity, workability, and consistency of the mix are maintained, with the further provision that the ratio of the fine aggregate to cement, based on dry and rodded measure, shall be not less than 1.5 nor more than 2.5.

The specified water/cement ratio shall not be exceeded and the minimum cement content shall be met.

A minimum of 15 working days prior to the commencement of paving operations, the contractor shall submit to the Engineer for review and approval the following:

- Certification for the low alkali cement proposed for use OR the results of the fine and coarse aggregates Potential Alkali Reactivity test (AASHTO T 303) in accordance with Options 1 or 2 of Subsection 501.02.
- A Job Mix Formula (JMF) that contains sources of all aggregates proposed for use, a composite gradation of all aggregates, and proportions of each aggregate. Individual gradations of each aggregate shall be included. The Job Mix Formula may only be changed upon written approval of the Engineer. Composite gradations will be calculated using AHTD Test Method 588.

**(b) Mix Design by the Contractor.** The proportions to be used in the mix shall be determined by the Contractor using the absolute volume method. The Contractor may use the procedure provided in the ACI Standard 211.1 or Portland Cement Association "Design

and Control of Concrete Mixes”, modified to comply with the minimum cement content and maximum water/cement ratio specified. Prior to the start of production of the concrete mixture, the Contractor shall submit test results and/or certifications for all materials and detailed mix design data to the Engineer. Aggregate, fly ash, and slag cement material properties used in the mix design shall be representative of the exact materials proposed for use. The testing source (commercial laboratory, qualified technician, AHTD provided data, etc.) and the date of the test shall be provided. The specific plant sources for the cement, fly ash or slag cement, and aggregates shall be shown on the mix design. The documentation submitted with the mix design shall specify which procedure was used and whether oven dry or saturated surface dry weights were used in the calculations. The mix design shall specify the quantity of each component of the mix, including all authorized additives. Acceptance of the mix design by the Engineer will be based on apparent conformity to the requirements in Subsection 501.03(a). If the mix design fails to produce acceptable results or if there is a change in the aggregates, fly ash, slag cement, or cement being used, a new mix design will be required. It shall remain the Contractor’s responsibility during production to produce concrete conforming to the mix design and the minimum acceptance criteria specified. When requested by the Engineer, the Contractor shall submit samples of all materials for verification testing. Production shall not begin until the mix design is accepted by the Engineer.

A mix design submitted for acceptance need not be prepared specifically for this project, but may be a previously accepted design that uses the same materials and meets the same design criteria.

Mix designs accepted under this section will become the property of the Department and may be accepted for use on other projects, by other contractors, or by the Department.

**501.04 Quality Control, Acceptance, and Adjustments in Payments.** (a) **Quality Control by the Contractor.** The Contractor shall perform all applicable quality control sampling and

testing of the Portland cement concrete pavements used on the project.

The Contractor is responsible for product quality control during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to produce an acceptable mix. The Contractor shall perform all applicable quality control sampling and testing required ensuring that the completed concrete pavement complies with all requirements of the specifications. The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing. The Contractor's facilities shall be separate from any Field Laboratory and/or Field Office furnished to the Department under the Contract. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*.

Quality control sampling and testing shall be accomplished in a timely manner. Sampling and testing shall be planned and conducted so that a representative sample is obtained and tested. The Contractor shall determine the specific locations for samples and frequency of sampling for quality control, except the minimum frequency which is listed below for aggregate gradation shall be used. In addition, the Contractor shall be required to perform acceptance sampling and testing at specific times and/or locations specified by the Engineer according to Subsection 501.04(b). The Contractor may use the results of these required tests in his quality control program.

Sampling shall be performed under AHTD 465.

Test methods for Contractor quality control shall be as shown below:

<b>Property</b>	<b>Test Method(s)</b>	<b>Remarks</b>
Gradation (coarse & fine aggregates)	AASHTO T 27	1 test per 1000 cubic yards (750 cubic meters) of mix (minimum). Split samples for Department verification testing.
Aggregate Moisture	AASHTO T 255	
Air Content & Slump	AASHTO T 152 AASHTO T 119	Sampled after placement on grade, but before consolidation by paver or vibrators.
Compressive Strength	AASHTO T 22	Test specimens for compressive strength determined by cores will be obtained according to AASHTO T 24 <u>OR</u> test specimens for compressive strength determined by cylinders will be obtained according to AASHTO T 23.

The Contractor shall certify to the Engineer that the calibration of the concrete cylinder compression testing machine has been verified. This verification shall be performed in accordance with AASHTO T 22 and T 67 under any of the following conditions and documented in accordance with AASHTO T 67:

1. After an elapsed interval of 18 months (maximum) since the previous calibration.
2. After original installation of the machine or following relocation of the machine.
3. Immediately after repairs or adjustments.
4. Whenever there is a reason to doubt the accuracy of the results, without regard to the time interval since the last verification.



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An adequate supply of aggregate must be stockpiled to allow representative sampling in advance of any placement, with the minimum amount being that required to complete the day's planned placement. The initial quality control test results for gradation must be completed and the test results submitted to the Engineer prior to the beginning of mix production each day. Subsequent tests shall be taken and tested during production and test reports submitted to the Engineer by the end of the next business day after the sample is taken. Any failing gradation test result will result in halting production. The aggregate remaining in the stockpile will be resampled and tested by the Contractor and the Engineer. If the test results indicate that the aggregate is outside of the specification limits in Subsection 501.02(b) and (c) or varies from the Job Mix Formula in excess of the limits shown below, the stockpile shall either be corrected or replaced. Passing test reports must be submitted to the Engineer before work resumes.

Sieve Size	Permitted Variation from % passing shown on Job Mix Formula	
	Minimum	Maximum
1 1/2" (37.5 mm)	-7%	+7%
1" (25.0 mm)	-7%	+7%
3/4" (19.0 mm)	-7%	+7%
1/2" (12.5 mm)	-7%	+7%
3/8" (9.5 mm)	-7%	+7%
#4 (4.75 mm)	-7%	+7%
#8 (2.36 mm)	-7%	+7%
#16 (1.18 mm)	-4%	+4%
#30 (0.600 mm)	-4%	+4%
#50 (0.300 mm)	-4%	+4%
#100 (0.150 mm)	-4%	+4%

Sampling and testing for acceptance and adjustment of payment will be performed as specified in Subsection 501.04(b) and 501.04(c).

The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures. The

Contractor's quality control personnel may observe the AHTD project personnel during acceptance sampling and testing for the purpose of comparing sampling and testing procedures.

The Contractor shall maintain a daily plot of all test results, and make the plots available to the Engineer. Upon completion of work on the item, these plots shall be furnished to the Resident Engineer for inclusion in the project files. The Resident Engineer will make acceptance test results available to the Contractor's personnel.

If the test results show that the material is outside the mix design limits, is widely varying, or is consistently marginal, corrective action shall be taken. Corrective actions taken shall be based on the Contractor's quality control test results. The Department's inspector will be notified of all proposed corrective actions before their implementation. If excessive changes are required, production will be suspended and a new mix design shall be developed according to the applicable specifications.

Quality Control and Acceptance testing of Portland Cement Concrete Pavements will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the Portland cement concrete pavements used on the project.

**(b) Acceptance Testing.** Acceptance will be by lot. The standard lot size for acceptance will be 4000 cubic yards (3000 cubic meters), with each standard lot divided into four sublots of 1000 cubic yards (750 cubic meters) each. The Engineer may establish a partial lot at any time. The Engineer will determine the size of any partial lots established and the number and size(s) of the sublots, if any. Although there are no specified limits for the size of such partial lots, they normally will be not less than 400 cubic yards (300 cubic meters) nor more than 4400 cubic yards (3300 cubic meters).

Thickness determination shall be made from cores sampled for compressive strength tests. The Contractor shall drill and fill core holes with a material approved by the Engineer at no cost to the

Department. Slump and air content will be determined by testing fresh concrete. Compressive strength will be determined by testing pavement cores at least 28 days and no more than 90 days after the concrete has been placed. Test methods for acceptance shall be the same as specified for quality control testing. Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*.

The Contractor shall obtain and test one sample taken at random from each subplot. The Department will determine the location for each sample in the subplot by AHTD Test Method 465. The Department's inspector shall be provided an opportunity to witness all Contractor sampling and testing. The test reports of all Contractor acceptance tests shall be provided to the Engineer on the next business day after the tests are performed.

The Department will obtain and test a minimum of one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. Verification testing will be conducted in accordance with Subsection 106.11 and the Department's *Manual of Field Sampling and Testing Procedures*. The location of the lot sample will be determined by the Department using AHTD Test Method 465.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

The Department will perform all tests for acceptance of material used to replace unacceptable material removed by the Contractor. The number of tests and the location(s) for sampling will be

determined by the Engineer using the same procedures used for the original material. The results of these tests will be used for acceptance of the lot or subplot, as applicable.

Additional requirements for concrete pavement are specified in Subsection 501.05(m), Surface Evenness and Testing, and Subsection 501.10, Tolerance in Pavement Thickness.

It is anticipated that when Portland cement concrete pavement is placed over the open graded base course, the concrete will penetrate the open graded base course. However, no adjustment in payment for Portland cement concrete pavement will be made as a result of this penetration.

When cores are taken to determine the compressive strength and thickness of the Portland cement concrete pavement, it is anticipated that a layer of open graded base course will adhere to the bottom of the core. All particles of open graded base course shall be removed from the bottom of the core prior to measuring the core for determining the thickness of the Portland cement concrete pavement.

**(c) Acceptance of the Pavement and Adjustments in Payments.** Acceptance of Portland Cement Concrete Pavements courses will be based on the following criteria:

- The results of tests for the properties listed in Table 501-1
- Pavement smoothness, Subsection 501.05(m)
- Pavement thickness, Subsection 501.10.

All sampling and testing for acceptance and for adjustments in payments shall be performed using the test methods specified in Subsection 501.04(a) for quality control sampling and testing. Samples for all properties except gradation and moisture shall be obtained at the project site.

Acceptance with respect to the properties listed in Table 501-1 will be by lot. Acceptance of a standard lot will be based on the average of the five (5) tests performed on the lot. Acceptance of a partial lot will be based on the average of the actual number of tests

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made on that partial lot. Acceptance of a subplot will be based on the results of the test(s) performed on samples from that subplot.

When the average of the test results for a lot fall within the range shown in Table 501-1 as "Compliance Limits", the lot will be accepted with no price reduction for those properties. If the average of the test results for a lot for any single property listed in the table falls within the limits shown as "Price Reduction Limits", the material may be left in place at a reduced price as shown in Table 501-1. If the average of the test results for a lot for any single property listed in the table falls outside the limits shown as "Lot Rejection Limits", the entire lot shall be removed and replaced at no cost to the Department. Sampling and testing of the replacement material will be according to Subsection 501.04(b).

For any single property, if the result of the single test in a subplot falls outside the limits shown as "Subplot Rejection Limits", that subplot shall be removed and replaced at no cost to the Department. In the subplot containing the Department's lot test, if the result of either the Contractor's subplot test or the Department's lot test fall outside the subplot rejection limits, the two tests will be averaged and the average of the two test results used to determine acceptance or rejection. The average of the two test results will also be used as a single value to compute the average for the lot for acceptance and adjustment.

Pavement that is determined to be non-complying for any reason other than the properties listed in Table 501-1 will be evaluated under Subsection 105.04. The Engineer will determine whether the non-complying pavement must be corrected, removed and replaced, or may be left in place at a reduced cost to the Department. Price reductions determined under Subsection 105.04 will be in addition to the price reductions, if any, determined under this Subsection, 501.04(c). If the total price reduction is determined to be greater than 50% for any lot, that lot will not be accepted.

Any lot or section of any Portland cement concrete pavement that is not accepted for any reason shall be removed and replaced by the Contractor at no cost to the Department. Payment for sections

where removal and replacement is required will be withheld or recovered, and released after replacement has been acceptably completed. The quantity for payment will be the original quantity and measurement of the quantity used in replacement operations will not be considered.

At the Contractor's option additional testing for confirming price reductions or pavement rejection due to compressive strength results may be performed by the Contractor at locations determined by the Department. In such cases, three cores shall be taken in each subplot containing compressive strength results not in Compliance Limits. The compressive strength shall be determined by the average result of the cores. Cores shall be sampled according to AASHTO T 24. The average of the three cores must meet or exceed applicable price reductions limits or pavement rejection limits. Acceptance and pay adjustments will then be determined based on these results. This testing will performed at no cost to the Department. The holes made in taking the samples shall be repaired by the Contractor at no cost to the Department.

Adjustments will be made by reducing the contract price of the lot according to Table 501-1. Price reductions will be computed from Table 501-1 for each property, and reductions for each property added together to obtain the total price reduction for the lot. The total price reduction will be applied to all components of the pavement for the entire quantity of the lot. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction. When the number of deviations for any property shown exceeds the maximum specified, or when the total price reduction for a lot is greater than 50%, that lot will not be accepted.

When two consecutive lots or any three out of five consecutive lots fail to qualify for full payment for any reason, work will be stopped until corrective action is taken. Continuous production of pavement not qualifying for full payment will not be allowed.

**501.05 Construction Requirements.** Equipment, tools, and machinery used on mainlane and ramp pavements shall be

**TABLE 501-1  
COMPLIANCE, PRICE REDUCTIONS, AND REJECTION LIMITS FOR  
PORTLAND CEMENT CONCRETE PAVEMENT**

<b>Property</b>	<b>Compliance Limits</b>	<b>Price Reduction Limits</b>	<b>Price Reduction</b>	<b>Lot Rejection Limits</b>	<b>Sublot Rejection Limits</b>
Air Content	4.0% -8.0%	3.5% - 3.9% and 8.1% - 8.4%	10%	less than 3.0% and more than 9.0%	less than 2.0% and more than 10.0%
		3.0% - 3.4% and 8.5% - 9.0%	20%		
Compressive Strength	4000 psi (min) (28.0 MPa)	3999 – 3800 psi (27.9 – 26.2 MPa)	10%	Less than 3400 psi (23.4 MPa)	Less than 3200 psi (22.1 MPa)
		3799 – 3600 psi (26.1 – 24.8 MPa)	20%		
		3599 – 3400 psi (24.7 – 23.4 MPa)	30%		

specifically designed for placing, consolidating, and finishing Portland cement concrete pavement and shall be maintained in a satisfactory working condition. The methods employed in performing the work and all equipment, tools, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the Engineer. Either the slip form paver or side form method may be used.

**(a) Subgrade.** The subgrade shall be prepared in compliance with Section 212.

**(b) Handling and Storage of Materials.** The handling and storage of concrete aggregates shall be such as to prevent segregation and contamination with foreign materials.

Coarse and fine aggregates shall be separated by bulkheads or stored in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming inter-mixed. Coarse aggregate stockpiles that are not confined by bulkheads or bins shall be built up in layers or wedges not to exceed 4' (1.25 m) in height, and each layer shall be completely in place before beginning the next. Coning or building up of stockpiles by depositing material in one place will not be permitted.

Coarse aggregates secured from different sources shall be unloaded into separate stockpiles and proportioned through separate storage bins. The Contractor will be required to furnish such additional storage bins and auxiliary equipment as may be necessary to combine and proportion the aggregate for the accepted mix.

There shall be adequate aggregate stockpiled to allow representative sampling sufficiently in advance of any placement to determine its acceptability, with the minimum amount being that required to adequately complete the planned placement. The stockpiles shall be large enough to ensure that the moisture content of any class of aggregates will remain sufficiently uniform to allow the accurate control of the amount of water entering into the concrete.

Cement shall be stored in suitable weatherproof buildings or silos that will protect the cement from dampness.



**(c) Measuring Materials.**

**(1) General.** Batch plants shall be equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocking proportioning devices of approved type.

Measuring devices shall be operated in a manner that will consistently allow the exact weight of cement within  $\pm 1\%$ , individual aggregates within  $\pm 2\%$ , and total weight of aggregate within  $\pm 2\%$  of the required weight. Measuring devices shall be so designed and plainly marked that the weights can be accurately and conveniently verified for the quantities of each component actually being used.

The batching plant shall be equipped with an automatic weighing system, including an automatic ticket printer, as described in Subsection 109.01(f). A load ticket shall accompany each load delivered to the project and shall be furnished to the Engineer at the time of delivery. The load ticket shall show the following information:

1. Unique ticket number.
2. Identification of the truck.
3. Date and time of batching.
4. Total weights and/or volumes of each component.
5. Total volume of mix.
6. Total quantity of water added after batching.
7. Time of discharge.

A printout showing the above information for each truckload of mix may be maintained at the plant and provided to the Engineer at the end of the day's run whenever a dedicated central batch plant is used to provide concrete for the paving operation. This printout for the day's operation will be accepted in lieu of individual tickets accompanying each load.

**(2) Aggregates.** Aggregates shall be measured separately and accurately by weight. The batch plant shall include batcher bins, of either the stationary or mobile type, with adequate separate compartments for fine aggregate, each compartment designed to discharge efficiently and freely into the weighing hopper or

hoppers. Means of control shall be provided in each case so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly in small quantities and shut off with precision. Means of removing any overload of any one of the several materials shall be provided.

In the type where more than one aggregate is weighed into one hopper, each aggregate shall be held in a separate compartment, so arranged that an overload of any aggregate can be removed. Hoppers shall be constructed so as to eliminate accumulations of tare materials and to fully discharge without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent mixing of adjacent materials under any working conditions. Batch plant structures shall be maintained properly leveled within the accuracy required by the design of the weighing mechanism.

The scales for weighing aggregates and cement may be the horizontal beam, the springless dial, or the electronic type, designed as an integral unit of the batch plant, of rugged construction to withstand hard usage due to working conditions, and shall have a maximum allowable error of  $\pm\frac{1}{2}\%$  of one net load. When beam-type scales are used, provisions such as a "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached, which device shall indicate at least the last 200 pounds (90 kg) of load. A device on weighing beams shall indicate critical position clearly. Poises shall be designed for locking in any position and to prevent unauthorized removal. The weigh beam and the "tell-tale" device shall be in full view of the operator while charging the hopper. The operator shall have convenient access to all controls.

Clearance between scale parts, hoppers, and bin structures shall be such as to avoid displacement of, or friction between, parts due to accumulations, vibration, or other causes. Pivot mountings shall be designed so none of the parts will jar loose

and so as to assure unchanging spacing of knife edges. Scales shall be so designed that all exposed fulcrums, clevises, and similar working parts may readily be kept clean. Scales shall be constructed of non-corrosive materials, excluding material softer than brass. Weight beams shall have leveling lugs, and weighing parts of other types shall be provided with means for precision adjustment. Scales shall be satisfactory to the Engineer and shall be inspected, adjusted, and certified by a registered scale mechanic according to Subsection 109.01(f).

**(3) Cement.** Cement shall be proportioned on the basis of 94 pounds per cubic foot (1500 kg/cu m) and shall be measured by weight on scales as specified above.

Pneumatic charging of the weigh hopper shall be so arranged that the measurement will not be affected by air pressure in the supply line.

**(4) Water.** The mixer shall be equipped with an automatic water measuring device that shall be within a range of error not to exceed  $\pm 1\%$  and shall be so arranged that the measurement will not be affected by variations of pressure in the water supply line and will be accurate under all construction conditions encountered. Water may be measured either by volume or by weight.

**(5) Admixtures.** The mixer shall be equipped with an approved automatic dispenser for adding to the mixing water the desired amount of admixtures. The dispenser shall be constructed and connected so that the amount of admixture entering into the mixing water can be visually determined.

**(d) Mixing Concrete.** Concrete shall be mixed according to Subsection 802.08 except as follows:

Concrete shall be delivered and discharged from the truck mixer or agitator into the paver or forms within one hour after the introduction of the mixing water to the cement. The Contractor shall supply sufficient trucks to assure a steady forward progress of the paver.

**(e) Cold Weather Concreting.** Concreting operations will not be permitted when a descending air temperature falls below 40° F (5° C) nor resumed until an ascending air temperature reaches 35° F (2° C) without specific authority from the Engineer. When

operations are authorized under such conditions or when it is anticipated that the air temperature will fall below 40° F (5° C) before the concrete has taken its final set, the concrete surface shall be covered with suitable material and to such depth as to prevent freezing. The covering shall remain in place until the slab has thoroughly cured. Under no circumstances will the placing of concrete on a frozen subgrade be permitted.

**(f) Protection Against Rain.** In order that concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor shall have available at all times materials for the protection of the edges and surface of the unhardened concrete. When rain appears imminent, all paving operations shall stop. Any concrete damaged by rain shall be repaired or removed and replaced by the Contractor at no cost to the Department.

**(g) Dowel and Tie Bars.** The Contractor shall establish the location of all dowel bars and tie bars and place them as shown on the plans. The dowel bars shall be held in position parallel to the surface and centerline of the slab by a metal assembly of sufficient strength to prevent displacement during the paving operations. Special attention may be required when anchoring the dowel bar baskets to the open graded base course. Tie bars may be placed by mechanical equipment contingent upon satisfactory performance and the Engineer's approval.

Dowel bars extending across transverse joints shall be of the type and size shown on the plans. Each smooth bar shall be field coated for a minimum distance of 2" (50 mm) greater than half the length of the bar with an approved grease as a bond breaker just prior to placement of concrete.

Each bar across expansion joints shall be capped on the greased end with a close-fitting, non-compressible paper, plastic, or metal expansion sleeve of approved design, approximately 6" (150 mm) long, which shall extend 1" (25 mm) beyond the end of the bar and shall carry a stop of compressible material to provide space for subsequent movement of the bar.

Tie bars extending across and through longitudinal joints shall be deformed bars of the type and size shown on the plans.

Other types of ties and load transfer devices may be used when shown on the plans or approved in writing by the Engineer.

**(h) Placing Reinforcement.** Reinforcing steel shall be clean and free from foreign material and scaling rust. Reinforcing mats shall be handled carefully and kept straight and free from bends and warps. They shall be placed parallel to the finished surface and to the depth shown on the plans.

When the concrete is placed in one course, mechanical or vibratory equipment shall be used to place the mesh fabric reinforcement in position. The reinforcement shall be placed immediately behind the first strike-off and followed immediately by the finishing machine to erase all marks made by the insertion of the reinforcing fabric in the concrete. Use of equipment for the insertion of wire mesh will be contingent upon satisfactory performance and the Engineer's approval.

When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off and consolidated to such length and depth that the sheet of mesh fabric may be layered full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete before initial set of the concrete has occurred. The top layer of the concrete shall then be placed, struck off, and screeded to the required thickness and crown. Sleds, chairs, or other devices supporting the mesh fabric reinforcing steel, with the consequent depositing of the concrete through the steel, will not be permitted.

**(i) Placing Concrete.** Concrete shall not be placed on a soft, muddy, or frozen subgrade. The subgrade shall be moistened immediately before placing concrete unless a waterproof subgrade or base course material is specified. Moistening shall not be excessive to the point of forming mud or pools.

No concrete shall be placed without the approval of the Engineer.

The concrete shall be deposited on the subgrade in such manner as to require as little re-handling as possible. Spreading required shall be done by means of an approved mechanical spreader supplemented by hand shoveling as required. Spreading by rakes will not be allowed.

**(j) Joints.**

**(1) General.** The Contractor shall establish the location of all joints in concrete pavement. Longitudinal and transverse joints

shall be located as shown on the plans in relation to the dowel or tie bars. Longitudinal and transverse joints shall be constructed to conform to the types, dimensions, and other details shown on the plans.

Longitudinal joints include the longitudinal joint between lanes, lanes and shoulders, and longitudinal construction joints between placements in sequence or placements against existing pavement. Transverse joints include expansion joints, contraction joints, warping joints, and construction joints.

All longitudinal and transverse joints shall be constructed, finished, filled, and sealed with joint material as shown on the plans. The joint grooves shall be thoroughly clean and dry when joint material is placed.

Sawed joints shall be formed by cutting the groove in the hardened concrete with an approved concrete saw capable of cutting the joint to the specified dimensions and true to line within the allowable variation.

Joints shall be sawed as soon as the concrete has hardened to the extent that tearing and raveling will not occur, but before development of any random cracking. Sufficient saws and saw blades to accomplish the work shall be available at all times. Should any procedure result in premature and uncontrolled cracking, the Contractor shall immediately revise the method and/or sequence of cutting the joints. Any curing media removed during sawing shall be immediately replaced.

All joints shall be constructed so that the plane of the finished joint is perpendicular to the surface of the pavement and shall be uniform and not deviate more than 1/2" (12 mm) from the planned alignment within any 24' (7 m) segment. In addition, all transverse joints shall be perpendicular to the centerline of the pavement.

The following methods shall apply for longitudinal, contraction, and warping joints when Type 3, 4, 5, or 6 joint sealer is used:

Within 15 minutes after sawing for joint installation, the joints shall be flushed with water under sufficient pressure to remove all slurry and residue left by the sawing operation. After

flushing, the joints shall be blown out with compressed air to remove excess water.

Joints shall not be filled and sealed for a minimum of 6 days following placement of the concrete except that when High Early Strength Concrete Pavement is specified, the period may be reduced to 18 hours.

When the joints are thoroughly dry, and just before sealer placement, both vertical faces shall be thoroughly cleaned by sandblasting with a nozzle attached to an aiming device that directs the sand blast at approximately a 45° angle and a maximum of 2" (50 mm) from the face of the joint. Each joint face shall be sandblasted individually. After sandblasting, the joints shall be blown out with compressed air that has been filtered and is completely free of oil and moisture. The joints shall be thoroughly dry before sealer is placed.

All joints shall be filled and sealed the same day of the final sandblasting. Cleaned joints left open overnight shall be re-cleaned by sandblasting before filling and sealing.

In the event freshly cleaned joints become contaminated before they are sealed, they shall be re-cleaned as specified above.

Backer material shall be installed in a manner that will result in the planned depth and shape for the sealant. If primer is required, the primer shall be applied before installing the backer material.

Joint sealer shall be applied by an approved mechanical device from inside the joint in a manner that causes it to wet the joint surfaces. Joint sealer application will not be permitted when the pavement surface temperature at the joint is less than the application temperature specified by the manufacturer.

In Type 3 and 4 joint sealant, the surface shall be tooled, using the appropriate tool, to produce a slightly concave surface as shown on the plans. Tooling shall be accomplished before a skin forms on the surface. The use of soap or oil as a tooling aid will not be permitted. When an approved self-leveling joint sealant is used, the Engineer may waive the requirement for tooling.

Failure of the joint material in either adhesion or cohesion will be cause for rejection. Removal, re-cleaning, and replacement of the failed material shall be at no cost to the Department.

**(2) Expansion Joints.** Standard transverse expansion joints shall be placed at or near the ends of bridges, unless otherwise specified, and at other points designated on the plans. Special expansion joints shall be placed at all structures projecting through, into, or against the pavement such as drop inlets, junction boxes, etc. Unless otherwise specified, joints at such projecting structures shall be 1/2" (12 mm) in width and shall be filled with material complying with Subsection 501.02(h) Type 2.

Transverse expansion joints shall extend for the full cross section of the pavement and shall be formed by a template or as shown on the plans. The template shall be securely staked or fastened in place before placing the concrete and in a manner to ensure the joint and dowel bars will remain in their proper position after finishing operations have been completed.

**(3) Contraction and Warping Joints.** Contraction and warping joints shall be constructed according to the spacing and dimensions shown on the plans. The joints shall extend continuously across the full width of the concrete surface.

**(4) Construction Joints.** Transverse construction joints shall be constructed when there is an interruption in the concreting operations of more than 30 minutes. Time may be adjusted, due to weather conditions, as directed by the Engineer. No transverse joint shall be constructed within 10' (3 m) of an expansion joint, contraction joint, or place of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10' (3 m) long, the excess concrete back to the last preceding joint shall be removed. No payment will be made for the portion of the pavement which is discarded.

The header may be made of wood or metal and shall have openings for the dowel bars. The header may be of one or two pieces and shall be rigid and accurately set to grade perpendicular to the centerline and surface of the pavement. In lieu of using a header, the Contractor may make the construction joint by cutting back the hardened concrete by sawing and installing dowel bars according to the provisions of Section 507.



**(5) Longitudinal Joints.** Longitudinal joints shall be constructed along the center line of two lane pavements and approach slabs, between lanes of multiple lane pavements and approach slabs, between pavements (new or existing) and added concrete lanes or concrete shoulders, and between approach slabs and approach gutters.

**(k) Consolidating and Finishing.**

**(1) Mechanical Methods.** After the concrete has been deposited and spread it shall be consolidated by means of a mechanical vibrating machine of approved type and design. The vibrating machine may be mounted either on the mechanical spreader or operated as a separate unit on an individual carriage. Vibrators for full width vibration of concrete paving slabs shall be the internal type with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. The frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

An electronic vibrator-monitoring device that displays the operating frequency of each individual internal vibrator shall be required. The monitoring device shall have a readout display near the operator's controls visible to the paver operator and the Department Inspector. It shall operate continuously while paving, and shall display all vibrator frequencies with manual or automatic sequencing among all individual vibrators. The monitoring system shall also record, at minimum, the clock time, station location, paver track speed, and operating frequency of individual vibrators. Recordings shall be made after each 25 feet (7.5 m) of paving or after 5 minutes of time. A record of the data shall be provided to the Engineer daily for the first 3 days of paving and weekly thereafter. The Engineer may determine that more frequent submission is necessary, particularly if equipment malfunctions occur.

If the electronic monitoring device fails to operate properly, the vibrators shall immediately be checked manually. If the vibrators are functioning properly, paving may continue but the Contractor shall make all efforts to correct the malfunction in a reasonable amount of time. If the recording device fails to

operate, paving may continue but the Contractor shall monitor the vibrators continuously and correct the malfunction within 3 paving days.

When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

If, for any reason, equipment previously approved becomes unsatisfactory, it shall be replaced before proceeding with the work.

Vibration shall extend over the entire pavement area and the vibrating machine shall satisfactorily consolidate the mixes required for this type of construction and shall not displace the reinforcement, side forms, joints, or dowel bar assemblies. The concrete shall be deposited, spread, and vibrated in a manner that will ensure minimum segregation and develop a maximum density and strength in the finished pavement.

After vibratory consolidation, the concrete shall be struck off by means of an approved power driven, mechanical finishing machine equipped with double screeds adjusted to strike-off to the required crowned section on tangents and to the plane section on curves as shown on the typical cross section. The finishing machine shall be operated with a roll of concrete in front of each screed sufficient to fill depressions and leave the top of the slab smooth and even with the desired crown and at the proper elevation.

**(2) Hand Methods.** At intersections and turnouts, and on additional widths or other irregular sections not readily accessible to conventional equipment, the concrete may be spread and struck off by hand methods as approved by the Engineer. Over all such areas, however, consolidation shall be accomplished through use of a suitable and approved mechanical vibrator unit.

When striking-off and consolidating by hand methods is permitted, the work shall be done in the following manner:

After the concrete has been deposited, it shall be leveled and then struck-off to such depth above the finished grade specified that when properly consolidated the surface shall conform to the line and grade desired. Before striking-off, the concrete shall be

thoroughly consolidated by means of a mechanical vibrator unit. The strike-board shall be moved forward with a combined longitudinal and transverse motion, so manipulated that neither end is raised from the side forms during the striking-off process.

A slight excess of material must be kept in front of the cutting edge at all times. Additional concrete shall be added to low places and porous spots and the striking and consolidating continued until the entire pavement has a uniform, even surface.

Strike-boards used must be straight, free from warp, shod on the striking surface with a strip of steel, shaped to the required crown, and have sufficient weight and rigidity to accomplish the purpose desired.

**(3) Floating.** After the concrete has been struck off and consolidated, it shall be further smoothed and consolidated by any approved method of mechanical floating, either longitudinal or transverse, which will satisfactorily finish the pavement to the required cross-section, elevation, and surface smoothness. The use of mechanical floating equipment will be contingent upon satisfactory results.

Excess water, laitance, or foreign materials brought to the surface during the floating operations shall not be reworked into the pavement but shall be removed immediately upon appearance by means of a squeegee or straightedge drawn from the center of the pavement toward either edge.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

**(4) Straightedging.** After the longitudinal floating has been completed and the excess water removed, but while the concrete is still plastic, the slab surface shall be checked by the Contractor in both directions for trueness, using a straightedge. For this purpose an accurate 10' (3 m) metal straightedge shall be used, swung from a handle longer than one-half the width of the slab. Additional floating may be necessary to eliminate all irregularities. The straightedge shall be held in successive positions parallel to the pavement centerline in contact with the surface and the surface checked for the full width of the slab.

Progression along the pavement shall be in successive stages of not more than one-half the length of the straightedge. Depressions found shall be immediately filled with freshly mixed concrete, struck-off, floated, and refinished. High areas shall be cut down and refinished. Straightedge testing and surface correction shall continue until the entire surface conforms to the required grade and section.

**(5) Final Finish.** Following the straightedging and after all excess moisture has disappeared, the surface of the concrete pavement shall be given a final finish with a drag followed by grooving. The drag shall consist of a seamless strip of damp burlap, cotton fabric, or artificial turf that will produce a uniform surface of gritty texture after dragging longitudinally along the full width of pavement. For pavement 16' (5 m) or more in width, the drag shall be mounted on a bridge and moved along the surface by mechanical means. The dimensions of the drag shall be such that a strip at least 2' (0.6 m) wide is in contact with the full width of pavement surface while the drag is used. A burlap or fabric drag shall consist of not less than 2 layers with the bottom layer approximately 6" (150 mm) wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16" (1.5 mm) in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags furnished.

The final finish shall be produced by using the drag finish as described above along with the further application of a metal tine finishing device. The tines shall be approximately 0.032" by 0.125" (0.8 mm by 3 mm) steel flat wire, 2" to 5" in length (50 mm to 125 mm) and spaced on 1/2" to 3/4" (13 mm to 19 mm) centers. The grooves produced in the concrete shall be substantially from 1/8" to 3/16" (3 mm to 5 mm) in depth. The grooves shall be transverse to the centerline of the pavement. On main lanes the metal tine device shall be operated by an approved mechanical means. Manual methods may be used on ramps, connections, and miscellaneous sections when approved by the Engineer.

As an alternate to the use of a burlap drag and a metal tine finishing device, a finned float may be used according to the following requirements:

After a tight uniform surface meeting the straightedge requirements of Subsection 501.05(k)(4) has been achieved, the surface shall be given a texture by transverse grooving with a finned float. The finned area of the float shall be at least 4" by 36" (100 mm by 900 mm). The fins shall extend the full length of the float and cover at least half the width. The grooving shall be approximately 3/16" (5 mm) in width at 3/4" (20 mm centers) and substantially between 1/8" to 3/16" (3 mm and 5 mm) in depth. This operation shall be performed at such time and in such manner that the desired texture will be achieved while minimizing displacement of the larger aggregate particles.

Other texturing equipment or methods may be approved by the Engineer provided it produces a texture equivalent to that produced by the metal tine or float.

**(6) Finishing Joints and Edging.** Longitudinal and transverse joints, where required, shall be so constructed as to allow the normal finishing operations to be executed and completed over the joint. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints and formed joints, shall be worked with an approved tool and rounded to a 1/4" (6 mm) radius. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during use.

At joints, tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. Concrete on top of the joint filler shall be completely removed.

Joints shall be tested with a straightedge before the concrete has set. Corrections shall be made if one side of the joint is higher or lower than the other.

**(I) Curing.** Immediately after finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured according to one of the following methods:

**(1) Polyethylene-Burlap Mats.** The mats used shall be of such length or width that as placed they will extend at least twice the thickness of the pavement beyond the edges of the slab. The

mat shall be placed so that the entire surface and both edges of the slab are completely covered. Before being placed, the mats shall be saturated thoroughly with water. The mats shall be so placed and weighted down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 5 days after the concrete has been placed unless otherwise specified.

**(2) Polyethylene Sheeting or Copolymer/Synthetic Blanket.**

When this type of curing is used, the sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such width that each unit as placed will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 5 days after the concrete has been placed.

**(3) Membrane Curing.** The entire surface of the pavement shall be sprayed uniformly with curing compound (ASTM C309 Type 1-D or Type 2) immediately after the finishing of the surface and before the set of the concrete has taken place, or, if the pavement is cured initially with an alternate method, it may be applied upon removal of the covering. The curing compound shall not be applied during rainfall.

Curing compound shall be applied using pressure sprayers at the minimum rate of 1 gallon per 125 square feet (1 L/3 sq m). The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment or dye uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed.

The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause during the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, when used, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

**(m) Surface Evenness and Testing.** The finished pavement surface shall have a maximum profile index of 5" per mile (75 mm/km) ( $\pm 0.1$ " [2.5 mm] blanking band) for each 0.1 mile (200 m) section, or portion thereof, for mainlane pavement and 10" per mile (150 mm/km) for each 0.1 mile (200 m) section, or portion thereof, for ramps and acceleration/deceleration lanes.

The cross slope of the pavement shall vary no more than 1/8" (3 mm) in 10' (3 m) when tested with a straightedge.

The Contractor shall furnish a California-style profilograph complying with ASTM E 1274 or an automated lightweight profilometer complying with ASTM E 950, Class I and calibrated to the California-style profilograph scale.

The Contractor will take all profiles required by this subsection, under the observation of the Engineer. All data obtained from the profiling operations will be furnished to the Engineer at the end of each day's operations. The Engineer will verify the calibration of the profilograph equipment as frequently as necessary to assure proper operation.

The Engineer will verify the profiles by testing approximately 10% of the pavement. This testing will be performed by the Engineer, using either the profilograph furnished by the Contractor or one provided by the Department, at the option of the Engineer.

A profile will be taken near the center of each traffic lane or ramp using the profilograph equipment. The profiles shall begin 25' (7.5 m) from an existing structure or from the end of the pavement or 25' (7.5 m) back onto the previous day's run. The finished surface of the 25' (7.5 m) sections adjacent to an existing structure or the end of pavement shall not show surface deviations in excess of 1/8" (3 mm) in 10' (3 m) when tested with a 10' (3 m) straight edge.

For the first day's run, profiles will be taken utilizing the profilograph equipment as soon as the hardness of the concrete is sufficient for proper testing. Smoothness profiles of the first day's run will be analyzed before the second day's run commences. Should the day's run not meet the profile index of 5" per mile (75 mm/km) or less (10" per mile [150 mm/km] for ramps and

acceleration/deceleration lanes), the paving operations shall be discontinued until better methods and equipment are obtained or until the present equipment is properly adjusted. If adjustments are necessary from the first day's run, the second day's run will be profiled to determine the ability of the equipment to finish the pavement within the specified tolerance. If the second day's operation fails to produce a finished surface having a profile index of 5" per mile (75 mm/km) or less (10" per mile [150 mm/km] for ramps and acceleration/deceleration lanes), the Contractor shall produce new methods and/or equipment that will obtain the specified results. The new methods and/or equipment will be given trial runs as indicated above for the original equipment.

For the duration of the work every reasonable effort shall be made to test smoothness within 5 working days after each day's run. Scheduling and testing shall be coordinated with the Engineer. The Contractor shall be responsible for traffic control associated with the testing operation.

All objects and foreign material on the pavement surface, including protective covers, shall be removed by the Contractor before testing. If appropriate, protective covers shall be properly replaced by the Contractor after testing.

Grinding shall be performed, if necessary, to reduce the profile index as determined by the profilograph to 5" per mile (75 mm/km) or 10" per mile (150 mm/km), as appropriate, in any 0.1 mile (200 m) section on all profiles, including the trial run. The grinding equipment shall be power driven and specifically designed to smooth and texture portland cement concrete by means of diamond blades. Areas that have been ground shall be re-grooved by grooving according to Subsection 802.19 for Class 7 surface finish, to provide a uniform texture equal in roughness to the surrounding unground pavement. However, if the ground area is less than 50' (15 m) in length and full width of the pavement lane, re-grooving will not be required.

Continual production of a final surface not qualifying for full payment will not be allowed.

In addition to the above requirements for profile indices, areas representing high points having deviations in excess of 0.3" (7.5 mm) in 25' (7.5 m) as determined by the profilograph equipment or 1/8" (3 mm) in 10' (3 m) as determined by the



straightedge, shall be reduced by grinding until such deviations as indicated by retest do not exceed the above limits.

Areas showing low spots of more than 1/4" (6 mm) in 10' (3 m) in the longitudinal direction shall be corrected by grinding or shall be removed and replaced according to Section 507 to an elevation that will not show surface deviations in excess of 1/8" (3 mm) in 10' (3 m).

**(n) Shoulder Construction.** In the construction of the shoulders, the base course material shall be placed directly on the shoulder area between the pavement edge and the outer shouldering limits indicated on the typical section. Material shall not be deposited on the surface of the pavement during placing. Care shall be exercised by the Contractor in manipulating and shaping of the material on the shoulders to assure a minimum amount of littering with base material on the pavement surface. Any littering of the surface of the pavement with base material shall be corrected by brooming.

**(o) Opening Pavement to Traffic.** The Contractor shall prevent all traffic, including construction traffic, from using newly constructed pavement until the concrete is found, by suitable tests of representative cylinders prepared at regular intervals and subjected to the same curing conditions as the pavement, to have a compressive strength of not less than 3000 psi (21.0 MPa). The pavement shall not be opened to traffic in less than 7 days, except that the minimum time for opening the pavement to traffic shall be reduced from 7 days to 24 hours when High Early Strength Pavement is specified and the requirements of Subsection 501.08 are met. Before opening the pavement to the public, all joints shall be cleaned and sealed, and the surface of the pavement cleaned of foreign substances.

**501.06 Slip Form Paver.** When a slip form paver is used, the following requirements shall apply:

**(a) Conditioning of Subgrade or Foundation Course.** After the subgrade or base has been placed and compacted to the required density, the area that will support the slip form paving machine and the area on which pavement is to be constructed shall be brought to the proper profile and cross section by means of a properly designed electronic or automatic screed control system for the control of grade and slope and recompact to the prescribed density. The subgrade and the top of each successive type of base course material

shall be graded to a stringline tolerance of 0" (0 mm) high and 1/2" (12 mm) low when compared to the computed grade for the subgrade or individual type of base course. Unless otherwise provided for in the plans or special provisions, no hauling will be allowed on the finished subgrade or base course except for dumping the concrete. Suitable temporary construction crossovers may be constructed when approved by the Engineer. The subgrade shall be prepared for a distance of not less than 500' (150 m) in advance of the paver or the entire remaining distance when within 500' (150 m) of the end of the paving or bridge end. The subgrade or base course shall be checked and corrected immediately ahead of the placing of the concrete.

**(b) Placing and Finishing.** The slip form paver shall be designed to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement conforming to the plans and specifications. The paver shall be self-propelled.

Final approval of spreading and finishing equipment will be based upon satisfactory performance during actual construction. If, for any reason, equipment previously approved becomes unsatisfactory, it shall be replaced or repaired before proceeding with the work.

The machine shall vibrate the concrete for the full width and depth of pavement being placed. This vibration shall be accomplished by means of satisfactory internal vibration in each course of concrete placed. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. Hand finishing shall be kept to a minimum. If the machine is of the trailing form type and hand finishing is required, it must be done within the length of the trailing forms.

**(c) Uniform Consistency and Progress.** The concrete shall have a uniform consistency. The slip form paver shall be operated with a continuous forward movement and all operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide a uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be

applied to the machine except that which is controlled from the machine.

**(d) Surface Test.** The surface tolerance of the finished pavement shall meet the requirements of Subsection 501.05(m). Any slump of the pavement edge in excess of 1/4" (6 mm) shall be corrected before the concrete has hardened.

**501.07 Stationary Side Forms. (a) General.** Side forms shall have a height and base width not less than the edge thickness of the pavement. Each section of forms shall be reasonably straight and free from warp. The method of connecting form sections shall be such that a joint is formed free from play or movement in any direction. The face of the forms shall be set normal to the cross-section slope of the pavement surface. When set to line and grade, the forms shall have a tolerance of 1/4" (6 mm) for alignment and 1/8" (3 mm) for grade, and shall be of such strength and so secured as to resist, without springing or settlement, the pressure of the concrete when placed and the impact and vibration of the finishing machine. The minimum length of sections of forms used on tangents shall be 10' (3 m).

Forms shall be cleaned before being set to line and grade and shall be oiled before placing concrete. Oiling shall be performed in such manner as to prevent contamination of reinforcing steel and dowels.

After the forms have been set to correct grade, the subgrade under and about them shall be thoroughly tamped by means of a mechanical form tamper so constructed that each side of the form will be tamped simultaneously. Hand tampers or other means shall be used to supplement the mechanical tamper as necessary to obtain an unyielding support for the forms. On treated bases, the forms may be supported by approved shimming methods.

The alignment and grade of forms shall be checked and must be approved immediately before placing the concrete. Forms that show a variation in excess of the surface tolerance requirements specified shall be removed and replaced or otherwise corrected.

**(b) Removing Forms.** Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully to avoid damage to the pavement. Immediately after the forms have been removed, the side

of the slab shall be cured by one of the approved methods. Honeycombed areas will be considered as defective work and shall be repaired or replaced, as directed.

**501.08 High Early Strength Concrete Pavement.** When High Early Strength Concrete Pavement is specified and used, it shall be made with the use of high early strength portland cement complying with AASHTO M 85, Type III cement, in lieu of AASHTO M 85, Type I cement. Upon written permission of the Engineer, the Contractor may substitute standard portland cement with a cement factor of 25% in excess of that specified for Portland Cement Concrete Pavement for the high early strength cement in the High Early Strength Concrete Pavement. No additional compensation will be allowed above the price bid for High Early Strength Concrete Pavement for the 25% additional cement if standard portland cement is used. All other requirements specified for Portland Cement Concrete Pavement shall be applicable to High Early Strength Concrete Pavement.

**501.09 Repair of Defective Pavement Slabs.** Broken slabs, random cracks, nonworking contraction joints, major honey-combed areas, and spalls shall be replaced or repaired according to Sections 507 and/or 509, as appropriate, at no cost to the Department.

**501.10 Tolerance in Pavement Thickness.** The pavement shall be constructed according to the thickness required by the typical cross section shown on the plans.

Cores will be drilled according to the procedures in Subsection 501.04.

Where not constructed according to the planned thickness, the following procedure for adjustment of payment will govern:

When any core is more than 1/2" (12 mm) less than the specified thickness, additional cores will be taken to determine the extent of the thickness deficiency. 2" (50 mm) diameter cores may be drilled for thickness deficiency determination. Cores will be drilled on cross sections of the same slab of the pavement, measured parallel to the centerline, 10' (3 m) back and 10' (3 m) ahead of the station of the original core. If both of these cores are within 1/2" (12 mm) of the specified thickness, no further special corings for this individual zone of deficiency need be made. If either or both of these cores are not within 1/2" (12 mm) of the specified thickness, additional cores

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will be taken on cross-sections of the slab in question, 25', 50', 100', and 200' (7.5, 15, 30, and 60 m) ahead and back of the original core, and thereafter at 200' (60 m) intervals until a thickness within the 1/2" (12 mm) tolerance is found in each direction. The Contractor shall drill and fill core holes at no cost to the Department.

No payment will be made for any section of pavement that is more than 1/2" (12 mm) deficient in thickness. The length of such section will be the sum of the distances measured in both directions, parallel to the centerline, from the deficient core to the nearest core that shows a thickness not more than 1/2" (12 mm) deficient. In all cases deductions will be made for the full width of the slab of which the cores are represented (normally 2 traffic lanes placed simultaneously).

When a deficiency in thickness of any portion of pavement slab in excess of 1/2" (12 mm) may seriously impair traffic service of the pavement, the Contractor will be required to remove such deficient slab and to replace it with a slab of satisfactory quality and thickness that, when accepted, will be included in the measurement for payment. The Contractor shall receive no compensation for any cost incurred in the original placement and subsequent removal of the deficient slab.

In removing pavement that is deficient in thickness, the pavement shall be removed from the edge to a longitudinal joint, or between longitudinal joints, and on each side of any deficient area until no portion of the exposed section is more than 1/2" (12 mm) deficient, except that in no instance shall there be less than 10 linear feet (3 m) of pavement removed. If in meeting the above requirement, there remains less than 10' (3 m) of acceptable pavement between the section that has been removed and a transverse plane of weakness, then the Contractor shall remove the pavement to the plane of weakness at no cost to the Department. The Contractor shall then replace all the pavement that has been removed with satisfactory, acceptable pavement according to Section 507 and the details of the Department's applicable Standard Drawings for PCCP Patching. If the plane of weakness is a contraction, expansion, or construction joint, the joint shall be replaced with a joint of the same design as the one removed. If the plane of weakness is a warping joint, the new joint shall be formed to comply with Subsection 501.05(j)(3).

The thickness of the pavement of each lot will be computed from the average of the thickness of the core(s) taken from that lot, and

the thickness of the pavement of the entire project will be computed from the average of the thickness determined for each lot, except that lots or sublots found more than 1/2" (12 mm) deficient in thickness will not be considered in such computation.

Should the thickness of the pavement as constructed, in any lot, exceed the thickness shown on the plans, the actual thickness as constructed, not to exceed 1/4" (6 mm) in excess of the thickness shown on the plans, will be used in computing the thickness of the pavement for that lot. No additional payment over the contract unit price will be made for any pavement in excess of the thickness specified.

Payment for pavement deficient in thickness, not in excess of 1/2" (12 mm), will be made by item deduction. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction.

The total price reduction for the isolated area shall be calculated by the following formula:

$$\% \text{ Price Reduction} = \left( 1 - \frac{\text{avg. thickness}^2}{\text{plan thickness}^2} \right) * 100$$

**501.11 Constructing Pavement in Half Widths.** When the pavement is placed in half widths, a longitudinal center joint with tie bars, as provided for by the plans and specifications, shall be used.

Where the pavement is being constructed in half widths, the Contractor shall maintain a safe passageway according to the provisions of Section 603.

**501.12 Incentives/Price Adjustments for Ride Smoothness.** It is the intent of this specification to produce a pavement that is durable and consistently exceeds the minimum test values in these specifications. Incentive payments will be accomplished by change order and will be shown on the final estimate as a separate item increase. Incentives will be calculated according to the following guidelines.

Price adjustments apply to the total area for the standard 12' (3.7 m) lane width represented by the profile index for a continuous mainlane section at least 0.1 mile (200 m) long. Price adjustments for incentives are only based on the initial measured profile index of continuous sections of at least 0.1 mile (200 m) in length, excluding

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approach slabs and bridges, and before any corrective work; however, grinding will be allowed to achieve full payment. Ramps, acceleration/deceleration lanes, shoulders, islands, tapers, or other incidentals shall not be considered for price adjustments. If grinding is required due to failure to meet the required profile index, the pavement will be ground to a level which qualifies for 100% payment.

Price adjustments shall be made as follows:

PROFILE INDEX		PRICE ADJUSTMENT % of payment of Unit Bid Price
In/Mi./0.1 Mi. section	mm/km/200 m section	
2 or less	30 or less	+ 6.0%
Over 2 to 3	Over 30 to 45	+ 4.0%
Over 3 to 4	Over 45 to 60	+ 2.0%
Over 4 to 5	Over 60 to 75	0
Over 5 to 6	Over 75 to 90	- 2.0%
Over 6 to 7	Over 90 to 110	- 4.0%
Over 7	Over 110	CORRECTIVE WORK REQUIRED

**501.13 Method of Measurement.** (a) Portland Cement Concrete Pavement and High Early Strength Concrete Pavement will be measured by the square yard (square meter). The width for measurement will be the width as constructed according to the plans and typical cross sections or as directed by the Engineer.

(b) Reinforcing steel, other than steel for joints, will be measured according to Section 502.

**501.14 Basis of Payment.** (a) Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Pavement or for High Early Strength Concrete Pavement, as the case may be, of the thickness and type specified, which price shall be full compensation for preparing the subgrade or base and shaping the shoulders unless otherwise specified; for furnishing, transporting, and placing materials, including steel bars for joints and all other joint materials; for the preparation and processing of materials; for mixing, spreading, vibrating, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; for sawing, cleaning, filling, and sealing joints; for half width construction; for furnishing the profilograph;

taking all required profiles, performing all necessary computations; and for all labor, equipment, tools, and incidentals necessary to complete the work; provided, that for such area as is deficient in thickness, only the adjusted price will be paid as specified in Subsection 501.10. No payment will be made for pavement deficient in thickness in excess of 1/2" (12 mm), even though the deficient pavement may be allowed to remain in place, nor for repair as specified in Subsection 501.09.

(b) Reinforcing steel, when specified, other than the steel for joints mentioned above, will be paid for as provided under Section 502. Steel for joints will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for Portland Cement Concrete Pavement and High Early Strength Concrete Pavement.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Pavement (__" [__mm] Uniform Thickness)	Square Yard (Square Meter)
High Early Strength Concrete Pavement (__" [__mm] Uniform Thickness)	Square Yard (Square Meter)

## **SECTION 502 REINFORCING STEEL FOR PAVEMENT**

**502.01 Description.** This item shall consist of furnishing and placing reinforcing steel of the type and size designated on the plans and conforming to the details shown on the plans for Portland Cement Concrete Pavement.

**502.02 Materials.** Reinforcing steel, dowel bars, and other steel reinforcement shall comply with the requirements of the following specifications:

Dowel bars shall comply with AASHTO M 31. Dowel bars and tie bars shall be epoxy coated according to the provisions of ASTM 775 using a coating material meeting Annex A1. The Contractor shall provide the coating applicator's certification in accordance with Subsection 804.02(d) and that all materials used, the preparation of the bars, the coating and curing were done according to these specifications. Damage to epoxy coated bars shall be



repaired according to the epoxy powder manufacturer's recommendations and Subsection 804.05. All repairs shall be made at no cost to the Department. No coating repairs will be required for uncoated cut or sheared ends of dowel bars or tie bars.

Reinforcing Steel shall comply with AASHTO M 31 or AASHTO M 322.

Welded Wire Fabric shall comply with AASHTO M 55 or M 221.

Tie bars that are bent and later straightened to facilitate construction shall comply with AASHTO M 31, Grade 40 (Grade 300).

Reinforcing Steel used for longitudinal members in continuously reinforced concrete pavement shall be AASHTO M 31, Grade 60 (Grade 400).

**502.03 Construction Requirements.** Reinforcing steel for pavement shall be placed according to Section 501 or Section 503, as applicable. Shipping, handling, and placement of epoxy coated bars shall be in accordance with Subsection 804.05.

**502.04 Method of Measurement.** Reinforcing steel placed and accepted will be measured by the pound (kilogram), complete in place, making no allowance for laps or splices. The weight for reinforcing steel will be computed by multiplying the gross area of the pavement by the quantity in lbs./sq. yard (kg/sq m) specified on the plans.

**502.05 Basis of Payment.** Work performed and accepted and measured as provided above will be paid for at the contract unit price bid per pound (kilogram) for Reinforcing Steel for Pavement of the type used, Bars or Mesh Fabric, as the case may be, which price shall be full compensation for furnishing and placing materials and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Reinforcing Steel for Pavement (Bars)	Pound (Kilogram)
Reinforcing Steel for Pavement (Mesh Fabric Type___)	Pound (Kilogram)

## SECTION 503 CONTINUOUSLY REINFORCED CONCRETE PAVEMENT

**503.01 Description.** This item shall consist of a continuously reinforced concrete pavement, constructed on a prepared subgrade or on a completed and accepted base course according to these specifications, and conforming to the lines, grades, thickness, and typical cross section shown on the plans or established by the Engineer.

**503.02 Proportions.** The concrete shall be proportioned according to Section 501.

**503.03 Materials.** Materials used under this item of work shall comply with the applicable requirements of Sections 501 and 502.

**503.04 Construction Requirements.** Except as modified below, the construction of continuously reinforced concrete pavement shall be performed according to the requirements of Sections 501 and 502. In the event a portland cement stabilized base material is used under the pavement, the specified bond breaker shall be in place and undamaged when pavement is placed. If the base, curing agent, or bond breaker has been damaged in any manner, repairs shall be made before pavement is placed.

**(a) Placement of Reinforcement.** Reinforcement may be installed by one of the following methods: 1) Preset on chairs, or 2) Placed by mechanical means.

Regardless of the method of placement used, the horizontal spacing tolerances shall be  $\pm 1/2"$  ( $\pm 12$  mm) for longitudinal steel and  $\pm 2"$  ( $\pm 50$  mm) for transverse steel. The spacing and vertical position of the longitudinal and transverse steel shall be as shown on the plans.

At the time concrete is placed, the reinforcement shall be free from loose, flaky rust, mud, oil, or other coatings that will materially reduce the bond and shall be handled with such care that the bars or mesh fabric sheets will remain reasonably flat and free from distortion. Loose bars shall be free from such kinks or bends as may prevent them from being properly assembled or installed.

**(1) Reinforcement Preset on Chairs.** The reinforcement shall be supported on chairs approved by the Engineer.

The arrangement and spacing of chairs shall be such that the reinforcement will be supported in proper position without permanent deflection or displacement during placing and consolidation of concrete. The tolerances specified herein shall not be exceeded. Chairs shall have sufficient bearing at the base to prevent overturning and penetration into the subbase, and shall be designed so as not to impede the placing and consolidation of concrete. Welding of chairs to transverse bars will be permitted.

If the support system does not maintain the reinforcement in the position required by these specifications during the placing and finishing of the concrete, the Contractor will be required to increase the number of chairs or take such other steps as necessary to assure proper position of the steel.

When the reinforcement consists of individual bars, the longitudinal bars shall be secured to the transverse bars by wire ties or clips at alternate intersections or more frequently if necessary to maintain their position within the horizontal and vertical tolerances specified herein.

**(2) Reinforcement Placed by Mechanical Means.** The reinforcement shall be incorporated into the concrete at its proper position by methods and/or equipment approved by the Engineer. When individual deformed bars are used, tying the intersection between longitudinal and transverse bars may be omitted if it can be demonstrated conclusively to the Engineer that the equipment and method used will assure proper placement of the reinforcement. The method of placement used shall maintain the splice pattern shown on the plans.

Embedment of the reinforcing steel shall be performed in such a manner that the concrete, after final finishing, shall show no segregation attributable to the placing operation.

**(b) Splices in Reinforcing Steel.** Reinforcing bars, bar mats, or welded wire fabric used as continuous reinforcement shall be lapped in the longitudinal direction in a staggered pattern as shown on the plans. All laps shall be securely tied or clipped. In lieu of lapped splices, the Contractor may use welded or mechanical splices according to Section 804.07.

**(c) Placement of Concrete.** The concrete shall be placed in a single course to the full depth.

**(d) Transverse Construction Joints.** At the end of each day's run, or at any time that the paving operation is delayed for more than 30 minutes, a transverse construction joint shall be formed as shown on the plans. The time may be adjusted, due to weather conditions, as directed by the Engineer. The joint shall be formed by placing the concrete against a header approved by the Engineer. The longitudinal reinforcing steel shall extend through the header for a sufficient length to provide a proper lap and be supported from the subgrade beyond the header to prevent undue deflections during paving operations. Hand vibrators shall be used to supplement mechanical vibrators at all construction joints.

**(e) Transverse Expansion Joints.** Expansion joints shall be provided where specified and according to the details shown on the plans.

**(f) Longitudinal Joints.** Longitudinal joints shall be constructed as specified in Subsection 501.05(j).

**(g) Temporary Pavement Crossings.** Where necessary to allow the passage of traffic across continuously reinforced concrete pavement at sites shown on the plans, or as directed, the Contractor shall construct and maintain suitable and substantial crossings to bridge the pavement. Such crossings shall be adequate for two-way traffic and satisfactory to the Engineer.

Pavement damaged before it is accepted shall be repaired or replaced at no cost to the Department.

Gaps in the pavement for temporary crossings will not be permitted.

**503.05 Method of Measurement.** (a) Continuously Reinforced Concrete Pavement and High Early Strength Continuously Reinforced Concrete Pavement will be measured by the square yard (square meter). The width for measurement will be the width as constructed according to the plans and typical cross sections.

(b) Reinforcing steel will be measured and paid for under Section 502.

(c) Temporary pavement crossings will not be measured for payment.

**503.06 Basis of Payment.** (a) Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Continuously

Reinforced Concrete Pavement or for High Early Strength Continuously Reinforced Concrete Pavement, as the case may be, of the thickness and type specified, which price shall constitute full compensation for furnishing and preparation of materials including transverse and longitudinal joints, joint filler, and dowels or load transfer devices as required on the plans; for placing, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; for furnishing the profilograph; taking all required profiles, performing all necessary computations; and for all labor, equipment, tools, and incidentals necessary to complete the work. For such area as is deficient in thickness, only the adjusted price will be paid as specified in Subsection 501.10. No payment will be made for pavement deficient in thickness in excess of 1/2" (12 mm), even though the deficient pavement may be allowed to remain in place, nor for repair as specified in Subsection 501.09.

(b) Reinforcing steel will be paid for under Section 502.

(c) Mix Design and Quality Control according to Section 501 will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Continuously Reinforced Concrete Pavement.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Continuously Reinforced Concrete Pavement (___" [___mm] Uniform Thickness)	Square Yard (Square Meter)
High Early Strength Continuously Reinforced Concrete Pavement (___" [___mm] Uniform Thickness)	Square Yard (Square Meter)

**SECTION 504  
APPROACH SLABS AND GUTTERS**

**504.01 Description.** This item shall consist of the construction of approach pavement slabs and gutters for structures, and furnishing and placing base material, according to these specifications and conforming to the location, type, dimensions, lines, and grades shown on the plans.

**504.02 Materials.** Materials used under this item of work shall comply with the applicable requirements of the following sections of the specifications, except as otherwise provided:

Base Material	Sections 303, 307, 308, or 405 as designated on the plans. As an alternate to Section 303 base material, the Contractor may substitute an equal depth of material complying with Sections 307, 308, 405, 406, or 407.
Corrugated Metal Pipe	Section 606.
Reinforcing Steel	Section 804.
Concrete	Section 501 for Portland Cement Concrete Pavement, or High Early Strength Portland Cement Concrete Pavement, or Section 802 for Class S Concrete. The Contractor shall furnish the mix design in accordance with Subsection 501.03 or 802.05 and perform Quality Control and Acceptance sampling and testing in accordance with Subsection 501.04 or 802.06, as applicable to the class of concrete used.
Joint Filler	Section 501.
Membrane Curing Compound	Section 501.

**504.03 Construction Requirements.** Except as otherwise provided, the methods employed in performing the work shall comply with the applicable requirements of the specification sections as listed:

Subgrade	Section 212.
Corrugated Metal Pipe	Section 606.
Base Course	Section 303, 307, 308, or 405 as designated on the plans, or the Sections applicable to the alternate materials.
Reinforcing Steel	Section 502.
Concrete	Section 501.
Joints	Section 501.

Approach slabs shall be given a Class 5 surface finish according to Subsection 802.19 unless a Class 7 finish is specified.

The curing of the concrete in the approach slabs and gutters shall be by one of the methods specified in Subsection 501.05(1).

**504.04 Method of Measurement.** (a) Approach Slabs will be measured by the cubic yard (cubic meter).

(b) Approach Gutters will be measured by the cubic yard (cubic meter).

(c) Base material will be measured as provided in Sections 303, 307, 308, or 405 for the material designated on the plans.

(d) Reinforcing Steel will be measured as provided in Section 804.

(e) Class 7 surface finish will be measured as provided in Section 802.

(f) Corrugated metal pipe will be measured as provided in Section 606.

Quantities shown on the plans for Approach Slabs, Approach Gutters, and Reinforcing Steel will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

**504.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Approach Slabs or Approach Gutters of the type designated, which price shall be full compensation for excavation and backfill; for furnishing materials; for forming, mixing, placing, curing, and finishing concrete; for performing mix designs and quality control and acceptance sampling and testing; for Class 5 surface finish; for sawing, filling, and sealing joints; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Base material will be paid for under Sections 303, 307, 308, or 405, for the material designated on the plans.

Reinforcing steel will be paid for under Section 804.

When Class 7 surface finish is specified, payment will be made under Section 802.

Corrugated metal pipe will be paid for under Section 606. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Approach Slabs	Cubic Yard (Cubic Meter)
Approach Gutters	Cubic Yard (Cubic Meter)

## **SECTION 505**

### **PORTLAND CEMENT CONCRETE DRIVEWAY**

**505.01 Description.** This item shall consist of portland cement concrete constructed in one course on the prepared subgrade or on a completed and accepted base course according to these specifications and conforming to the lines, grades, thickness, and typical cross section shown on the plans.

**505.02 Materials. (a) Concrete.** Concrete for driveways shall comply with Section 802 for Class A Concrete or Class M Concrete, except that mixing on site, volumetric proportioning, and commercial bagged concrete mix will not be allowed. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

**(b) Joint Filler.** Materials for joint filler shall comply with AASHTO M 213.

**(c) Curing Materials.** Curing materials shall comply with Subsection 501.02(i).

**505.03 Construction Requirements.** The methods employed in performing the work shall comply with Subsection 501.05. Transverse expansion joints shall be placed at 15' (4.5 m) intervals or as directed by the Engineer.

**505.04 Method of Measurement.** Portland Cement Concrete Driveway will be measured by the square yard (square meter).

**505.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement



Concrete Driveway, which price shall be full compensation for furnishing, preparing, hauling, and placing materials, including joint materials; for excavation and preparation of subgrade; for shaping and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Driveway	Square Yard (Square Meter)

**SECTION 506  
PORTLAND CEMENT CONCRETE  
CORRUGATIONS**

**506.01 Description.** This item shall consist of the forming of a corrugated rumble strip in the plastic concrete. The corrugations shall be of the size, shape, and spacing shown on the plans or as directed by the Engineer.

**506.02 Construction Requirements.** The corrugations shall be formed in the plastic concrete at the optimum time to produce a neat and uniform finish. The corrugations shall be formed using methods approved by the Engineer.

**506.03 Method of Measurement.** Corrugations will be measured by the square yard (square meter).

**506.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Corrugations, which price shall be full compensation for the formation of the corrugations and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Corrugations	Square Yard (Square Meter)

## SECTION 507 PORTLAND CEMENT CONCRETE PAVEMENT PATCHING

**507.01 Description.** This item shall consist of removing and replacing portland cement concrete pavement at the locations designated on the plans or where directed by the Engineer.

**507.02 Materials.** The materials and proportions for concrete patching shall comply with the applicable requirements of Sections 501 and 502, except that the mixed concrete shall have a maximum slump of 4" (100 mm) and that epoxy coated tie bars and dowel bars are not required. Mix designs shall be performed by the Contractor in accordance with Subsection 501.03. Quality control and acceptance testing shall be according to Subsection 501.04, except that compressive strength will be determined by cylinders obtained according to AASHTO T 23 and that coring will not be required to determine pavement thickness. Thickness will be determined immediately prior to placing the concrete for the pavement patch.

Each dowel bar shall be coated from one end for a minimum distance of 2" (50 mm) greater than half the length of the bar with a film of epoxy, plastic, epoxy paint, zinc chromate primer, zinc strontium phospho-silicate primer, red oxide primer, or tar paint. When bar coatings are found to be damaged prior to or during installation in the pavement, such bars shall be replaced with acceptable bars at no cost to the Department.

Materials for securing tie bars and dowel bars shall be listed on the QPL.

**507.03 Construction Requirements.** The construction requirements for Removal and Disposal of Concrete Pavement shall comply with Subsection 202.03 and the following:

The existing pavement to be removed shall be sawed the full depth of the slab as shown on the plans. If necessary and approved by the Engineer, one additional cut may be made to facilitate removal. Overcutting beyond the limits of the area to be removed shall be held to a minimum. All overcuts shall be thoroughly cleaned of saw slurry and other contaminants and completely filled with a low viscosity epoxy compound.

After sawing, the pavement to be removed shall be carefully lifted out in a manner that will not damage the existing pavement

that is to remain or the existing base material. Any damage shall be repaired to the satisfaction of the Engineer at no cost to the Department. The material removed shall be placed in locations that will not cause a hazard to motorists and shall be removed from the project site by the end of each day's work.

Before placing the patch, any loose base material shall be removed. If the existing base material is granular, it shall be recompacted as necessary.

The Contractor shall take all precautions necessary to ensure that the base material remains dry until the new concrete is placed.

The construction methods for Portland Cement Concrete Pavement Patching shall comply with Subsections 501.05 and 503.04 and the following:

**(a) Installation of Dowel Bars and Tie Bars.** Dowel bars and tie bars shall be installed according to details included on the plans. Drills used to make holes shall be held in a rigid frame to assure proper horizontal and vertical alignment. The equipment shall be operated so as to prevent damage to the pavement being drilled. The drilling procedure shall be approved by the Engineer. When using a resin anchoring system, the bars shall be installed according to information provided by the manufacturer. To secure the bars, special care must be taken to ensure that the filling system completely surrounds the bars and fills the holes.

The filling system shall be an injection type system approved by the Engineer that will ensure that sufficient material is injected into the hole before the bar is inserted.

**(b) Joints.** Joints shall be constructed according to details shown on the plans. Joints that will require sawing and sealing shall be re-established as soon as possible to prevent random cracking.

**(c) Patches.** The initial areas to be patched will be marked by the Engineer. If there are subsequent pavement or patch failures in the initial patching phase, not due to the Contractor's negligence, they shall be repaired and will be paid for under the appropriate bid item. At this time, the item of patching will be considered to be completed.

Completed patches, and areas of the existing pavement adjacent to a completed patch, that are found to contain cracks or other

damage due to Contractor negligence shall be removed and replaced at no cost to the Department.

Full depth side forms shall be used to form the shoulder edge of concrete patches.

Shoulder areas adjacent to completed pavement patches shall be repaired full depth with ACHM Surface Course meeting the requirements of Section 407 or Asphalt Concrete Cold Plant Mix meeting the requirements of Section 411 of the Specifications. Asphalt repairs shall be accomplished prior to opening the lane to traffic. All loose material and formwork shall be removed from the shoulder area prior to placing the asphalt material. The Asphalt Concrete Mix shall be placed, compacted and finished to a uniform grade to eliminate any drop-off along the concrete pavement edge and to match the slope of the existing shoulder.

The completed patch shall show no deviation in excess of 1/8" (3 mm) when checked with a 10' (3m) straightedge, including overlapping half of the length of the straightedge on to the existing pavement. The patch will then be finished in accordance with Subsection 501.05(k)(5).

**(d) Equipment.** Hand methods of spreading, consolidating, and finishing will be permitted, provided that satisfactory results are obtained.

**(e) Measuring Materials and Mixing.** The Contractor may elect to use a mobile, continuous volumetric mixer at the patching location in lieu of a batch plant equipped with an automatic ticket printer as described in Subsection 501.05(c). A mobile, continuous volumetric mixer is defined as a truck mounted system where each component is automatically proportioned out for a selected batch size from on-board storage bins and automatically fed into a mixing unit to produce a mix complying with the requirements of Subsection 507.02. The unit shall be calibrated according to the manufacturer's recommendations by the Contractor in the presence of the Engineer before any placements are made on the project. Copies of all calibration forms/calculations shall be submitted to the Engineer.

A trial batch of at least 2 cubic yards shall be produced from the mobile, continuous volumetric mixer prior to placement of any patches on the project. The trial batch shall be accomplished by the Contractor under the observation of the Engineer. Trial batches will

be sampled and tested by the Engineer to determine compliance with the specifications of the mix produced from the mobile, continuous volumetric mixer for slump, air content, and compressive strength.

**507.04 Method of Measurement.** Removal and Disposal of Concrete Pavement and Portland Cement Concrete Pavement Patching will be measured by the square yard (square meter).

**507.05 Basis of Payment. (a) Removal and Disposal of Concrete Pavement for Patching.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Removal and Disposal of Concrete Pavement for Patching, which price shall be full compensation for sawing, removing, and satisfactorily disposing of the concrete pavement and any underlying base material as directed; for cleaning and filling all overcuts; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(b) Portland Cement Concrete Pavement Patching.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Pavement Patching of the thickness specified, which price shall be full compensation for preparing the existing base material; for furnishing, transporting, and placing materials, including reinforcing steel for pavement, tie bars, dowel bars, and materials for anchoring tie bars and dowel bars; for preparation and processing of materials; for mixing, spreading, vibrating, finishing, and curing concrete; for performing mix designs and quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Adjustment for Additional Thickness. Where the thickness of Portland Cement Concrete Pavement Patching is in excess of the specified uniform thickness (U.T.) plus 1" (25 mm), payment will be made for the percentage in excess of this amount. Payment will be made as follows:

$$Add'l. S.Y. = \frac{Avg. Depth - (Spec. U.T. + 1")}{Specified U.T.} * Normal S.Y.$$

**OR**

$$Add'l. sq. m. = \frac{Avg. Depth - (Spec. U.T. + 25 mm)}{Specified U.T.} * Normal sq. m.$$

(c) **Joints.** When Joint Rehabilitation under Section 509 is included as a pay item in the Contract, joints in concrete pavement patches will be measured and paid for under Section 509. When Joint Rehabilitation under Section 509 is not included as a pay item in the Contract, sawing and sealing of joints in concrete pavement patches will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for PCCP Patching.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal and Disposal of Concrete Pavement for Patching	Square Yard (Square Meter)
Portland Cement Concrete Pavement Patching (___" [__mm]Uniform Thickness)	Square Yard (Square Meter)

**SECTION 508 VACANT**

**SECTION 509  
JOINT REHABILITATION**

**509.01 Description.** This item shall consist of sawing and cleaning existing transverse and longitudinal joints in portland cement concrete pavement, patches, approach slabs, and bridge decks, and filling and sealing the prepared joints with approved material according to these specifications and the details shown on the plans.

**509.02 Materials.** Joint filler and joint sealer shall comply with Subsection 501.02(h).

**509.03 Construction Requirements.** Joint Rehabilitation shall comply with the construction requirements of Subsection 501.05(j) and the following:

Existing joints shall be sawed to expose a new concrete face, free of any joint sealer, and to provide a sealer reservoir. Joints shall be sawed to a sufficient depth to accommodate the joint sealer and backer rod as shown on the plans. Any existing joint inserts,

regardless of type or material that interfere with joint rehabilitation, shall be removed. Any debris resulting from the removal of the inserts shall be disposed of according to Section 201.

No joints, except those for concrete pavement patches, shall be sawed after December 1 and before March 1, without written permission of the Engineer.

All joints, except those for concrete pavement patches, shall be sealed within 15 calendar days after sawing. All joints shall be sealed before opening the pavement to traffic.

Type A Joint Rehabilitation shall include contraction joints in existing concrete pavement, patches, approach slabs, and joints in the decks of concrete slab span bridges. Contraction joints shall be sawed a minimum width as shown on the plans and cleaned, filled, and sealed with Type 3 or 4 joint sealer. Contraction joints in patches shall be sawed according to the details shown on the plans and cleaned, filled, and sealed with Type 3 or 4 joint sealer. Bridge deck joints shall be sawed a minimum of the existing joint width plus 1/8" (3 mm) and cleaned, filled, and sealed with Type 3 or 4 joint sealer.

Type B Joint Rehabilitation shall include all warping and longitudinal joints in existing concrete pavement, patches, and approach slabs. Joints of this type in existing pavement shall be sawed a minimum of the existing joint width plus 1/8" (3 mm) and cleaned, filled, and sealed with Type 3, 4, or 5 joint sealer. Joints of this type in patches shall be sawed according to the details shown on the plans and cleaned, filled, and sealed with Type 3, 4, , or 5 joint sealer.

Type C Joint Rehabilitation shall apply to expansion joints. Existing expansion joints that are 3½" (90 mm) or greater in width shall be thoroughly cleaned to remove all existing joint filler and sealer. Existing expansion joints that are less than 3½" (90 mm) in width shall be sawed full depth to a minimum width of 4" (100 mm) and thoroughly cleaned to remove all joint filler and sealer. Following cleaning and preparation, the expansion joints shall be filled with Type 1 joint filler.

Type D Joint Rehabilitation shall include the joints around the area of concrete pavement patches that are not bounded by normal longitudinal or transverse joints. These joints shall be sawed along the joint created by the concrete pavement patch. The joints shall be

sawed to the details shown on the plans. These joints shall be cleaned and sealed with Type 3, 4, or 5 joint sealer.

**509.04 Method of Measurement.** Joint Rehabilitation will be measured by the linear foot (meter).

**509.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Joint Rehabilitation of the type specified, which price shall be full compensation for sawing and cleaning joints; for removal and disposal of existing inserts; for furnishing and placing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Joint Rehabilitation (Type___)	Linear Foot (Meter)

**SECTION 510**  
**GRINDING PORTLAND CEMENT CONCRETE**  
**PAVEMENT**

**510.01 Description.** This item shall consist of grinding portland cement concrete pavement to substantially eliminate vertical differentials and to restore drainage, riding characteristics, and skid resistance to the pavement surface.

**510.02 Equipment.** The grinding equipment shall be a power driven, self-propelled machine that is specifically designed to smooth and texture portland cement concrete pavement.

The equipment shall be capable of grinding the surface without causing spalls at cracks, joints, or at other locations.

**510.03 Construction Requirements.** The pavement will be initially profiled by the Contractor using an automated lightweight profilometer complying with ASTM E 950, Class 1 and calibrated to the California-style profilograph scale. The initial profilograph will be used to locate high and low areas for correction.

Areas representing high points having deviations in excess of 0.3" (7.5 mm) in 25' (7.5 m) as determined by the profilograph or 1/8" (3 mm) in 10' (3 m) as determined by the straightedge, shall be



reduced by grinding until such deviations as indicated by retest do not exceed the above limits.

Areas showing low spots of more than ¼" (6 mm) in 10' (3 m) in the longitudinal direction shall be corrected by grinding the adjacent higher pavement to an elevation that will not show surface deviations in excess of 1/8" (3 mm) in 10' (3 m).

The construction operation shall produce a uniform finished surface without damaging the existing pavement that is to remain. Grinding shall be accomplished in a manner that eliminates joint or crack faults while providing positive lateral drainage by maintaining a constant cross-slope. Grinding shall transition as required to provide positive drainage and an acceptable riding surface. The pavement shall be ground in a direction opposite to normal traffic flow.

The entire area designated on the plans shall be ground until the pavement surfaces of adjacent sides of transverse joints and cracks are in the same plane. It is intended that the faulting at joints and cracks be eliminated and that substantially all of the pavement surface shown on the plans be textured. Extra depth grinding to eliminate minor depressions in order to provide texturing for 100% of the pavement surface will not be required.

The Contractor shall establish positive means for removal of grinding residue. Solid residue including joint material shall be immediately removed from the pavement surface. Residue shall not be permitted to flow across lanes used by traffic. Drainage facilities shall be kept free of accumulated residue.

**510.04 Final Surface Finish.** The grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. The line type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. The peaks of the ridges shall be approximately 1/32" (0.8 mm) higher than the bottoms of the grooves with approximately 53 to 57 evenly spaced grooves per foot (170 to 190 evenly spaced grooves per meter).

The finished pavement surface will be measured for roughness by the Contractor. Roughness will be measured using an automated lightweight profilometer complying with ASTM E 950, Class 1 and calibrated to the International Roughness Indicator (IRI) scale. The IRI shall not exceed 100 inches per mile per 0.5 mile section (1.60m per km per 0.8 km section). Bridges or any other non-ground sections will not be included in the calculation of the IRI.

The Engineer will verify the roughness indices by testing approximately 10% of the pavement. This testing will be performed by the Engineer, using either the lightweight profilometer furnished by the Contractor or one provided by the Department, at the option of the Engineer.

Vertical misalignment of the planes of the surfaces on adjacent sides of the joints or cracks that is in excess of 1/16" (2 mm) shall be ground until the surfaces are flush.

The transverse slope of the pavement shall be uniform to a degree that no depressions or misalignment of slope greater than 1/4" (6 mm) in 10' (3 m) are present when tested with a straightedge placed perpendicular to the centerline.

**510.05 Method of Measurement.** Grinding Portland Cement Concrete Pavement will be measured by the square yard (square meter).

**510.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Grinding Portland Cement Concrete Pavement, which price shall be full compensation for furnishing equipment; for grinding the existing concrete pavement; for removing residue and cleaning the pavement; for furnishing and operating the automated lightweight profilometer, for measuring the surface profile indices and the IRI; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Grinding Portland Cement Concrete Pavement	Square Yard (Square Meter)

**SECTION 511**  
**PORTLAND CEMENT CONCRETE SHOULDER**  
**(ADD-ON)**

**511.01 Description.** This item shall consist of adding a portland cement concrete shoulder to an existing concrete pavement according to these specifications and conforming to the lines, grades, thickness, and typical cross section shown on the plans.

**511.02 Materials. (a) Concrete.** Concrete shall comply with Section 501. The Contractor shall furnish the mix design in accordance with Subsection 501.03 and shall perform Quality Control and Acceptance sampling and testing in accordance with Subsection 501.04.

**(b) Joint Materials.** Joint materials shall comply with Subsection 501.02(h) Type 3, 4, or 5 for longitudinal joints and Type 3 or 4 for transverse joints.

**(c) Curing Materials.** Curing materials shall comply with Subsection 501.02(i).

**511.03 Construction Requirements.** The work shall comply with Subsection 501.05 with the following exceptions:

**(a)** Transverse joints shall match the transverse joints in the existing pavement.

**(b)** Longitudinal joints shall be constructed as shown on the plans.

**(c)** The longitudinal profile of the concrete shoulder shall match the longitudinal profile of the existing pavement edge.

**(d)** The transverse slope of the concrete shoulder shall be as specified on the plans. The slope shall vary no more than 1/8" per foot (10 mm/m) from the planned slope.

**(e)** The final surface finish shall be accomplished using a burlap drag or broom.

**511.04 Method of Measurement.** Portland Cement Concrete Shoulder (Add-On) will be measured by the square yard (square meter).

**511.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Shoulder (Add-On), which price shall be full compensation for excavation of existing shoulder and preparation of the subgrade; for furnishing, preparing, hauling, and placing materials, including tie bars, dowels, and joint materials; for mixing, spreading, vibrating, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; for sawing, filling, and sealing joints; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Shoulder (Add-On)	Square Yard (Square Meter)

**SECTION 512**  
**CLEANING AND FILLING JOINTS IN EXISTING**  
**CONCRETE PAVEMENT**

**512.01 Description.** This item shall consist of routing, cleaning, and filling existing transverse and longitudinal joints in portland cement concrete pavement in preparation for an asphalt overlay.

**512.02 Materials.** Materials to fill the joints shall be one of the following types:

Type 1. Type 1 joint filler complying with Subsection 501.02(h)(1)a.

Type 7. Type 7 joint sealer complying with Subsection 501.02(h)(2)f.

**512.03 Construction Requirements.** The Contractor shall remove all existing joint material and other foreign material from the longitudinal and transverse joints.

Before placement of joint material, the joints shall be dry and cleaned of all loose material. The material shall fill the joint to within 1/4" (6 mm) of the surface and shall be applied under pressure if necessary.

**512.04 Method of Measurement.** Cleaning and Filling Joints in Existing Concrete Pavement will be measured by the linear foot (meter).

**512.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Cleaning and Filling Joints in Existing Concrete Pavement for the type specified, which price shall be full compensation for cleaning joints; furnishing and placing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Cleaning and Filling Joints in Existing Concrete Pavement (Type___)	Linear Foot (Meter)

**SECTION 513  
RUBBLIZING PORTLAND CEMENT  
CONCRETE PAVEMENT**

**513.01 Description.** This item shall consist of rubblizing and compacting existing portland cement concrete pavement at the locations shown on the plans or where directed by the Engineer.

**513.02 Equipment.** The equipment used shall be subject to the approval of the Engineer and shall comply with the following:

(a) Rubblizing equipment shall be a self-contained, self-propelled resonant frequency breaker specifically designed for the purpose of rubblizing portland cement concrete pavement and capable of producing low amplitude 2000 pound (8900 N) force blows at a rate of not less than 44 cycles per second.

(b) Compacting equipment shall be a steel drum vibratory roller having a gross weight of 10 tons (9100 kg), operated in the vibrating mode.

Any other equipment needed for rubblizing shall have prior approval from the Engineer.

**513.03 Materials.** Stone Backfill shall meet the requirements of Section 207.

Aggregate base course shall meet the requirements of Section 303 for Aggregate Base Course (Class 7).

**513.04 Construction Requirements.** The rubblization shall be done in partial widths when necessary to maintain traffic. When rubblizing in a lane adjacent to a lane that is open to traffic, measures shall be taken to prevent debris from entering the traffic lane. Rubblizing shall be scheduled and performed to minimize exposure to inclement weather and to provide sufficient time to place the base or binder course within one allowable lane closure period as set forth in plans or Contract.

A joint shall be saw cut full-depth at existing longitudinal joints between the main lanes and ramps and at transverse joints where rubblizing abuts pavement that is to remain in place.

The existing concrete pavement shall be broken into pieces ranging from sand size to pieces generally 6" (150 mm) or less in size. No individual pieces shall exceed 8" (200 mm) in any dimension. The majority of rubblized concrete volume shall be nominal 1" to 3" (25 mm to 75 mm) in size. At the beginning of the rubblizing operations, a 4' by 4' (1.2 m by 1.2 m) test pit shall be excavated in the middle of a lane at a location selected by the Engineer to determine if the breaker is producing pieces of the specified sizes. Additional test pits may be required if the Engineer determines that they are necessary.

The breaker shall be operated with a maximum amplitude of one inch (25 mm) to avoid damaging the base and underlying structures.

Existing asphalt overlays and thin asphalt patches shall be removed by cold milling or other approved methods prior to rubblization. Where directed by the Engineer, existing full-depth asphalt patches shall be removed and new patches placed according to the requirements of Section 415. All material resulting from the removal of existing overlay and patches shall be disposed of in accordance with Section 201.

Rubblizing shall begin at a free edge or previously broken edge and progress toward the opposite shoulder or longitudinal centerline of the road. In areas where the roadway is to be overlaid one lane at a time, rubblizing shall extend a minimum of 6" (150 mm) beyond the edge of pavement to be overlaid.

Reinforcement in the rubblized pavement shall be left in place. However, any reinforcement exposed at the surface during rubblizing or compacting operations shall be cut off below the surface and removed.

The rubblized pavement shall be compacted with a minimum of three passes up and back with a steel drum vibratory roller. Additional passes may be required by the Engineer if necessary to satisfactorily compact the rubblized pavement. The roller shall be operated at a speed not to exceed 6 feet per second (2 meters per second).

At locations where the operations of rubblizing and compacting the existing pavement reveal soft spots or depressions in the surface, they shall be repaired by removing the rubblized pavement, base course and subgrade as necessary as unclassified excavation in accordance with Section 210 and placing and compacting stone backfill and/or aggregate base course as directed by the Engineer. Depressions in the surface that are deemed stable by the Engineer shall be corrected by adding aggregate base course and compacting as directed by the Engineer.

**513.05 Method of Measurement.** (a) Rubblizing portland cement concrete pavement will be measured by the square yard (square meter) in accordance with Section 109. No deduction will be made for minor non-rubblized areas such as catch basins or full-depth asphalt patches.

(b) Removal of existing asphalt overlays and asphalt surface patches will be measured by the square yard (square meter).

(c) Material for patching will be measured and paid for by the ton (metric ton) according to Section 415.

(d) Removal of existing rubblized portland cement concrete pavement and base course will be measured as unclassified excavation by the cubic yard (cubic meter). The volume will be determined by measuring the average length, width and depth.

(e) Stone Backfill will be measured by the ton (metric ton) according to Section 207.

(f) Aggregate base course will be measured by the ton (metric ton) according to Section 303.

**513.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) **Rubblizing Portland Cement Concrete Pavement.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Rubblizing Portland Cement Concrete Pavement, which price shall be full compensation for sawing joints; for rubblizing the existing pavement; for compacting the rubblized pavement; and for all equipment, tools, labor and incidentals necessary to complete the work.

(b) **Removal of Existing Asphalt Overlay and Surface Patches.** Work completed and accepted and measured as provided

above will be paid for at the contract unit price bid per square yard (square meter) for Removal of Existing Asphalt Overlay, which price shall be full compensation for removal and satisfactory disposal of the existing asphalt overlay and asphalt surface patches; and for all equipment, tools, labor and incidentals necessary to complete the work.

(c) Removal of existing rubblized portland cement concrete pavement will be paid for as Unclassified Excavation under Section 210.

(d) Stone Backfill will be paid for according to Section 207.

(e) Aggregate Base Course will be paid for according to Section 303.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Rubblizing Portland Cement Concrete Pavement	Square Yard (Square Meter)
Removal of Existing Asphalt Overlay	Square Yard (Square Meter)



**DIVISION 600  
INCIDENTAL CONSTRUCTION**

**SECTION 601  
MOBILIZATION**

**601.01 Description.** This item shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of the Contractor's offices, buildings, and other facilities necessary to undertake the work on the project.

This item shall also include other work and operations that must be performed, or for expenses incurred, before beginning work on the various Contract items on the project site. It shall also include pre-construction costs which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the Contract.

**601.02 Measurement and Payment.** Mobilization will be measured as a complete unit and will be paid for at the contract lump sum price bid. In computing the allowable partial payments from the schedule below, the percentage of the original Contract earned will be based on all items exclusive of the item Mobilization and any materials estimates paid. Payment for Mobilization at any of the listed stages of completion will be made on the basis of the percentage of the item allowed less all payments made.

**PARTIAL PAYMENT SCHEDULE**

<b>Percentage of Original Contract Amount Earned</b>	<b>Percentage of Bid Price for Mobilization Allowed</b>
First Progress Estimate	25
10	50
25	100

This item will be paid for on regular estimates. Payments on percentages of the original Contract amount other than those set out above will not be considered. No adjustment in the amount bid for this item will be made for additional quantities or items of work required to satisfactorily complete the Contract.

IN NO CASE SHALL THE AMOUNT BID FOR THE ITEM OF "MOBILIZATION" EXCEED 5% OF THE TOTAL CONTRACT AMOUNT FOR ALL OTHER ITEMS LISTED IN THE PROPOSAL. Should the amount entered in the Proposal for this item exceed 5%, the Engineer will reduce it to the maximum allowed amount to determine the correct total bid.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided for by the Contract.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Mobilization	Lump Sum

**SECTION 602  
FURNISHING FIELD OFFICES AND  
LABORATORIES**

**602.01 Description.** This item shall consist of providing and maintaining temporary field office and field laboratory facilities, with the services listed below, at convenient locations on or near the work for the exclusive use of the Engineer. These facilities shall remain the property of and will be released to the Contractor when the Engineer determines that they are no longer needed or when all construction work is completed.

**602.02 Facilities to be Furnished. (a) General.** Field offices and laboratories shall comply with the requirements listed below. The dimensions and other requirements specified herein are minimums and the facilities may be built by the Contractor for the specific purposes noted herein. It is not intended, however, to prohibit the use of commercially built trailers or prefabricated buildings that may deviate in minor dimension or detail from the requirements listed herein but may in some features exceed the listed requirements and in all major respects be entirely suitable for the purpose intended. The Contractor may furnish, in lieu of a separate building, a facility having sufficient space in a building, parts of which are used for other purposes, provided that the facility furnished complies with all other requirements of this Section; is physically separated from the remainder of the building; and has an

outside entrance with unrestricted access allowed and reserved for the exclusive use of the Engineer. Adequate space shall be provided for the parking of at least three Department vehicles in the vicinity of each facility furnished. The Engineer will determine the suitability of any building or facility furnished.

Minimum requirements for offices and laboratories:

(1) Buildings may be portable or other suitable types with 7' (2 m) minimum ceiling height; must be floored, weatherproof, and reasonably dustproof; must have at least two clear glazed windows capable of being opened and locked only from the inside. The facility must have at least one door provided with a substantial lock and all keys placed in the possession of the Engineer. Doors and windows shall be screened. The facilities need not be new for each contract but facilities furnished under this item shall be neat, clean, sound, and usable for the purpose intended.

(2) Each facility shall be provided with adequate electric lights and power outlets usable for the purpose intended. In cold weather each facility shall be provided with adequate vented space heating facilities and fuel for heating. In hot weather each facility shall be equipped with adequate air conditioning units. Heating and cooling utility service will be furnished at no cost to the Department.

(3) Suitable toilet facilities shall be available in reasonably close proximity to each office and laboratory furnished.

**(b) Field Offices.** Facilities for field offices shall provide not less than 120 square feet (11 sq m) of floor space. At least two tables suitable for desk or drafting work shall be provided with approximate dimensions of 30" x 48" (750 mm x 1200 mm). These tables may be movable, attached to a wall, or built in. Each table shall be provided with at least two drawers (minimum dimensions: 8" [200 mm] deep by 12" [300 mm] wide by 24" [600 mm] long) or an equivalent cabinet or shelf space for storing field records and plans. At least three chairs shall be provided. A local access touchtone telephone line with access to toll free telephone numbers but otherwise blocked for out-going long distance calls, a landline modular jack, and a touchtone telephone shall be provided in the

field office for use by Department personnel. The local landline telephone service will be furnished at no cost to the Department.

**(c) Field Laboratories.** Facilities for field laboratories shall provide not less than 120 square feet (11 sq m) of floor space with a work bench approximately 30" (750 mm) wide built along one side wall and one end wall. A single sink, approximately 20" x 24" (500 mm x 600 mm) with outside drain, suitable for washing samples, shall be provided. A water supply shall be provided with not less than 50 gallons (200 L) storage discharging through a faucet mounted above the sink. An adequate supply of clean water shall be maintained at all times when work is in progress. Adequate shelves and/or cabinets shall be provided for storing testing equipment. A 24" x 36" (600 mm x 900 mm) desk shall be provided, or may be built in, with at least two drawers, each being a minimum of 13" x 13" x 18" (330 mm x 330 mm x 450 mm) long, for storing records. At least three chairs shall be provided. An exhaust fan adequate for removing fumes from the laboratory stove used for heating samples shall be installed and maintained operational.

**602.03 Number of Facilities to be Furnished.** The number of facilities to be furnished will be listed on the plans or in the Proposal. The Engineer may reduce or expand the number of facilities required according to the location of the work and according to the sequence of the Contractor's operations in order to facilitate the administration of the work and to furnish adequate testing facilities. Facilities shall be provided at the project site on or before the date their use is requested by the Engineer. The Contractor may be required to move a facility from one location to another according to the requirements of the work. The Contractor shall not remove any Field Office or Field Laboratory from the project site until the Engineer has determined that it is no longer needed or until all construction work has been completed. The Contractor shall notify the Engineer at least five business days prior to removing a facility from the project. This notification requirement may be waived by the Engineer.

**602.04 Method of Measurement.** Field offices and/or field laboratories furnished as provided above will be measured by the unit.

**602.05 Basis of Payment.** Facilities furnished and accepted and measured as provided above will be paid for at the contract unit price bid per each for Furnishing Field Office or Furnishing Field Laboratory, which price shall be full compensation for furnishing and maintaining the facilities and services.

Payment will be made under this item at the rate of 75% of the contract unit price bid at the time the facility is complete in place and accepted by the Engineer. The remaining 25% of the contract unit price bid will be paid upon completion of all work under the Contract.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Furnishing Field Office	Each
Furnishing Field Laboratory	Each

**SECTION 603**

**MAINTENANCE OF TRAFFIC AND TEMPORARY STRUCTURES**

**603.01 Description.** This item shall be accomplished according to the plans, this specification, Subsections 104.05 and 107.07, and the MUTCD. It is also applicable to the furnishing, installing, maintaining, and removal of Temporary Culverts and Temporary Bridge Structures and to those traffic control devices and operations required to delineate temporary hazards that are a result of the Contractor's operations and which are not otherwise specified on the plans.

The Contractor shall maintain the existing roads, including shoulders, bridges, and culverts, within the limits of the project from the date work is begun until the project has been completed and accepted. This maintenance of existing roads, including shoulders, bridges, and culverts, is the ordinary day to day maintenance, including minor repairs. Major repairs or reconstruction of existing roads, including shoulders, bridges, and culverts, will be the

responsibility of the State, County, or City, unless such are made necessary by the Contractor's operations.

The Contractor shall provide, under the item of Maintenance of Traffic, those traffic control devices and operations required to delineate temporary hazards that are a result of Contractor operations. When the pay item of Maintenance of Traffic is not included in the Contract, the Contractor shall perform operations according to Subsection 104.05 and this Section. Full compensation for this work will be considered included in the contract unit prices bid for the various items of the Contract.

The Contractor shall provide a competent traffic control supervisor for the project. When the pay item Traffic Control Supervisor is not included in the Contract, the work required will not be paid for separately, but full compensation therefor will be considered included in the contract lump sum price bid for Maintenance of Traffic, or, if Maintenance of Traffic is not included in the Contract as a pay item, included in the contract unit prices bid for the various items of the Contract.

Speed limits through construction zones will be determined by the Department.

**603.02 Construction Requirements. (a) Maintenance of Traffic.** Maintenance of Traffic shall be accomplished by the Contractor in an expeditious manner to preserve the integrity of the traveled way and shoulders and to protect traffic from temporary hazards created by Contractor operations.

The delineation of temporary hazards shall include the placement of any traffic control devices that are necessary for the protection from, and/or delineation of, such objects as open trenches or holes, stationary objects, drop-offs, parked equipment, stockpiled materials, fresh oil, etc. These traffic control devices shall be placed at locations where they will provide adequate warning to the traffic, including side roads that enter the work limits. All traffic control devices used shall comply with the applicable requirements of Section 604.

Traffic control plans for detours, lane closures, lane width reductions, shoulder closures, and other alterations to the original traffic pattern shall not be placed in operation more than 72 hours before the work begins which requires the traffic control changes.

After a traffic control plan is placed in operation, if progress on the work that required such plan is interrupted by more than 72 continuous hours, the original traffic operations must be restored as conditions allow, unless otherwise directed by the Engineer. Removal and restoration of traffic control devices to restore original traffic operations, and the subsequent reinstallation of the traffic control modifications will be at no additional cost to the Department.

Passageways for traffic shall be maintained dust free by the application of water or other approved material.

The Contractor shall make judicious use of pilot vehicles or properly attired and trained flaggers or sentinels, as necessary, to safely and conveniently guide traffic through the work limits.

On unpaved traveled ways or shoulders, the Contractor shall keep the surface smooth and stable by blading, ditching, etc.

Shoulder material shall be maintained to closely match the grade of the existing pavement.

**(b) Traffic Control Supervisor.** When the pay item Traffic Control Supervisor is included in the Contract, the traffic control supervisor shall be certified as a worksite traffic supervisor by either the American Traffic Safety Services Association (ATSSA) or the Arkansas Associated General Contractors, and shall be someone other than the Contractor's superintendent. The name, address, and telephone number of the traffic control supervisor shall be furnished to the Engineer at the pre-construction conference. The Contractor shall advise the Engineer of any changes to the contact information for the traffic control supervisor or changes in person designated as the traffic control supervisor.

The traffic control supervisor shall:

- Perform or supervise the performance of the inspections required in Section 604;
- Prepare, sign, and submit to the Engineer the certification of inspection required in Section 604;
- Train and supervise flaggers and pilot car operators, as needed;

- Review the project for additional traffic control measures needed to delineate hazards due to the Contractor's operations;
- Correct all traffic control deficiencies;
- Provide emergency maintenance of traffic control devices as needed.

Emergency maintenance shall consist of maintenance, repair, or replacement of traffic control devices that have been damaged, vandalized, or otherwise rendered ineffective to the extent that a serious hazard exists. The traffic control supervisor, or a designated alternate, shall begin such emergency work within two (2) hours after being notified. When emergency maintenance is required during non-working hours, devices that are classified as "unacceptable" according to ATSSA *Quality Standards for Work Zone Traffic Control Devices* may be used in emergency maintenance provided the devices are effective in reducing the existing hazard and further provided that they are replaced not later than the next business day. The traffic control supervisor shall keep the Resident Engineer informed of the name, address, and telephone number of the individual responsible for performing emergency maintenance.

**(c) Detour or Stage Construction.** Where shown on the plans for the maintenance of traffic, the Contractor shall construct and maintain detours or stage roadway sections to provide for the construction of the roadway, culverts, bridges, or miscellaneous items.

Any temporary culvert shall be of sufficient length to provide the specified roadway width, but in no case be less than that required to provide a minimum 20' (6 m) traveled way, and shall have a minimum design capacity of H15 (M13.5) loading.

Any temporary bridge structure, regardless of type or centerline roadway lengths, shall have a minimum 20' (6 m) bridge roadway width and a minimum design capacity of H15 (M13.5) loading, unless otherwise specified.

Except as provided herein, a layout and working drawings shall be submitted to the Engineer for informational and record purposes for all temporary bridges and drainage structures, except standard pipe culverts. The layout submitted shall show the length and type



of spans, and the type of substructure. Working drawings shall show all dimensions and details necessary to construct the structure, and the type and condition of all materials that will be used. The Contractor shall construct the temporary structures according to these drawings, or shall submit revised drawings if changes become necessary.

The Department's plans will, as appropriate, include temporary bridge details. The Contractor may elect to use these temporary bridge details, or use an optional design. If an optional design is used, the Contractor shall submit a layout and working drawings signed by a Registered Professional Engineer and a certification by a Registered Professional Engineer that the design and working drawings meet all the requirements of the plans, specifications, and the design requirements of the current edition of the AASHTO Standard Specifications for Highway Bridges with interim Specifications, except as modified herein. The rail and curb system for an optional design shall be at least equal in strength to that shown on the Department's temporary bridge details. If the Department's temporary bridge details are used, only a layout and a listing of the type and condition of materials to be used will be required for submittal. When an optional design is used, file copies of the design calculations shall be maintained by the Contractor until final acceptance of the project.

No work other than the driving of test piles shall be performed on a temporary bridge until the Contractor has submitted the layout, working drawings, and any required certifications to the Engineer.

Materials used in temporary bridges and temporary drainage structures, whether Department design or Contractor design, may be new or used and in good condition. Materials and workmanship shall comply with the requirements of the applicable sections of the specifications covering the items. Timber used in the substructure or superstructure may be untreated unless treatment is specified on the plans. Lumber and timber materials and construction shall comply with Section 817 except that 1) the preservative requirements for used material shall be a minimum of 50% of that required for new material, and 2) the differential of two adjacent planks in the finished deck surface shall not exceed 1/4" (6 mm).

Timber flooring shall be installed in a transverse direction. Longitudinal runners will not be permitted.

Unless otherwise specified, the Contractor has the option of using timber, steel, or concrete piling. If timber piling is used, the piling shall be peeled as specified in Subsection 818.02. Untreated piling may be used unless treatment is specified on the plans. If treated timber piling is specified, the preservative requirements for used timber piling shall be 50% of that required for new material.

Pile driving shall be according to the provisions of Subsections 805.06 through 805.09 except that painting of steel piles is not required. Safe bearing values shall be determined by Method A, Empirical Pile formula.

**Before the temporary structure is open to traffic, the Contractor shall submit a certification that the structure was built according to the submitted layout, working drawings, and materials. The certification will be required whether the Department's temporary bridge details are used or the Contractor's optional design is used.**

The materials and completed drainage structure shall be maintained in good serviceable condition that will safely accommodate traffic using the facility for the duration of the work.

Temporary pipes in detour or stage construction shall be as shown on the plans or shall be approved before installation. No additional payment will be allowed if a bridge type structure is furnished in lieu of a temporary culvert at the Contractor's request.

Construction of approaches to temporary culverts or bridge structures, or other roadway construction shown on the plans as part of detour or stage construction, shall conform to the lines, grades, cross sections, and typical sections shown on the plans or established by the Engineer. Materials used in detour or temporary roadway construction, and the maintenance thereof, shall comply with the requirements of the applicable sections of the specifications covering the items.

The detour or temporary roadway shall be maintained in a condition to allow the safe and convenient passage of vehicles. When the plans do not provide for a dust free surfacing, the passageway shall be maintained dust free by the application of water

or other approved material to the roadway itself or to adjacent areas of construction activity that are the source of dust.

Temporary culverts or bridge structures shall be removed when the new facility has been completed and opened to traffic.

Materials from temporary culverts or temporary bridge structures shall remain the property of the Contractor. Materials used on detours and in stage construction and not incorporated into the permanent work, shall be salvaged to the extent practicable and used for base on other detours, drives, approaches, islands or shoulders, or stockpiled as directed. Non-salvageable materials shall be disposed of by the Contractor according to Section 201.

**(d) Projects on Existing Roadways.** Shoulder material shall not be cut away from the edge of the pavement on both sides of any section open to traffic. Unless otherwise specified, the total length of work areas on the entire project having vertical differences greater than 4" (100 mm) adjacent to the edge of traveled lanes shall be limited to 5,280 linear feet (2 km) in advance of backfill.

Where detour or stage construction is specified, traffic control shall be accomplished as shown on the plans or as modified by the Engineer.

The Contractor shall provide the Engineer with a minimum of three full business days advance, written notification of any non-emergency lane closure or lane width restriction. The first full business day shall commence at midnight on the first business day following written notification to the Engineer. This advanced notification is required to allow adequate notice for the issuance of over width load permits by the Department.

Where any operations result in a vertical differential at the centerline, lane lines, or edge of pavement, the Contractor shall immediately place traffic control devices or install a positive barrier according to the plans. Traffic control devices shall be maintained until the planned typical section is completed or until temporary shoulders are constructed.

In addition to the above requirements, when pavement construction in lanes open to traffic results in a vertical differential at the centerline, lane lines, or edge of pavement, then backfill or

adjacent pavement construction shall be accomplished as soon as practicable but in all cases no later than the following:

Vertical Differential		Location	Time Limitation
(1" or less)	25 mm or less	centerline, lane lines, and/or edge of pavement	None
(1" to 3")	25 to 75 mm*	centerline and/or lane lines	Next working day
(1" to 4")	25 to 100 mm	edge of pavement	30 calendar days
(greater than 4")	greater than 100 mm	edge of pavement	**

\*No vertical differential greater than 3" (75 mm) will be permitted at centerline or lane lines.

\*\*Traffic control devices shall be installed according to the plans. However, shoulder work in conjunction with overlay projects shall be accomplished within 7 business days.

Where temporary shoulder construction is utilized, the shoulder material shall closely match the grade at the edge of the pavement, but not necessarily conform to the planned typical section. The temporary material shall be stable, but specification density will not be required. Caution shall be exercised in temporary shoulder construction to prevent damage to the pavement. The Contractor will be required to maintain the temporary shoulder in a safe condition until the planned typical shoulder section is constructed.

The Contractor may utilize the planned shoulder material for the temporary shoulder or, at Contractor option, may use other materials approved by the Engineer. Any temporary material that does not comply with the requirements of the planned shoulder material shall be removed by the Contractor before constructing the planned shoulder. There will be no additional payment for constructing, maintaining, or removing temporary shoulders.

Where Contracts do not include shoulder work, the Contractor shall coordinate work with the State, County, or City forces that will be performing the shoulder work. In this case, the State, County, or

City will be responsible for placing and maintaining the required "Low Shoulder" signs. The Contractor will be responsible for all other construction signs until completion of the Contract.

Temporary culverts or bridge structures required in detour or stage construction shall be according to Subsection 603.02(c).

The Contractor shall schedule all work in a manner that will allow the routing of traffic over the permanent pavement as quickly as practicable.

When the plans do not show a detailed sequence of construction or planned detour, the Contractor shall provide a safe and convenient two-way passage throughout the entire length of the work. The Contractor shall perform the work and operate equipment in a manner that will permit the safe, continuous flow of two-way traffic through the work at all times, except when blasting or other potentially hazardous construction operations are actually in progress and where the unregulated movement of traffic would be unsafe. In such sections, the Contractor shall provide a safe and convenient passageway for traffic either by means of one-way passage on the roadway, with traffic controlled by flaggers or signal lights, or by means of short, two-way temporary detours within the right-of-way. Such sections shall be limited to approximately 1500' (500 m) in length. If traffic conditions warrant, the length of such sections may be increased or decreased as directed or approved by the Engineer.

The Contractor shall utilize, and store when directed, material available within the project, including existing surfacing, which is suitable for surfacing temporary portions of the grading for use as passageways for traffic. Gravel or crushed stone may be used for temporary surfacing if other suitable materials are not available within the project limits.

If it is determined that the Contractor's performance of the work was not completed in an efficient, workmanlike manner, making it necessary to use temporary surfacing materials for maintaining traffic, the Contractor shall provide the necessary temporary surfacing material at no cost to the Department.

The Contractor shall maintain access for the safe and convenient use of the adjacent property owners/occupants. The Contractor shall maintain all existing highway, street, and county road regulatory,

warning, guide, and informational signs in an effective location at all times for the duration of the work and shall install them at the correct location upon completion of the work. Any signs damaged by the Contractor shall be replaced at no cost to the Department.

**(e) Projects Constructed on New Location.** When projects on new location sever existing public or private roads or the access to premises, the Contractor shall schedule and perform the various items of construction to provide a safe and convenient passageway for traffic at all times according to Subsections 603.02(a), (b), (c) and (d).

**603.03 Method of Measurement.** **(a)** Maintenance of Traffic will be measured by the lump sum.

**(b)** Traffic Control Supervisor will be measured by the lump sum.

**(c)** The construction and subsequent removal of Temporary Culverts will be measured by the linear foot (meter) measured parallel to the flow line of the culvert. For multiple pipes, the measured length will be the sum of the lengths of the individual barrels. No measurement or payment will be made for lengths in excess of that required to provide the roadway width specified on the plans or as directed by the Engineer for the particular location.

The construction and subsequent removal of Temporary Bridge Structures, of the specified width, will be measured by the linear foot (meter) of bridge structure actually constructed, not to exceed the length specified on the plans for the particular location. No additional measurement or payment will be made for widths or lengths in excess of those shown on the plans or as directed by the Engineer for the particular location.

**(d)** Materials designated on the plans or authorized by the Engineer to be used for the maintenance of traffic, for repairs to the existing roadway within the limits of the work, for temporary bases and surfaces directed to be used during stage construction and reconstruction, and for the construction and maintenance of detours will be measured according to the specifications for the particular item used. Materials required for maintenance of traffic due to negligence of the Contractor or failure of the Contractor to construct and maintain the work in proper sequence will not be measured or paid for.

Materials removed from detours or temporary passageways and placed as directed will be measured under the item of Common Excavation, Unclassified Excavation, or Removing and Replacing Base Course and Asphalt Surfacing, as appropriate.

**603.04 Basis of Payment.** (a) Work completed and accepted under the item of Maintenance of Traffic and measured as provided above will be paid for at the contract lump sum price bid for Maintenance of Traffic, which price shall be full compensation for furnishing, placing, maintaining, and removing traffic control devices; for ordinary maintenance of the existing roads, bridges, and culverts; for the application of water or other approved materials to alleviate dust conditions on passageways; for furnishing flaggers, pilot vehicles, and sentinels, as necessary; for maintaining a smooth and stable passageway; for maintaining and re-erecting all existing highway, street, and county road signs; and for all materials, labor, equipment, tools, and incidentals necessary to safely maintain traffic during the construction period.

(b) Work completed and accepted under the item Traffic Control Supervisor and measured as provided above will be paid for at the contract lump sum price bid for Traffic Control Supervisor, which price shall be full compensation for providing the traffic control supervisor and for all materials, additional labor, equipment, tools, and incidentals necessary to accomplish the specified work.

(c) Work completed and accepted under the item Temporary Culverts and/or Temporary Bridge Structures and measured as provided above will be paid for at the price bid per linear foot (meter) for \_\_\_" (\_\_\_mm) Temporary Culvert and/or at the price bid per linear foot (meter) for Temporary Bridge Structure (\_\_\_' [\_\_\_m] Roadway Width), which price shall be full compensation for the preparation of necessary design details and/or Registered Professional Engineer certifications; the construction, maintenance, and subsequent removal of the structures; and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work. The Contractor may substitute temporary culverts of different sizes and shapes from those specified on the plans, provided that the minimum specified waterway opening is obtained for the particular location. Payment will be based on the culvert size specified for the particular location.

(d) Materials furnished and used for the maintenance of traffic and measured as provided above will be paid for at the contract unit price bid for the particular items used, which price shall be full compensation for furnishing all materials; for removal, if applicable; and for all labor, equipment, tools, and incidentals necessary to complete the work. Advanced payment for stockpiled materials will not be allowed for any of the pay items in this Section.

(e) Traffic control devices required for temporary hazard delineation as a result of the Contractor's operations; for those operations required to provide smooth and dust free traffic passageways; for flaggers, pilot vehicles, and/or sentinels required to safely and conveniently guide traffic through the work limits; and for maintaining and re-erecting all existing highway, street, and county road signs will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Maintenance of Traffic.

(f) Periodic payments will be made for Temporary Culverts, Temporary Bridge Structures, Maintenance of Traffic, and Traffic Control Supervisor.

The periodic payments for Temporary Culverts and Temporary Bridge Structures will be limited to the following percentages of the total price bid for each culvert or structure:

<u>Temporary Culverts</u>	<u>Temporary Bridge Structures</u>
Installation - 80%	Substructure - 30%
Removal and Disposal - 20%	Superstructure - 50%
	Removal and Disposal - 20%

The periodic payments for the items Traffic Control Supervisor and Maintenance of Traffic will be in proportion to the percent of the total work performed on the Contract.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Maintenance of Traffic	Lump Sum
Traffic Control Supervisor	Lump Sum
__" (___mm) Temporary Culvert	Linear Foot (Meter)
Temporary Bridge Structure	
(___' [___m] Roadway Width)	Linear Foot (Meter)



## SECTION 604 TRAFFIC CONTROL DEVICES IN CONSTRUCTION ZONES

**604.01 Description.** This item consists of furnishing, installing, maintaining, moving from one location to another, and removing traffic control devices as specified on the plans according to this Section, Subsections 104.05 and 107.07, and the MUTCD. Traffic control devices shall include, but not be limited to: traffic cones, signs, vertical panels, barricades, barrier units, traffic drums, advance warning arrow panels, portable changeable message signs, pavement markings, and removal of pavement markings.

**604.02 Materials. (a) General.** All work zone traffic control devices used on the project, including sign supports, barricades, traffic drums equipped with flashing lights, crash cushions, and impact attenuators shall comply with the requirements of National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH). The Contractor shall furnish a certification of such compliance from the manufacturer or supplier of all work zone traffic control devices prior to using the devices on the project. The certification shall state the device meets the requirements of NCHRP 350 or MASH and include a copy of the Federal Highway Administration's (FHWA) approval letter with all attachments for each device. Devices shall be fabricated and installed in accordance with the plans and with the crash testing documentation provided in the FHWA approval letter, which is available at:

[http://safety.fhwa.dot.gov/roadway\\_dept/policy\\_guide/road\\_hardware/](http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/).

The 2lb. (0.9 kg) minimum channel post or 4" x 4" (100 mm x 100 mm) wood post sign support systems, installed in accordance with the plans (direct buried), have been previously tested and accepted, and, therefore, do not require certification. No direct payment will be made for fulfilling the requirements of this Specification, but full compensation will be considered included in the contract unit prices bid for the various traffic control devices.

Traffic control devices will be accepted based on a visual inspection according to ATSSA *Quality Standards for Work Zone Traffic Control Devices* as to their effectiveness and condition. At the time of initial setup, 100% of all traffic control devices shall be

classified as "acceptable". Maintenance, repair, and replacement operations shall be conducted so that at least 75% of each type device in use are maintained in the "acceptable" classification, with the remaining devices classified as "marginal". Traffic control devices that are classified as "unacceptable" shall be removed from the project and replaced within 12 hours after notification.

Used signs, vertical panels, barricades, drums, traffic cones, precast concrete barrier, advanced warning arrow panels and portable changeable message signs will be allowed provided such devices comply with the requirements set out herein and on the plans.

**(b) Signs, Vertical Panels, Barricades, Drums, and Traffic Cones.** Materials for signs, vertical panels, and barricades required under this subsection shall comply with materials requirement of the plans, specifications and the MUTCD for the construction of signs using ASTM D 4956 for Type VIII or IX sheeting furnished according to the QPL. All orange signs must meet requirements for Fluorescent Orange.

Sign messages, symbols, borders, and backgrounds shall be of the size, type, and/or color shown on the plans. All colors for signs shall match the colors specified by the MUTCD. All sign messages designating project lengths in miles shall be carried only to the nearest mile.

All letters and numerals shall be standard Series C, D, E, E modified, and F as specified in the current edition of *Standard Highway Signs*.

All letters, numerals, symbols, and borders shall have a regular outline, be clean-cut and sharp, and have a continuous stroke and border.

The letters, numerals, arrows, symbols, borders, and other features shall be produced on the retroreflective sheeting of the sign field by a silk screen process approved by the Engineer. Sign messages and borders of a color darker than the sign field shall be applied to the retroreflective sheeting by direct process. Sign messages and borders of a color lighter than the sign field shall be produced by the reverse process in which the message and border are outlined by applying darker transparent color to the retroreflective sheeting of the sign field. Transparent colors, inks, and paints used

in the silk screen process shall be of the type or quality recommended by the manufacturer of the retroreflective sheeting and shall conform to the colors shown in the current editions of the MUTCD and *Standard Highway Signs*. Precut letters, symbols, and numerals, when applied according to the manufacturer's recommendation, will be permitted.

The Contractor shall submit a certification to the Engineer stating that the retroreflective sheeting complies with the requirements of the specifications.

Traffic cones used for night work or which will be used for delineation during nighttime hours shall be reflectorized with retroreflective sheeting meeting the requirements of ASTM D 4956 for Type III or IV with the additional requirements for Reboundable Sheeting. All traffic cones shall meet the requirements of the MUTCD.

**(c) Precast Concrete Barrier.** Materials for precast concrete barrier shall comply with the applicable requirements of the plans.

The Contractor shall certify to the Engineer, in writing, that the materials and the design used in the construction of the barrier comply with the requirements of the plans and specifications and that the barrier was constructed according to the details of the plans.

**(d) Construction Pavement Markings. (1) Asphalt Surfaces.** Construction pavement marking material shall consist of an adhesive backed retroreflective tape that can be applied to the pavement. As an alternate, painted markings complying with Section 718 may be used. Markings shall be yellow for centerlines and inside edge lines, white for lane lines and outside edge lines, and have straight, unbroken edges.

For all markings that are to be removed, paint will not be allowed on the final roadway surface or on any pavement surface that will not be resurfaced or obliterated unless otherwise authorized in writing by the Engineer. The Contractor may, at Contractor expense, use painted markings on the final surface as a primer for permanent thermoplastic markings.

**(2) Portland Cement Concrete Surfaces.** Construction pavement markings for Portland cement concrete surfaces shall comply with the requirements for removable pavement markings as

specified in Subsection 604.02(f). As an alternate, painted markings complying with Section 718 may be used. Markings shall be yellow for centerlines and inside edge lines and white for lane lines and outside edge lines, and shall have straight, unbroken edges.

For all markings that are to be removed, paint will not be allowed on the final roadway surface or on any pavement surface that will not be resurfaced or obliterated unless otherwise authorized in writing by the Engineer. Paint may be used as a primer for thermoplastic markings.

**(e) Interim Pavement Markings.** For interim pavement markings, the Contractor may use paint or tape as specified above for Construction Pavement Markings. Retroreflectorized raised pavement markers complying with Section 721 may be used in lieu of paint or tape specified above. Three raised pavement markers shall be installed, equally spaced, in the place of the 4' (1.2 m) stripe. The markers shall be retroreflectorized in the direction(s) facing traffic and shall be the color required for tape or paint.

In lieu of raised pavement markers complying with Section 721, the Contractor may use Construction Raised Pavement Markers (CRPM) listed on the QPL.

**(f) Removable Construction Pavement Markings.** Removable markings shall meet the requirements of Section 720 for Type 4.

**(g) Certification for Construction and Interim Pavement Markings.** The Contractor shall submit a certification to the Engineer stating that the construction and/or interim pavement markings used comply with the requirements of the specifications.

**(h) Advance Warning Arrow Panel.** Advance warning arrow panels shall meet the requirements of the MUTCD.

**(i) Portable Changeable Message Signs.** Portable changeable message signs shall meet the requirements of the MUTCD.

**604.03 Construction Requirements. (a) General.** Traffic control devices shall be installed and maintained in good condition and in compliance with the plans, this specification, and the MUTCD. The Contractor shall certify weekly to the Engineer that all traffic control devices in use have been inspected on at least a daily basis and that any devices failing to comply with the requirements set out herein or on the plans were corrected. The

certification for inspection of traffic control devices shall be documented on the attached "Traffic Control Device Inspection Checklist", which is to be completed in its entirety, as applicable, on a daily basis. The Traffic Control Device Inspection Checklist form is available on the Department's website at:

[http://www.arkansashighways.com/construction\\_division/TrafficControlDeviceInspectionForm](http://www.arkansashighways.com/construction_division/TrafficControlDeviceInspectionForm).

At least one inspection weekly shall be performed at night. The work involved in performing the required inspections and furnishing the certification will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the Contract.

Traffic control devices shall be constructed according to the plans. The Contractor shall be responsible for properly locating the traffic control devices according to the plans, or as directed.

The Contractor shall accomplish the items of work required for traffic control through construction zones in a logical sequence throughout the duration of the project. Any item constructed prematurely will not be accepted until the item is required for its intended use.

All traffic control devices shall be constructed and maintained in such manner that the devices will be fully visible, intact, and erect for the entire duration of their intended use and shall be removed from the project when their use is no longer required. All devices shall remain the property of the Contractor unless otherwise specified.

**(b) Signs.** Regulatory, warning, and guide signs, and vertical panels of a permanent nature, shall be placed and maintained in a vertical position as shown on the plans or as directed. Each device will be considered as a unit, including the sign and support assembly as shown on the plans.

After the project has been declared substantially complete by the Engineer, the Contractor shall either cover or remove the advance warning signs. In the event that work is required after the project is declared substantially complete, the Contractor will uncover the advanced warning signs or provide appropriate signs and traffic control devices needed to perform the work. Additional signs or

traffic control devices required for such work will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Maintenance of Traffic.

**(c) Barricades.** Type III barricades and assemblies used on detour signing and signing required to close off all or part of a roadway shall be placed as shown on the plans or as directed.

**(d) Traffic Drums.** Traffic drums shall be placed as shown on the plans or as directed.

**(e) Precast Concrete Barrier.** Precast concrete barrier shall be placed as shown on the plans or as directed.

**(f) Pavement Markings.** At the end of each day's operations, pavement markings, either permanent, construction, or interim, shall be in place on all roadways open to traffic. Work shall not continue or commence until the required pavement markings are in place. Before opening a detour or stage roadway to traffic, pavement markings, either permanent or construction, shall be in place.

Conflicting pavement markings shall be removed to prevent confusion to drivers. Removal of pavement markings shall leave a minimum of pavement gouging. Unless otherwise specified, painting over conflicting markings as a means of line removal will not be allowed.

**(1) Classification of Markings.** Pavement markings are classified as follows:

**a. Permanent Pavement Markings.** Permanent pavement markings are those markings that will be left in place upon completion of the project. Permanent pavement markings shall comply with the requirements of Sections 3A and 3B of the MUTCD and Section 718, 719, or 720, as specified on the plans or in the Contract. Skip lines shall be placed on a 40' (12 m) cycle (10' [3 m] stripe, 30' [9 m] skip) for white lane lines and for yellow centerlines where passing is permitted. No-passing zones shall be marked with solid yellow lines. Edge lines shall be white solid lines for both edges of the pavement on two-way traffic roadways. On divided multi-lane roadways, edge lines shall be white solid lines on the

outside edge and solid yellow on the inside edge. Unless otherwise specified, all lines shall be broken only for street and/or ramp intersections.

b. Construction Pavement Markings. Construction pavement markings are those markings that will be removed, replaced with permanent markings, or covered with a pavement course before the completion of the project. Construction pavement markings shall comply with the requirements of Sections 3A and 3B of the MUTCD and shall be the same pattern as Permanent Pavement Markings. Unless otherwise specified, edge lines will not be required. The Contractor shall replace all markings that become ineffective, as determined by the Engineer, at no cost to the Department.

c. Interim Pavement Markings. Interim pavement markings are those that may be used for a short period of time until it is practical and possible to place either permanent or construction pavement markings. Interim pavement markings shall be replaced with permanent or construction markings or covered with a succeeding course of paving within three (3) calendar days on high-volume roads or fourteen (14) calendar days on low-volume roads. (Day 1 of the 3- or 14-day period is the first calendar day that it becomes practical and possible to place permanent or construction pavement markings.) If interim markings are not covered or replaced with permanent or construction markings within the specified time period, no work on the project shall continue or commence until either permanent or construction pavement markings are in place. High-volume and low-volume roads will be designated on the plans.

Except as noted below for divided multi-lane roadways, interim pavement markings shall consist of white lane lines and yellow centerlines placed on a 40' (12 m) cycle (4' [1.2 m] stripe, 36' [10.8 m] skip). When interim markings are used and unless otherwise specified, all two- and three-lane, two-way traffic roadways shall be marked with a single 4" (100 mm) wide yellow skip line on the centerline so as to operate as two-lane roadways.

Four lane two-way traffic roadways shall be marked with double 4" (100 mm) wide yellow skip lines on the centerline and a single 4" (100 mm) wide white skip line on lane lines in each direction so as to operate as four-lane roadways. On all roadways with existing turn lanes (either continuous or dedicated), the existing striping pattern shall be maintained with the interim markings. The center turn lane shall be marked with double 4" (100 mm) wide yellow skip lines on each side of the turn lane and a single 4" (100 mm) wide white skip line shall be used on lane lines in each direction. On multi-lane divided roadways, a 4" (100 mm) wide white skip line 10' (3 m) long on a 40' (12 m) cycle shall be installed on the lane line(s) in each direction.

In conjunction with interim pavement markings on roadways marked for two-way traffic, no-passing zones shall be marked with signs. DO NOT PASS signs (R4-1) shall be placed at the beginning of no-passing zones and the PASS WITH CARE sign (R4-2) shall be placed at the end of no-passing zones. When the length of the no-passing zone exceeds 1/2 mile (800 m) in length, or when the alignment of the roadway warrants, supplemental DO NOT PASS signs shall be placed at 1/2 mile (800 m) intervals, or more frequently if necessary, to provide adequate warning to the public. The signs shall be mounted as shown on the plans.

Construction Raised Pavement Markers, when used, shall be securely attached to the surface in such manner that the surface will not be damaged and the device will remain in place for the time required for its use. Markers that become detached from the surface, are damaged, are coated with asphalt, or otherwise lose their effectiveness shall be replaced or repaired by the Contractor at no cost to the Department.

**(2) Application of Markings.** Pavement markings shall be applied as follows:

a. Final Surfaces. Permanent or construction markings, as specified in the Contract, shall be in place on the final surface at the end of each day's operations on all lanes



open to traffic. Unless otherwise specified, edge lines will not be required. The Contractor may, at Contractor option and expense, use interim pavement markings as follows:

*High volume roads.* On roadways designated on the plans as high volume, interim pavement markings may be used for not longer than 3 calendar days. All centerline and lane line permanent markings shall be placed within the three-day period.

*Low volume roads.* On roadways designated on the plans as low volume, interim pavement markings may be used for not longer than 14 calendar days. All centerline and lane line permanent markings shall be placed within the 14 day period.

The Contractor shall carefully place all interim markings to avoid any overlapping by the permanent pavement markings. Interim pavement markings shall be removed from the final surface as soon as possible after the placement of permanent markings. Any voids caused by the removal of interim markings shall be repaired immediately at the Contractor's expense. For all markings that are to be removed, paint will not be allowed on the final surface unless otherwise authorized in writing by the Engineer.

On roadways open to traffic, if interim pavement markings are used, they shall be removed only after permanent pavement markings are in place.

b. Intermediate Surfaces. On all except the final surfaces, construction pavement markings shall be in place at the end of each day's operations on roadways open to traffic. Unless otherwise specified, edge lines will not be required. The Contractor may, at Contractor option and expense, use interim pavement markings under the same conditions and time limits as specified for final surfaces.

When CRPM are used on an intermediate surface before a final surface of ACHM and when the final ACHM surface course will not completely cover the CRPM, the CRPM shall be removed immediately in advance of the paver placing the final surface course. Removal of the CRPM shall be at the Contractor's expense.

c. Detours and Stage Construction. On detours and stage construction, construction pavement markings, including edge lines when required as shown on the plans, shall be in place before opening the roadway to traffic.

d. Asphalt Surface Treatment. When the final surface is asphalt surface treatment, pavement markings shall not be placed until the asphalt has set, the aggregate firmly embedded, and loose aggregate removed from the surface. No-passing zones shall be marked with signs as specified under interim pavement markings above. Permanent or construction pavement markings shall be placed within 14 calendar days after placement of the final surface.

**(g) Removable Construction Pavement Markings.** The tape, pavement, and ambient air temperature shall be 50° F (10° C) and rising and the pavement surface shall be free of moisture at the time of placement. If weather conditions prohibit placement of removable construction pavement markings and the Engineer determines that pavement markings must be placed due to the sequencing of the work, the Contractor shall place and remove painted markings. The placement and removal of painted markings in this case will be measured and paid for at the contract unit price bid for removable construction pavement markings. No payment will be made for removable construction pavement markings that do not properly adhere to the pavement.

On jointed concrete pavement, the tape shall be cut at all joints. On all other pavements, the tape shall be cut at approximately 40' (12 m) intervals.

**(h) Referencing No-Passing Zones.** On two-way traffic roadways, the Contractor shall reference the locations of all no-passing zones with standard DO NOT PASS and PASS WITH CARE signs before obliteration of the existing pavement markings.

On detours, new construction, and when construction significantly changes the horizontal or vertical alignment of an existing roadway, the Department will establish the locations of no-passing zones for referencing by the Contractor. Signs used to mark no passing zones shall remain in place until installation of permanent markings or final acceptance of the project, whichever is earlier.

On unpaved or unmarked roadways, the Contractor shall mark the locations of no-passing zones with signs immediately after the Department establishes the locations of the zones. If permanent or construction pavement markings are placed immediately after zoning is completed, the marking of no-passing zones with signs will not be required.

**(i) Advance Warning Arrow Panel.** Advance warning arrow panels shall be placed as shown on the plans or as directed, and shall remain in place for the time specified by the Engineer. The Engineer will specify the mode of operation to be used.

**(j) Portable Changeable Message Signs.** Portable changeable message signs shall be installed at the locations shown on the plans or as directed by the Engineer. The Engineer will specify the message(s) to be displayed and the mode of display. The sign shall be maintained operational in the specified location until the Engineer directs that it be removed.

**(k) Traffic Cones.** Traffic cones shall be placed as shown on the plans or as directed.

**604.04 Method of Measurement.** Traffic control devices designated on the plans or authorized by the Engineer will be measured by the square foot (square meter), linear foot (meter), each, or day. The maximum quantities of traffic control devices, other than pavement markings, authorized for payment will be the maximum amounts of each, shown on the plans or authorized by the Engineer, that may be required to be in place at any one time during the construction period.

The various traffic control devices will be measured according to the following:

**(a) Signs, Vertical Panels, Traffic Drums, Barricades, and Traffic Cones.** The actual amount of signs, vertical panels, traffic drums, barricades, and traffic cones, furnished and in place, up to the

maximum amount that is authorized to be in place at any one time, will be measured by the square foot (square meter), each, each, linear foot (meter), and each, respectively. No additional payment will be made for moving these devices from one location to another or for maintenance or repair.

**(b) Precast Concrete Barrier. (1) Furnishing and Installing Precast Concrete Barrier.** The actual amount of precast concrete barrier, furnished and installed, up to the maximum amount that is authorized to be in place at any one time, will be measured by the linear foot (meter).

**(2) Relocating Precast Concrete Barrier.** The actual amount of precast concrete barrier, previously furnished and installed, which is relocated within the project limits will be measured by the linear foot (meter) for each authorized relocation.

**(c) Pavement Markings.** Permanent pavement markings will be measured and paid for under Sections 718, 719, or 720, as applicable.

Construction Pavement Markings will be measured by the meter (linear foot). Construction Pavement Markings (Words), (Arrows), and (Railroad Emblems) will be measured by the unit. One railroad emblem unit will consist of both R's, the X, the transverse lines, and the stop line near the tracks.

Interim pavement markings will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the work.

Markings that become ineffective for any reason other than normal wear shall be replaced by the Contractor at no cost to the Department. Replacement of markings that become ineffective due to normal wear will be measured by the meter (linear foot) or unit.

Removal of Permanent Pavement Markings and Removal of Construction Pavement Markings will be measured by the linear foot (meter) of marking removed. Removal of Permanent and Construction Pavement Markings (Words), (Arrows), and (Railroad Emblems) will be measured by the unit. One railroad emblem unit consists of both R's, the X, the transverse lines, and the stop line near the tracks.

Removal of interim pavement markings, including RPM and/or CRPM, will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the work.

When any pavement marking is removed in conjunction with the removal, scarification, milling, or grinding of the pavement, or is covered by a succeeding pavement course, the removal of the marking will not be measured for payment.

There will be no payment for removal of Removable Construction Pavement Markings.

Signs used to mark no-passing zones will be measured by the square (square meter) according to Subsection 604.04(a). Each sign will be considered as a unit, including the sign and the support assembly as shown on the plans.

**(d) Advance Warning Arrow Panels and Portable Changeable Message Signs.** Advance Warning Arrow Panels and Portable Changeable Message Signs furnished will be measured for payment by the number of days each panel or sign is required and authorized by the Engineer. Payment for a full day will be made for any portion of a day that the panel or sign is used, but the measurement shall not exceed one per panel or sign in any calendar day. When Advance Arrow Warning Panels or Portable Changeable Message Signs are required after the contract time has expired and liquidated damages are being assessed, the Contractor shall furnish such panels and/or signs at no cost to the Department.

**604.05 Basis of Payment.** Traffic control devices completed and accepted and measured as provided above will be paid for at the contract unit price bid per square foot (square meter), each, linear foot (meter), or day, as applicable for the particular item, according to the following:

**(a) Signs, Vertical Panels, Traffic Drums, Barricades, and Traffic Cones.** The unit prices bid for these items shall be full compensation for all materials, labor, equipment, tools, and incidentals necessary for installation, moving from one location to another, and for maintenance, repair, and removal.

**(b) Precast Concrete Barrier. (1) Furnishing and Installing Precast Concrete Barrier.** The unit price bid for this item shall be

full compensation for all materials, labor, equipment, tools, and incidentals necessary for the initial furnishing and installation of the barrier on the project; for maintenance and repair; and for final removal of the barrier upon completion of the work.

**(2) Relocating Precast Concrete Barrier.** The unit price bid for this item shall be full compensation for all materials, labor, equipment, tools, and incidentals necessary for each relocation of the barrier that was initially furnished and installed on the project and that is authorized to be used at other locations within the project limits.

The maximum unit bid price for Relocating Precast Concrete Barrier shall not exceed 25% of the unit price bid for Furnishing and Installing Precast Concrete Barrier. Any unit bid price submitted in an amount more than the specified maximum will be automatically adjusted by the Engineer downward to the specified maximum to determine the correct total bid. This adjustment to the specified maximum will be automatically made, without any counter-adjustments in prices for other items.

**(c) Pavement Markings.** The contract unit prices bid for these items shall be full compensation for installing and maintaining markings; for removing pavement markings; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Replacement of construction pavement markings, when required due to normal wear, completed and accepted and measured as provided above, will be paid for at the contract unit price bid for construction pavement markings.

Signs used to mark no-passing zones will be paid for under Subsection 604.05(a).

**(d) Advance Warning Arrow Panel.** The contract unit price bid for this item shall be full compensation for furnishing, installing, moving, and maintaining the panel; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(e) Portable Changeable Message Sign.** The contract unit price bid for this item shall be full compensation for furnishing, installing, moving, and maintaining the sign; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(f) Payment for replacing traffic control devices that are damaged beyond use by traffic or vandalism will be made at 75% of the actual measurement of the items being replaced if their continued use on the project is required. The damaged devices will be inspected by the Engineer and marked for disposal before payment for replacement. The replacement device shall be classified as "acceptable" according to ATSSA *Quality Standards for Work Zone Traffic Control Devices*. The Department reserves the right to seek any and all recovery of the amount of any such payment from the parties responsible for the damage.

No payment will be made for repair or replacement of Advanced Warning Arrow Panels or Portable Changeable Message Signs. No payment will be made for replacing any traffic control device that has been stolen or has been damaged due to the negligence of the Contractor.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Signs	Square Foot (Square Meter)
Vertical Panels	Each
Traffic Drums	Each
Barricades	Linear Foot (Meter)
Furnishing and Installing Precast Concrete Barrier	Linear Foot (Meter)
Relocating Precast Concrete Barrier	Linear Foot (Meter)
Construction Pavement Markings	Linear Foot (Meter)
Construction Pavement Markings (Words, Arrows, Railroad Emblems)	Each
Removal of Permanent Pavement Markings	Linear Foot (Meter)
Removal of Permanent Pavement Markings (Words, Arrows, Railroad Emblems)	Each
Removal of Construction Pavement Markings	Linear Foot (Meter)
Removal of Construction Pavement Markings (Words, Arrows, Railroad Emblems)	Each

Removable Construction Pavement	
Markings	Linear Foot (Meter)
Advance Warning Arrow Panel	Day
Portable Changeable Message Sign	Day
Traffic Cone	Each

## SECTION 605 CONCRETE DITCH PAVING

**605.01 Description.** This item shall consist of the construction of concrete ditch paving, according to these specifications and in conformity with the locations, lines, and grades shown on the plans, or as directed.

**605.02 Materials.** The concrete shall comply with Section 802 for Class M Concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

When required, reinforcing steel shall comply with Section 804.

Curing materials shall comply with Subsection 501.02(i).

**605.03 Construction Requirements. (a) Subgrade.** The subgrade shall be excavated or filled to the required grade. Soft and yielding material shall be removed and replaced with suitable material and the entire subgrade shall be thoroughly compacted.

**(b) Forms.** Forms shall be constructed of metal or wood, free from warp, and of sufficient strength to resist springing during the process of depositing concrete. They shall be securely staked, braced, set, and held firmly to the required line and grade. Forms shall be cleaned and oiled before concrete is placed against them. As an alternate to stationary forms, the Contractor may use a slip form paver method with a template matching the plan configuration of the ditch paving.

**(c) Placing and Finishing.** The concrete shall be deposited in the forms upon a wetted subgrade to such depth that when it is compacted and finished, the flow line shall be at the required elevation and the sides at required widths, slopes, and thicknesses. The concrete shall be thoroughly compacted and the edges along the



forms spaded to prevent honeycomb. The flow lines and sides shall be struck off with a straightedge and tamped sufficiently to flush mortar to the surface, after which it shall be finished with a wood float to a smooth and even surface. Edges shall be rounded with a 1/4" (6 mm) edger.

Transverse joints shall be cut with a 1/4" (6 mm) jointer at intervals not greater than 5' (1.5 m) measured longitudinally along the flow line.

When completed, the concrete shall be cured as specified in Section 501.

**(d) Backfilling.** Immediately after the forms have been removed, the spaces on each side of the paving shall be backfilled with suitable material, compacted with mechanical equipment, and solid sod placed to the top of the ditch paving. The Contractor shall be responsible for any damage to the ditch paving and the area adjacent to the ditch paving that occurs before the solid sod is placed. All such damage shall be repaired by the Contractor at no cost to the Department.

**(e) Expansion Joints.** When a section of ditch paving terminates at a drop inlet or other structure, a space not less than 1/2" (12 mm) wide shall be left between the end of the paving and the structure. This space shall be filled with joint filler complying with AASHTO M 213.

**(f) Placement on Slopes.** Slope paving shall begin at the toe of the slope and be constructed to the lines and dimensions as shown on the plans or as directed.

**605.04 Method of Measurement.** Concrete Ditch Paving constructed within the limits shown on the plans or as directed will be measured by the square yard (square meter) of exposed surface.

**605.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Concrete Ditch Paving of the type specified, which price shall be full compensation for furnishing materials, including joint filler; for constructing the concrete ditch paving; for excavation and backfilling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete Ditch Paving (Type___)	Square Yard (Square Meter)

**SECTION 606  
PIPE CULVERTS**

**606.01 Description.** This item shall consist of the construction of pipe culverts, flared end sections for pipe culverts, and safety end sections for pipe culverts according to these specifications; of the type, size, and dimensions shown on the plans; and in conformity with the locations, lines, and grades shown on the plans; or as directed.

For side drains, when the type is not specified on the plans, the Contractor may furnish any of the types listed in Subsection 606.02 provided that only one type and material shall be used for all side drains on the project. In addition, when circular pipe is specified for a side drain the Contractor may, at no additional cost to the Department, substitute an arch pipe providing the equivalent waterway.

**606.02 Materials.** Materials and design requirements for the several types of pipe culverts and flared end sections shall comply with the following:

**(a) All Pipe and Flared End Sections.** All pipe, flared end sections, precast curtain walls, preformed gaskets, and other accessories shall be furnished from those sources listed on the QPL.

The Contractor shall furnish the Engineer an itemized statement of the sizes and lengths of culvert pipe in each shipment. A field inspection will be made by the Engineer. This inspection will include an examination of the culvert pipe for nominal specified diameter, net length of finished culvert pipe, condition of pipe, and any evidence of poor workmanship. The inspection may include an examination for deficiencies in lengths of sheets used and a check of the brand name and heat numbers.

**(b) Reinforced Concrete Pipe.** The pipe may be of either bell and spigot or tongue and groove unless one type is specified on the plans or is required to extend an existing culvert. Tests shall be conducted according to AASHTO T 280.

(1) The manufacture and furnishing of circular pipe shall be according to the provisions of AASHTO M 170 with a minimum B wall thickness.

(2) The manufacture and furnishing of arch shaped pipe shall be according to the provisions of AASHTO M 206.

(3) The manufacture and furnishing of horizontal elliptical pipe shall be according to the provisions of AASHTO M 207.

(4) Joints shall be sealed with either preformed rubber gaskets or bitumen/butyl rubber plastic gaskets complying with AASHTO M 198 or with tubular cross-section closed cellular rubber gaskets complying with the physical requirements of ASTM D 1056 (Type 2, Class C, Grade 1) and meeting the chemical requirements of AASHTO M 198.

When a primer is recommended by the manufacturer to be used with the gasket, the material in the primer shall comply with the requirements as specified by the manufacturer.

When Reinforced Concrete Arch Pipe is specified, Reinforced Concrete Horizontal Elliptical Pipe of equivalent size may be substituted unless Arch Pipe is required to extend an existing culvert.

**(c) Corrugated Metal Pipe and Arch Pipe.** Each end of individual metal pipe sections, 12" (300 mm) or equivalent diameter and larger, shall be reformed so as to have not less than two annular

corrugations. Metal pipe shall comply with the following requirements:

**(1) Zinc Coated (Galvanized) Corrugated Steel Pipe.** The manufacture and furnishing of zinc coated (galvanized) corrugated steel pipe shall be according to AASHTO M 36 and M 218.

**(2) Aluminum Coated Corrugated Steel Pipe.** The manufacture and furnishing of aluminum coated corrugated steel pipe shall be according to AASHTO M 36 and M 274.

**(3) Aluminum-Zinc Alloy Coated Corrugated Steel Pipe.** The manufacture and furnishing of aluminum-zinc alloy coated corrugated steel pipe shall be according to AASHTO M 36 and AASHTO M 289.

**(4) Corrugated Aluminum Pipe.** The manufacture and furnishing of corrugated aluminum pipe shall be according to AASHTO M 196 or M 197.

**(5) Asphalt Coated Corrugated Metal Pipe.** The manufacture and furnishing of asphalt coated corrugated metal pipe shall be according to AASHTO M 190, Type A.

**(6) Polymer Precoated Metallic Coated Corrugated Steel Pipe Culverts.** The manufacture and furnishing of polymer precoated metallic coated corrugated steel pipe culverts shall comply with AASHTO M 245. The metallic coating shall comply with the applicable requirements of AASHTO M 218 or M 289 for zinc or aluminum-zinc alloy coating.

The sheets shall have a polymeric coating of 0.010" (250  $\mu\text{m}$ ) minimum thickness on each side after corrugation.

**(7) Smooth Lined Polymer Precoated Metallic Coated Corrugated Steel Pipe** shall comply with AASHTO M 245, AASHTO M 246, and AASHTO *Specifications for Highway Bridges*, except as follows:

- a. The minimum acceptable steel sheet thickness for the outer corrugated shell shall be 0.046" (1.17 mm).
- b. Both the outer corrugated shell and smooth inner liner shall have a standard 2 oz./sq. foot (610 g/sq m) coating of zinc

(1 oz./sq foot [305 g/sq m] per side) and be precoated 10 mils (250  $\mu\text{m}$ ) on each side with a polymer precoated laminate.

c. The pipe ends shall be reformed in such manner as to seal the outer shell and liner together to protect the ends from damage. The band coupler for connecting pipe ends shall have a minimum of 2 corrugations and be a minimum of 12" (300 mm) wide.

**(d) Plastic Pipe.**

**(1) Polyethylene Pipe.** The manufacture and furnishing of polyethylene pipe shall be according to AASHTO M 294, Type S. Polyethylene pipe shall have a corrugated outer shell with an essentially smooth wall waterway. Couplings and fittings supplied or recommended by the pipe manufacturer shall be used.

**(2) PVC Pipe.** The manufacture and furnishing of PVC pipe shall be according to AASHTO M 304. PVC pipe shall have annular or helical projections or ribs on the outer surface and an essentially smooth wall waterway. Couplings and fittings supplied or recommended by the pipe manufacturer shall be used.

**(e) Flared End Sections for Pipe Culverts.** The manufacture and furnishing of flared end sections for pipe culverts shall comply with Subsection 606.02(b) for concrete pipe and Subsection 606.02(c) for metal pipe. The flared end sections shall be of the same material as the culvert pipe for a given installation except that Zinc Coated, Aluminum Coated, or Aluminum-Zinc Alloy Coated Corrugated Steel Flared End sections may be used with any Corrugated Steel Pipe.

Reinforced concrete flared end sections for circular, arch, or elliptical pipe shall comply with the applicable requirements for Class II or higher classes of pipe. The area of reinforcing for circular pipe flared end sections shall be according to the requirements for elliptical reinforcing for Class II pipe for the appropriate wall thickness.

Concrete for curtain walls shall comply with Section 802 for Class M concrete.

Reinforcing steel for curtain walls shall comply with Section 804.

In lieu of constructing concrete curtain walls in place, the Contractor may elect to precast the units. Precast units shall comply with all applicable requirements of Subsection 606.02(b) for concrete pipe.

Flared end sections for corrugated steel circular or arch pipe shall be fabricated from steel sheets having a thickness of 0.064" (1.63 mm) or more.

Flared end sections for corrugated aluminum circular or arch pipe shall be fabricated from aluminum sheets having a thickness of 0.060" (1.5 mm) or more.

**(f) Coupling Bands.** Except as otherwise required herein, coupling bands and other hardware for corrugated metal pipe shall comply with the requirements of AASHTO M 36 for steel pipe and M 196 for aluminum pipe. Coupling bands shall be made of the same base metal and coating (metallic or otherwise) as the pipe.

Band widths shall be as specified in AASHTO M 36 and M 196.

Pipes shall be field jointed with corrugated locking bands. This includes pipe with helical corrugations that has reformed annular corrugations on the ends.

Helical pipe without annular end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe that was installed with no annular end corrugations. In this event pipe furnished with helical corrugations at the ends shall be field jointed with either helically corrugated bands or with bands with projections (dimples).

Bands with projections shall have circumferential rows of projections with one projection for each corrugation.

Unless otherwise shown on the plans, all bolts for coupling bands shall be 1/2" (12 mm) diameter. Bands 15" (380 mm) wide or less shall have a minimum of 2 bolts and bands greater than 15" (380 mm) wide shall have a minimum of 3 bolts.

**(g)** Selected pipe bedding shall consist of silty loam, loam, sand, or other similar material free from lumps, clods, and rocks.

**(h)** Selected pipe backfill shall comply with the requirements established by the Engineer.

(i) Structural Bedding for Reinforced Concrete Pipe Culverts shall be as shown in the plans for the specified installation type.

(j) Structural Bedding and Structural Backfill for Corrugated Metal Pipe Culverts shall meet the requirements for SM-3 material as shown in Subsection 302.02 of these specifications or for Aggregate Base Course Classes 4, 5, 6, or 7, as shown in Subsection 303.02.

(k) Structural Bedding and Structural Backfill for Plastic Pipe Culverts shall meet the requirements for SM-3 material as shown in Subsection 302.02 of these specifications except that the maximum particle size shall be 1¼" (31.5 mm) for Structural Bedding and 1½" (37.5 mm) for Structural Backfill.

(l) **Safety End Sections for Pipe Culverts.** The manufacture and furnishing of safety end sections for pipe culverts shall comply with Subsection 606.02(c) (1) and the details shown in the plans.

**606.03 Construction Requirements. (a) Depth of Excavation.** Excavation shall be carried to a depth where foundation materials are satisfactory to the Engineer regardless of the elevations shown on the plans, and foundations shall be inspected and approved before placing any part of the structure. Unless otherwise provided, soft or yielding material below the bottom of the specified pipe bedding shall be removed and replaced with a suitable material.

Pipe culverts under the roadbed shall be so placed that the minimum depth of cover at the subgrade shoulder for pipe of any diameter or type shall be not less than one foot (0.3 m).

(b) **Forming Bed for Pipe.** Where the pipe is to be laid below the ground line, a trench shall be excavated to the required depth and to the minimum width practicable for working conditions. Structural bedding shall be placed and compacted as shown in the plans. For Reinforced Concrete Pipe Culverts using bell and spigot pipe, recesses shall be excavated to receive the bells. Where unsuitable material exists at the bottom of the excavated trench, the unsuitable material will be excavated and replaced with selected pipe bedding, which shall be compacted thoroughly into place with mechanical equipment. Where rock is encountered, the trench shall be excavated to a minimum depth as shown on the plans and

backfilled with suitable material, which shall be tamped thoroughly with mechanical equipment.

Where pipe is not laid in a trench, structural pipe bedding shall be placed as shown in the plans.

**(c) Laying Pipe.** The pipe laying shall begin at the downstream end and bell or groove ends of concrete pipe and outside circumferential laps of corrugated metal pipe shall be placed facing upstream. Corrugated metal pipe shall be placed with longitudinal laps or seams at the sides. Pipe that is not in true alignment or which shows settlement after laying shall be corrected by the Contractor at no additional cost to the Department.

**(d) Joining Pipe.** The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Pipe protruding through structure walls shall be cut off flush with the inside face of wall.

All surfaces of the joint upon or against which joint seal gaskets may bear shall be smooth, free of spalls, cracks, fractures, and imperfections that would adversely affect the performance of the joint. A primer shall be applied if recommended by the manufacturer.

(1) When preformed rubber gasket is selected by the Contractor, the gasket shall be the sole element depended upon to make the joint flexible and watertight. The gasket shall be a continuous ring that fits snugly into the annular space between the overlapping surfaces of the assembled pipe joint to form a flexible watertight seal. The circumference of the seated gasket shall not be more than 130% of its original circumference.

(2) When bitumen/butyl plastic gasket is selected by the Contractor, the following procedure shall be used. The protective wrapping shall be removed from one side of the gasket. The gasket shall be placed and pressed firmly to the surface of the pipe joint around the entire circumference of the joint. The remaining protective wrapping shall be removed and the pipe forced into connection until material fills the joint space.

(3) When tubular cross-section closed cellular rubber gaskets are selected by the Contractor, the gaskets shall be a single,



continuous part conforming to the joint shape. The outer surface of the gasket shall be completely covered with a natural skin. The cross-sectional diameters and installation practices shall be in accordance with the manufactures' recommendations for the size of pipe or culvert being placed.

To ensure an even and well-filled joint, the final joining of the pipe shall be accomplished by either pushing or pulling, by approved mechanical means, each joint of the pipe as it is laid. In cold weather, when directed, the joint material shall be warmed in a hot water bath, or by other approved methods, to the extent required to keep the material pliable for placement without breaking or cracking. (e) Field cutting of polymer precoated pipe shall be by mechanical means as approved by the Engineer. Torch cutting or other applied heat methods shall not be used. Ends of pipe that have been field cut shall be treated and/or repaired according to the manufacturer's recommendations.

Coatings damaged during manufacturing, shipping, or installation shall be repaired according to the applicable AASHTO specifications. Treatment and/or repair of damaged or cut ends shall be at no cost to the Department.

**(f) Backfilling. (1) General.** Special care shall be taken to compact the fill under the haunches of the pipe. In trench excavation, the backfill above the area specified as structural backfill (or structural bedding for reinforced concrete pipe culverts) shall be placed in 6" (150 mm) lifts and compacted with mechanical equipment to 95% of the maximum density, as determined by AASHTO T 99. In a fill section, the backfill shall be brought up evenly on each side for the full length of the pipe to avoid displacement. The berm of thoroughly compacted material on each side of the pipe shall be at least as wide as the outside diameter of the pipe. The Department will perform acceptance sampling and testing of the compacted backfill material in accordance with Subsection 210.10 at the frequencies established in the Department's *Manual of Field Sampling and Testing Procedures*. Pipe damaged during construction operations shall be replaced at no cost to the Department.

When the existing material excavated for the pipe trench is determined by the Engineer to be unsuitable for pipe backfill, this

material shall be placed at other locations on the project such as backfill behind curbs, placed on the fill slopes, etc. If the Engineer determines that no suitable location exists on the project to utilize this material, the Engineer may approve the material to be wasted at an appropriate location outside the project limits according to Subsection 210.08. Material declared unsuitable for backfill shall be replaced with suitable material from roadway excavation and/or borrow. If suitable material from roadway excavation and/or borrow is not available, the Engineer may authorize the use of the Selected Pipe Backfill.

**(2) Reinforced Concrete Pipe Culverts.** Backfilling around the pipe shall be with material as shown on the plans. The material shall be placed along side the pipe in layers not to exceed 6" (150 mm) at near optimum moisture content and compacted with mechanical equipment to 95% of the maximum density, as determined by AASHTO T 99.

**(3) Corrugated Metal Pipe Culverts and Plastic Pipe Culverts.** Structural backfill material shall be placed along side the pipe in layers not to exceed 6" (150 mm) at near optimum moisture content and compacted with mechanical equipment to 95% of the maximum density, as determined by AASHTO T 99, up to an elevation of not less than 12" (300 mm) above the top of the pipe. Backfilling of the pipe trench above the structural backfill will be accomplished as described in (1) above.

**(g) Curtain Walls for Flared End Sections.** The foundation for curtain walls shall be prepared to the required depth. For cast in place curtain walls, the forming, placement of reinforcing steel, and placement, finishing, and curing of concrete shall be according to the applicable requirements of Sections 802 and 804. Precast curtain walls shall be installed according to the applicable requirements for laying concrete pipe. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

**606.04 Method of Measurement.** (a) Pipe Culverts and Side Drains will be measured by the linear foot (meter) measured parallel to the flow line of the pipe. Where inlets, catch basins, junction boxes, or other structures are included in lines of pipe, that length of pipe extending to and flush with the inside of the structure wall will

be included for measurement but no other portion of the structure length or width will be so included. No allowance will be made for any pipe cut-off. Whenever possible, the lengths shown on the plans may be adjusted by the Engineer to accommodate the pipe lengths available from the supplier that most nearly match the plan lengths.

For multiple pipes, the measured length will be the sum of the lengths of the individual barrels measured as prescribed above.

(b) Flared End Sections for pipe culverts will be measured by the unit and will include the curtain wall, complete in place.

(c) Selected Pipe Bedding material will be measured either by the cubic yard (cubic meter) or ton (metric ton). When measured by the cubic yard (cubic meter), no adjustment will be made for swell.

(d) Selected Pipe Backfill material will be measured either by the cubic yard (cubic meter) or ton (metric ton). When measured by the cubic yard (cubic meter), no adjustment will be made for swell.

(e) When pipe culvert is used for extensions of existing culverts, the removal of any headwall, end section, or pipe joints shall be accomplished according to Section 202.

(f) Structural Bedding for Reinforced Concrete Pipe Culverts, Structural Bedding and Structural Backfill for Corrugated Metal Pipe Culverts, and Structural Bedding and Structural Backfill for Plastic Pipe Culverts will not be measured or paid for separately but full compensation therefor will be considered included in the contract unit prices bid per linear foot (meter) for the respective type of pipe culvert.

(g) Safety End Sections for Pipe Culverts will be measured by the unit.

**606.05 Basis of Payment.** (a) Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for the respective type of Pipe Culverts of the several sizes, which price shall be full compensation for furnishing, hauling, and installing the pipe; for materials including joint filler for concrete pipe and connecting bands for metal pipe; for excavation and backfilling, including compacting backfill; for furnishing, placing, and compacting structural bedding and structural backfill; for removing and disposing of the existing headwall and attached end joint of concrete pipe or the flared end

section on all types of pipe, in order to accomplish culvert extensions; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(b)** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid each for the respective type of Flared End Sections of the several sizes, which price shall be full compensation for furnishing, hauling, and installing the end sections; for materials, including joint filler for concrete end sections and connecting bands for metal end sections; for excavation and backfilling, including compacting backfill; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(c)** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) or ton (metric ton) for Selected Pipe Bedding, which price shall be full compensation for excavating and disposing of soft and yielding material; for furnishing, placing, and compacting bedding material; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(d)** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) or ton (metric ton) for Selected Pipe Backfill, which price shall be full compensation for furnishing backfill material; and for all labor, equipment, tools, and incidentals necessary to complete the work. Placing and compacting backfill will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Pipe Culverts and Flared End Sections.

**(e)** Side Drains completed and accepted and measured as provided above will be paid for at the unit price bid per linear foot (meter) for Side Drains of the size specified, which price shall be full compensation for furnishing, hauling, and installing the pipe; for materials including joint filler for concrete pipe and connecting bands for metal pipe; for excavating and backfilling; and for all labor, equipment, tools, and incidentals necessary to complete the work. Backfill for PVC pipe will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Side Drains.

(f) Work completed and accepted and measured as provided above will be paid at the contract unit price bid each for Safety End Sections of the several sizes, which shall be full compensation for furnishing, hauling and installing the end section; for all materials; for excavating and backfilling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
__" (__mm) Reinforced Concrete Pipe Culverts (Class__)	Linear Foot (Meter)
__" (__mm) Zinc Coated (Galvanized) Corrugated Steel Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__mm) Aluminum Coated Corrugated Steel Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__mm) Aluminum-Zinc Alloy Coated Corrugated Steel Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__mm) Corrugated Aluminum Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__mm) Asphalt Coated Corrugated Steel Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__mm) Polymer Precoated Metallic Coated Corrugated Steel Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__mm) Asphalt Coated Corrugated Aluminum Pipe Culverts (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Reinforced Concrete Arch Pipe Culverts (Class__)	Linear Foot (Meter)
__"x__" (__x__mm) Reinforced Concrete Horizontal Elliptical Pipe Culverts (Class__)	Linear Foot (Meter)
__"x__" (__x__mm) Zinc Coated (Galvanized) Corrugated Steel Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Aluminum Coated Corrugated Steel Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)

<b>Pay Item</b>	<b>Pay Unit</b>
__"x__" (__x__mm) Aluminum-Zinc Alloy Coated Corrugated Steel Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Corrugated Aluminum Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Asphalt Coated Corrugated Steel Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Polymer Precoated Metallic Coated Corrugated Steel Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Asphalt Coated Corrugated Aluminum Arch Pipe Culverts (__Gauge)	Linear Foot (Meter)
__" (__ mm) Flared End Sections for ____ Pipe Culverts	Each
__"x__" (__x__mm) Flared End Sections for ____ Arch Pipe Culverts	Each
__" (__ mm) Smooth Lined Polymer Precoated Metallic Coated Corrugated Steel Pipe	Linear Foot (Meter)
__"x__" (__x__mm) Smooth Lined Polymer Precoated Metallic Coated Corrugated Steel Arch Pipe	Linear Foot (Meter)
__" (__ mm) Side Drain	Linear Foot (Meter)
__"x__" (__x__mm) Side Drain	Linear Foot (Meter)
Selected Pipe Bedding	Cubic Yard (Cubic Meter),or Ton (Metric Ton)
Selected Pipe Backfill	Cubic Yard (Cubic Meter), or Ton (Metric Ton)
__" (__ mm) Safety End Sections for Cross Drain Pipe Culverts (Class ____)	Each

Pay Item	Pay Unit
__"x__" (__x__mm) Safety End Sections for Cross Drain Arch Pipe Culverts (Class ____)	Each
__" (__ mm) Safety End Sections for Side Drain Pipe Culverts (Class ____)	Each
__"x__" (__x__mm) Safety End Sections for Side Drain Arch Pipe Culverts (Class ____)	Each

## SECTION 607 PRECAST REINFORCED CONCRETE BOX CULVERTS

**607.01 Description.** This item shall provide for the substitution of precast reinforced concrete box culverts as an equal alternate to cast in place box culverts, as further detailed below.

**607.02 Materials.** The manufacturer shall furnish design drawings for each project sufficiently in advance of casting operations to allow for review by the Engineer. Precast units shall bear evidence that the component materials have been tested and approved and the construction methods have been inspected by an inspector approved by the Engineer.

**607.03 Design. (a) Load and Resistance Factor Design.** When a cast in place box culvert has been designed meeting the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, current edition, with current interims, the precast box culvert proposed for substitution shall be designed to meet the LRFD Bridge Design Specifications noted above. The design shall be certified by a Professional Engineer, who is registered in any of the United States.

The manufacture and furnishing of precast reinforced concrete box culverts meeting these design specifications shall be according to ASTM C 1577. The manufacturer shall furnish a certification to the Engineer that the units comply with ASTM C 1577 and that all steel materials incorporated in the units comply with Subsection 106.01.

**(b) Alternate Design.** When a cast in place box culvert has not been designed meeting AASHTO LRFD Bridge Design Specifications, , the precast box culvert proposed for substitution may be designed to meet the AASHTO Standard Specifications for Highway Bridges, 16<sup>th</sup> Edition, with interims or the AASHTO LRFD Bridge Design Specifications noted

above. The design shall be certified by a Professional Engineer, who is registered in any of the United States.

The manufacture and furnishing of precast reinforced concrete box culverts shall be according to AASHTO M 259 or M 273, or ASTM C 1577, as applicable. The manufacturer shall furnish a certification to the Engineer that the units comply with AASHTO M 259 or M 273, or ASTM C 1577, as appropriate, and that all steel materials incorporated in the units comply with Subsection 106.01.

**607.04 Construction Requirements.** Excavation and backfill shall be according to the requirements of Section 801. The Department will perform acceptance sampling and testing of the compacted backfill material in accordance with Subsection 210.10 at the frequencies established in the Department's *Manual of Field Sampling and Testing Procedures*.

Precast reinforced concrete box culvert units shall be bedded on a foundation of firm and stable material, accurately shaped to conform to their base. When required by the plans, special bedding material shall be provided.

Joints and joint materials shall comply with the requirements of Section 606.

Lifting holes shall be filled with mortar or concrete and cured as directed.

When precast boxes are used to form multiple barrel structures, they shall be placed in conformance with the details shown on the plans. Material required between barrels shall be as shown on the plans.

Connections of precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap, or other structure shall comply with the details shown on the plans.

Headwalls, wingwalls, and footings shall be according to the details of the plans, except that the overall widths of the headwalls and footings shall be modified to fit the finished width of the various structures.

**607.05 Method of Measurement and Basis of Payment.** Precast Reinforced Concrete Box Culverts will not be measured and paid for directly.

Measurement and payment for precast culvert will be made on the same basis as for a cast in place culvert under Sections 802 and 804 for the length and size of culvert specified.



## SECTION 608

### STRUCTURAL PLATE PIPE AND ARCHES

**608.01 Description.** This item shall consist of the construction of corrugated metal structural plate pipe, pipe-arches, and arches according to these specifications, of the type, size, and dimensions shown on the plans, and in conformity with the locations, lines, and grades shown on the plans, or as directed.

**608.02 Materials.** The material furnished shall be either steel or aluminum, at the Contractor's option, and shall comply with the following requirements:

The manufacture and furnishing of structural plate shall be according to AASHTO M 167 or M 219 as amended below:

1) No metal will be accepted until after the sheet manufacturer's certified analysis and fabricator's certification have been received and approved by the Engineer of Materials.

If the Engineer so elects, the material may be inspected and sampled in the rolling mill or in the shop where fabricated and a detailed chemical analysis of any heat may be required from the mill. The inspection, either in the mill or in the shop, shall be made under the direction of the Engineer. The Engineer shall have free access to the mill or shop for inspection and every reasonable facility shall be provided for this purpose. The inclusion of any material or pipe that has been previously rejected at the mill or shop will be considered sufficient cause for the rejection of the entire lot.

2) A field inspection shall be made by the Engineer. The Contractor shall furnish an itemized statement of the number and length of the plates in each shipment. Each plate included in a shipment shall comply with the requirements of these specifications. If 25% of the plates in any shipment fail to comply with the requirements, the entire shipment may be rejected.

3) The gauge of structural plate and radius of curvature shall be as specified on the plans.

4) When specified on the plans, an asphalt coating complying with Subsection 606.02 shall be applied to the structure.

**608.03 Construction Requirements. (a) Excavation.** When a structure is to be erected in a trench or channel, the width of the excavation shall be sufficient to permit thorough tamping of the backfill material, but shall not exceed the span width by more than 3' (1 m) on each side at the bottom of the trench. Side slopes of the excavation shall not be flatter than 2:1 except where unsuitable material is encountered.

**(b) Bedding.** The pipe shall be bedded in an earth foundation of uniform density, carefully shaped by means of a template supported at the desired grade, to fit the lower plate of the pipe. A minimum camber of 1% of the length of pipe shall be made to allow for settlement. The amount of camber shall be varied to suit the height of fill and supporting soil as directed.

Where rock in either ledge or boulder formation is encountered, it shall be removed to a depth of at least 12" (300 mm) below the grade established for the bottom of the structure, and to a minimum width equal to the span. This additional excavation shall be backfilled with material complying with Subsection 608.03(d).

If the existing material exposed at the grade established for the bottom of the structure appears unstable and is of such character as to invite unequal settlement along the length of the structure, such unstable material shall be removed as directed and the excavation shall be backfilled with gravel or other suitable material as hereinafter specified and thoroughly tamped or otherwise compacted in place to ensure a firm foundation. Any necessary excavation below the invert of the structure shall be made according to Section 801.

**(c) Assembly.** All plates shall be unloaded and handled with reasonable care. Plates shall not be rolled or dragged over gravel or rock and shall be prevented from striking rock or other hard objects during placement in trench or on bedding.

Structural plate pipe shall be assembled progressively according to the manufacturer's instructions starting at the downstream end with the inside circumferential laps pointing downstream.

On all plates above the invert plate or plates, only sufficient bolts shall be used to hold the plates loosely in position until assembly has been completed for four or more rings. When all plates are in position, all bolts not already in place shall be inserted and the nuts

tightened progressively through the structure. All nuts shall be tightened a second time to a torque of not less than 100 foot-pounds (135 newton meters [N·m]) nor more than 250 foot-pounds (340 N·m). Each 20th bolt will be checked with a torque wrench that shall be furnished by the Contractor. Where tests indicate loose bolts, the bolts in that area shall be properly tightened and additional tests made. Standard bolts are furnished in two lengths: the short bolts shall be placed where two plates lap and the long bolts shall be placed where three plates lap. All service bolts used in drawing the plates together shall be replaced with standard bolts.

**(d) Backfill.** Unless otherwise specified on the plans, backfill material shall be of a granular nature with a maximum size of 3" (75 mm), free of frozen lumps, chunks of highly plastic clay, or other objectionable matter. Materials from roadway excavation or borrow meeting these requirements may be used if approved by the Engineer.

After the structure has been erected according to these specifications, backfill material shall be placed in layers not to exceed 6" (150 mm) thickness at near optimum moisture content and compacted. The side fill shall be placed and compacted with care under the haunches of the structure and shall be brought up evenly and simultaneously on both sides of the structure to not less than 1' (0.3 m) above the top for the full length of the structure. Compaction equipment shall be mechanical hand tamps and rolling equipment in such combination as to provide 95% of maximum density as determined by AASHTO T 99. The Department will perform acceptance sampling and testing of the compacted backfill material in accordance with Subsection 210.10 at the frequencies established in the Department's *Manual of Field Sampling and Testing Procedures*. Pipe damaged during construction operations shall be replaced or repaired at no cost to the Department.

**608.04 Method of Measurement.** Structural Plate Pipe, Pipe-Arch, or Arch will be measured by the linear foot (meter) along the bottom centerline of the structure.

**608.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Structural Plate Pipe, Structural Plate Pipe-Arch, or Structural Plate Arch, of the sizes specified,

which price shall be full compensation for furnishing, handling, erecting, strutting, and installing; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Channel excavation, backfilling, and concrete and reinforcing steel for headwalls and foundations will be paid for as separate items as specified on the plans. Structural excavation will be paid for under Section 801 for the appropriate classification of Excavation for Structures - Roadway.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
__" (__mm ) Structural Plate Pipe (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Structural Plate Pipe-Arch (__Gauge)	Linear Foot (Meter)
__"x__" (__x__mm) Structural Plate Arch (__Gauge)	Linear Foot (Meter)

## **SECTION 609**

### **DROP INLETS AND JUNCTION BOXES**

**609.01 Description.** This item shall consist of the construction of drop inlets, yard drains, junction boxes, and drop inlet extensions with rings and covers or grates and frames, according to these specifications, of the type, size, and dimensions shown on the plans, and in conformity with the locations, lines, and grades shown on the plans, or as directed.

**609.02 Materials.** (a) The concrete shall comply with Section 802 for Class A Concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

(b) Reinforcing steel shall comply with Section 804.

(c) Steel for welded steel grates and frames shall comply with AASHTO M 270, Grade 36 (250).

(d) Iron castings for rings and covers, grates and frames, and other appurtenances, shall comply with AASHTO M 105, Class 35B. Bearing surfaces between rings and covers or grates and

frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact.

(e) Paint shall comply with Section 638.

(f) Precast concrete units of the type, size, and designation shown on the plans may be used in lieu of cast-in-place concrete units and shall be subject to the requirements of AASHTO M 199 or ASTM C 913 as applicable, and shall be furnished from sources listed on the Department's QPL. Units so manufactured must bear evidence that the component materials have been tested and approved and that the construction methods have been inspected by an Inspector approved by the Engineer. Joint materials shall comply with Subsection 606.02(b)(4).

(g) **Curing Materials.** Curing materials shall comply with Subsection 501.02(i).

(h) Pipe culverts for yard drains shall comply with Subsection 606.02.

**609.03 Construction Requirements.** Drop inlets, junction boxes, and drop inlet extensions shall be constructed with either reinforced or non-reinforced concrete, as shown on the plans. The Engineer may adjust the plan locations of drop inlets and junction boxes to avoid the necessity of cutting pipe or to avoid utility lines provided such adjustment does not move the drop inlet out of a low point in the gutter line or into a curb radius.

Concrete shall not be placed until the Engineer has inspected the forms and the placement of reinforcing steel and rings or frames.

Round monolithic drop inlets may have the floors cast monolithically with the walls. All other concrete floors shall be placed at least 24 hours before beginning construction of the walls. A longer period of time may be required if weather conditions make it necessary.

When completed, the concrete shall be cured as specified in Subsection 501.05(l).

Walls shall be constructed to form a tight joint with the floor and around the inlet and outlet pipes. Pipes shall be cut flush with the inside surfaces of the wall.

Utility lines that are carried through the walls shall be protected to avoid damage.

When tops of drop inlets are cast in place, the faces of drop inlets and drop inlet extensions shall be placed as a part of the curb in order to preserve the proper alignment.

Precast reinforced concrete drop inlet or junction box sections shall be set with joints complying with Subsection 606.02(b)(4).

Yard drains shall be constructed of a 12" (300 mm) corrugated metal pipe with the use of a pipe elbow or tee, as the case requires, at the bottom of the drain. The ring and grate shall be set on the top of the pipe culvert as shown on the plans. The concrete square frame shall be formed and placed to match the grade of the ring and grate.

Metal rings or frames shall be set accurately to the finished elevations so that no subsequent adjustments will be necessary. They shall be set in a full mortar bed with firm bearing on the walls or securely fastened to the forms so that no movement will occur when concrete is placed around them.

Welded steel grates and frames shall be welded with 1/4" (6 mm) fillet welds according to Section 807. The grates and frames shall be painted according to Section 638 or hot dip galvanized according to AASHTO M 111, Thickness Grade 100.

Iron castings for rings and covers or grates and frames shall not be painted.

Backfilling around structures shall be with approved material, free from large lumps or clods. The material shall be placed alongside the structure in layers not to exceed 6" (150 mm) in depth at near optimum moisture content and compacted with mechanical equipment to 95% of maximum density as determined by AASHTO T 99 for the full depth of structure. The Department will perform acceptance sampling and testing of the compacted backfill material in accordance with Subsection 210.10 at the frequencies established in the Department's *Manual of Field Sampling and Testing Procedures*.

Structures shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be reasonably free of such accumulations at the time of final inspection.

**609.04 Method of Measurement.** Drop Inlets, Junction Boxes, and Drop Inlet Extensions of the length specified will be measured by the unit. Yard Drains will be measured by the unit. Each unit shall consist of the concrete frame, the ring and grate, and all pipe required to form the vertical portion of the drain including a standard elbow or tee.

**609.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Drop Inlets, Drop Inlet Extensions, Yard Drains, or Junction Boxes, of the type specified, which price shall be full compensation for constructing drop inlets, drop inlet extensions, yard drains, or junction boxes; for furnishing, installing, and painting, if required, of rings and covers or grates and frames; for excavation and backfill; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Drop Inlets (Type___)	Each
Junction Boxes (Type___)	Each
Drop Inlet Extensions (___')(___m)	Each
Yard Drains	Each

### **SECTION 610**

#### **MANHOLES, DROP INLETS AND JUNCTION BOXES ADJUSTED TO GRADE**

**610.01 Description.** This item shall consist of adjusting the top elevation of existing manholes, drop inlets, or junction boxes according to these specifications and to the grades shown on the plans, or as directed.

**610.02 Materials.** New materials used in the grade adjustment shall comply with Subsection 609.02.

**610.03 Construction Requirements.** Construction methods, as modified below, shall comply with Subsection 609.03, except that painting of existing rings and covers or grates and frames will not be required.

The existing rings and covers or grates and frames shall be removed in a manner to avoid breaking or cracking and cleaned of old mortar before resetting at the specified elevation. Structures damaged because of the Contractor's negligence shall be repaired or replaced at no cost to the Department.

If the top of the structure is to be lowered, masonry courses shall be removed and old mortar cleaned from the remaining top course, or concrete shall be cut on a horizontal line as directed, to an elevation that will allow the rings or frames to be set in concrete to the specified grade.

If the top of the structure is to be raised, the top of walls shall be cleaned of old mortar, or the top of concrete walls shall be cleaned of old mortar and roughened, and the walls built up with concrete to an elevation that will allow the rings and frames to be set to the specified grade.

**610.04 Method of Measurement.** Manholes, Drop Inlets, or Junction Boxes Adjusted to Grade will be measured by the unit.

**610.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Manholes Adjusted to Grade, Drop Inlets Adjusted to Grade, or Junction Boxes Adjusted to Grade, which price shall be full compensation for adjusting manholes, drop inlets, or junction boxes; for excavation and backfill; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Manholes Adjusted to Grade	Each
Drop Inlets Adjusted to Grade	Each
Junction Boxes Adjusted to Grade	Each



## SECTION 611 PIPE UNDERDRAINS, OUTLET PROTECTORS, AND COVERS

**611.01 Description.** This item shall consist of constructing underdrains using pipe, filter fabric, and granular filter material according to these specifications and in reasonably close conformity with the lines and grades shown on the plans, or as directed; and the inspection for acceptance of the underdrain system installed on the project, if included as a pay item.

**611.02 Materials (a) Pipe.** All corrugated metal pipe, polyethylene tubing, and acrylonitrile butadiene styrene (ABS) pipe shall be furnished from those sources listed on the Department's Qualified Products List (QPL). The types of pipe for underdrains shall comply with the following requirements:

**(1) Corrugated Metal Pipe for Underdrains.** Corrugated Metal Pipe shall comply with Subsection 606.02(c). Pipe furnished with a nominal diameter of 6" to 8" (150 to 200 mm) shall be fabricated from metal with a thickness not less than 0.052 inch (1.32 mm).

**(2) Corrugated Polyethylene Tubing.** The tubing shall be the heavy duty type and shall comply with AASHTO M 252. The tubing shall have a minimum pipe stiffness of 46 psi (3.23 kg/cm<sup>2</sup>) at 5% deflection and shall be capable of 60 percent vertical deflection in parallel plate loading without splitting or cracking when tested in accordance with ASTM 2412.

**(3) Acrylonitrile Butadiene Styrene (ABS) Pipe.** The pipe shall be extruded from virgin ABS complying with ASTM D2680.

Fittings shall be of the same composition and have the same physical properties as the pipe and shall not restrict flow.

Corrugated polyethylene tubing shall have AASHTO M 252, Class 2 perforations. Perforations for other types of pipes shall be approximately circular and cleanly cut; shall have nominal diameters not less than 3/16" (5 mm) nor more than 3/8" (10 mm); and shall be arranged in at least two rows parallel to the axis of the pipe.

**(b) Underdrain Outlet Protectors.** Concrete shall comply with Section 802 for Class M Concrete. Reinforcing steel shall comply with Section 804. In lieu of constructing underdrain outlet protectors in place, the Contractor may use precast units that comply with the applicable requirements of Subsection 606.02(b) for concrete pipe and are furnished from sources listed on the QPL.

**(c) Granular Filter Material.** Granular filter material shall comply with Subsection 403.01 and 403.02 for Class 5 Mineral Aggregate, or Section 802 for coarse aggregate for concrete. Granular filter material shall be crushed stone or crushed gravel. Uncrushed gravel shall not be used. All acceptance sampling and testing will be performed by the Department.

**(d) Filter Fabric.** Filter fabric shall be a nonwoven geotextile complying with Section 625, Type 1.

**(e) Underdrain Cover.** The material used for underdrain cover shall be as specified on the plans.

**611.03 Construction Requirements. (a) Pipe Installation.** Trenches shall be excavated to the width shown on the plans. The trench depth shall be as shown on the plans or as established by the Engineer.

Pipe of the type selected by the Contractor and of the size specified shall be laid with perforations down and the pipe sections joined securely with the appropriate coupling fittings or bands, or joint filler. The upgrade end of pipe installations shall be closed with suitable plugs to prevent entry of soil materials. The pipe shall be installed in such a manner that continuous outflow is provided during construction.

**(b) Underdrain Outlet Protectors.** The foundation shall be prepared to the required depth, forms set rigidly to the line and grade designated, and the concrete placed, spaded, vibrated, and finished with a wood float to a true and even surface. When completed, the concrete shall be cured as specified in Section 802.

Precast units shall be placed on a foundation prepared to the proper depth and the pipe underdrain shall be firmly secured to the outlet protector.

The outlet protector shall be placed in such a manner that the underdrain lateral has a uniform slope to ensure proper drainage.

Abrupt changes in slope along any portion of the lateral will not be permitted.

**(c) Granular Filter Material.** After the pipe installation has been inspected and approved, granular filter material shall be placed and uniformly compacted with mechanical equipment to a stable condition as directed by the Engineer.

**(d) Filter Fabric.** When required, the filter fabric shall be installed as shown on the plans. Care shall be taken during the placement of the Granular Filter Material, as well as pipe installation, to prevent damage to the fabric. The Granular Filter Material shall be compacted using a vibratory compactor to the satisfaction of the Engineer before making the filter fabric closure at the top of the trench.

**(e) Underdrain Cover.** When required, underdrain cover shall be placed immediately following the granular filter material. The width and depth of the cover shall be as specified on the plans.

**(f) Inspection.** When included as a pay item in the Contract, the underdrain system that is installed shall be inspected by the Contractor. If the planned final surface is asphalt concrete hot mix (ACHM), the inspection shall be performed prior to placement of the final surface course and after placement of the ACHM preceding this course. If the planned final surface is Portland cement concrete pavement (PCCP), the inspection shall be performed after the base course has been placed and before the PCCP is placed. A video record and written report for each line inspected shall be furnished to the Engineer. The line identification, distance traversed by the camera and pipe deficiency shall be recorded on the videotape and in the written report.

Equipment used for inspecting the underdrain system shall satisfy the following minimum requirements:

- (1) The system shall be capable of providing color video inspection of pipelines from 3.5" to 8.0" (88 mm to 200 mm) inside diameter in a wet, corrosive environment and shall be capable of negotiating a 90° bend in a 4" (100 mm) or larger diameter, smooth bore or corrugated drainpipe.
- (2) The system shall be capable of video inspecting up to 300 linear feet (91 m) of laterals and 4" (100mm) pipe

underdrains, by push rodding, pull cabling, jetting or tractoring the camera through the line and recording the condition.

- (3) The system shall be equipped with a video monitor capable of allowing live viewing of the video inspection
- (4) The system shall be capable of displaying and recording the date, line identification, footage and type of pipe deficiency.
- (5) The system shall be capable of recording the distance traversed by the camera to within 0.5 feet (0.15 m), allowing for overlapping of distances if a reversal is required to permit full-length inspection.

Any foreign materials that impede the placement or movement of the inspection equipment within the underdrain system shall be flushed from the system. Flushing of the underdrain system shall be required when efforts are needed beyond the normal, as determined by the Engineer, to allow forward progress or to prevent obscured vision of the video inspection equipment.

Any underdrain pipe that is damaged or does not conform to the lines and grades shown on the plans shall be replaced at no cost to the Department.

The Contractor shall install the required rodent screens promptly after satisfactory video inspection is completed on a section of underdrain.

**611.04 Method of Measurement.** Pipe Underdrains will be measured by the linear foot (meter) measured parallel to the flow line of the pipe on a variable depth basis. The measurement of variable depth required for pipe installation will be made from the finished roadway or ditch elevation as shown on the plans, or from natural ground elevation, whichever is lower, to the established flowline elevation of the pipe.

Underdrain Cover will be measured by the linear foot (meter).

Underdrain Outlet Protectors will be measured by the unit.

Underdrain Video Inspection will be measured by the linear foot (meter) of pipe underdrains and laterals inspected as directed by the Engineer.

**611.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) of variable depth for Pipe Underdrains of the size specified; per each for Underdrain Outlet Protectors; or per linear foot (meter) for Underdrain Cover, which price shall be full compensation for excavation and backfill; for furnishing materials, including necessary fittings, bands, or joint filler; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Granular Filter Material and Filter Fabric will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Pipe Underdrains.

Underdrain inspection completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Underdrain Video Inspection, which price shall be full compensation for furnishing all video records and written reports; for flushing the completed underdrain whenever foreign material impedes the movement of the inspection equipment or quality of the video; and for all labor, equipment tools and incidentals necessary to complete the work.

Variable depth installation of pipe underdrains, measured as provided above, will be paid for at the contract unit price bid plus a percentage as provided in the following schedule:

<b>DEPTH OF EXCAVATION</b>		<b>RATE</b>
<b>From more than</b>	<b>To and including</b>	
0' (0 m)	3' (1 m)	Contract Price
3' (1 m)	6' (2 m)	Contract price plus 25%
Depth greater than 6' (2 m)		To be established by Supplemental Agreement

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
__" (__mm) Pipe Underdrains	Linear Foot (Meter)
Underdrain Cover	Linear Foot (Meter)
Underdrain Outlet Protectors	Each
Underdrain Video Inspection	Linear Foot (Meter)

## **SECTION 612 PIPE SIPHONS**

**612.01 Description.** This item shall consist of constructing pipe siphons according to these specifications and in conformity with the locations, lines, and grades shown on the plans, or as directed.

**612.02 Materials.** The manufacture and furnishing of steel pipe for siphons shall comply with ASTM A 139, Grade A or B; or ASTM A 53, Type E or S, Grade A or B, with the further provision that all pipe sizes shall have a minimum wall thickness of 0.250" (6.35 mm) and shall have a beveled end finish for field welding.

**612.03 Construction Requirements.** Construction requirements shall be according to Subsection 606.03, as applicable.

Field welding of pipe shall comply with the applicable requirements of Section 807 and proper alignment shall be maintained to provide a straight axis before backfilling.

**612.04 Method of Measurement.** Pipe Siphons will be measured by the linear foot (meter). The measurement upon which payment will be made will be the horizontal length measured between the ends of the pipe without allowance for bends or connections.

**612.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Pipe Siphons of the size specified, which price shall be full compensation for furnishing, hauling, and installing the pipe; for excavation and backfilling; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Concrete and reinforcing steel for headwalls will be paid for as separate items as specified on the plans.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
__" (___mm) Pipe Siphons	Linear Foot (Meter)

**SECTION 613  
STEEL GRATE ASSEMBLY**

**613.01 Description.** This item shall consist of the construction of reinforced concrete wingwalls and aprons and the attachment of a shop fabricated steel grate according to these specifications and in conformity with the type, locations, design, dimensions, lines, and grades shown on the plans, or as directed.

**613.02 Materials.** (a) The concrete shall comply with Section 802 for Class S concrete or Section 501 for paving concrete. The maximum allowable slump shall be 4" (100 mm). The maximum water/cement ratio shall not be exceeded. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance sampling and testing in Subsection 802.06.

- (b) Reinforcing steel shall comply with Section 804.
- (c) Structural steel shall comply with Section 807.
- (d) Steel pipe for grates and bolts shall comply with Section 807.

Steel pipe for grates shall be "Standard Weight" pipe complying with ASTM A 53 National Standard Pipe.

Bolts, nuts, and washers shall comply with ASTM A 307, Grade A or AASHTO M 314, Grade 36, and shall be galvanized according to AASHTO M 232 or ASTM B695, Class 40 or 50. After galvanizing, the nuts shall be free running on the bolts.

**613.03 Construction Requirements.** Except as otherwise provided, the methods employed in performing the work shall comply with the applicable requirements of the following:

(a) Concrete shall be placed, finished, and cured according to Section 802. Concrete shall not be placed until the Engineer has inspected the forms and the placement of reinforcing steel or frames.

(b) Reinforcing steel shall be placed according to Section 804.

(c) Structural steel shall be placed according to Section 807.

(d) Bolts shall be installed according to Section 807.

Welded steel grates shall be welded with 1/4" (6 mm) fillet welds according to Subsection 807.26.

Steel grates and angles shall be hot-dip galvanized according to AASHTO M 111 after fabrication and punching. Field galvanizing shall be allowed as directed by the Engineer only to repair small areas damaged during installation.

**613.04 Method of Measurement.** Steel Grate Assemblies will be measured by the unit of the size and type designated on the plans. Each unit will be a complete grate assembly for one end of a pipe culvert.

**613.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Steel Grate Assembly of the Type designated, which price shall be full compensation for furnishing materials; for excavation, forming, mixing, placing, curing, and finishing; for backfill; for furnishing and placing steel grate panels; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___" (___mm) Steel Grate Assembly (Type___)	Each

## SECTION 614 CONCRETE SPILLWAY

**614.01 Description.** This item shall consist of the construction of concrete spillways according to these specifications and in conformity with the design and detailed dimensions and at the locations shown on the plans, or as directed.



**614.02 Materials.** Concrete shall comply with Section 802 for Class A Concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance sampling and testing in Subsection 802.06.

Reinforcing steel shall comply with Section 804.

Precast concrete spillways of the type and size shown on the plans may be used in lieu of cast-in-place concrete units and shall be furnished from sources listed on the Department's QPL.

**614.03 Construction Requirements.** The foundation shall be prepared to the proper depth, forms set rigidly to the line and grade designated, and the concrete placed, spaded, vibrated, and finished with a wood float to a true and even surface. When completed, the concrete shall be cured as specified in Section 501.

**614.04 Method of Measurement.** Concrete Spillways will be measured by the unit.

**614.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Concrete Spillway of the Type designated, which price shall be full compensation for furnishing, preparing, hauling, and placing materials, including reinforcing steel; for excavation and backfill; for preparation of subgrade; for mixing, shaping, finishing, and curing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete Spillway (Type___)	Each

## **SECTION 615**

### **PAVEMENT REPAIR OVER CULVERTS**

**615.01 Description.** This item shall consist of replacing the existing pavement that has been removed for the purposes of constructing new culverts or replacing existing structures. The material replaced shall conform to the lines, grades, and cross section of the existing pavement.

**615.02 Materials.** Concrete for Pavement Repair Over Culverts (Concrete) shall comply with Section 802 for Class A Concrete. High Early Strength Concrete complying with Subsection 501.08 shall be used when specified by the Engineer. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance sampling and testing in Subsection 802.06.

Reinforcing steel shall comply with Section 804.

The patching materials for Pavement Repair Over Culverts (Asphalt) shall comply with Section 406 or 407 for ACHM Binder Course or ACHM Surface Course.

**615.03 Construction Methods.** The pavement repair shall be placed on a prepared surface. The depth of the pavement repair shall be the depth of the existing pavement with a minimum depth of 9" (225 mm). For concrete patch, the concrete shall be cured according to the requirements of Section 802.

**615.04 Method of Measurement.** Pavement Repair Over Culverts (Concrete) will be measured by the cubic yard (cubic meter).

Pavement Repair Over Culverts (Asphalt) will be measured by the ton (metric ton).

**615.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

Pavement Repair Over Culverts (Concrete) will be paid for at the unit price bid per cubic yard (cubic meter) for Pavement Repair Over Culverts (Concrete), which price shall be full compensation for preparing the subgrade, any forming, for furnishing, transporting, and placing all materials, including steel; for the preparation and processing of materials; for the mixing, spreading, vibrating, finishing, and curing; and for all labor, equipment, tools, and incidentals necessary to complete the work. Reinforcing Steel will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Pavement Repair Over Culverts (Concrete).

Pavement Repair Over Culverts (Asphalt) will be paid for at the unit price bid per ton (metric ton) for Pavement Repair Over Culverts (Asphalt), which price shall be full compensation for

preparing the subgrade; for furnishing, placing, and compacting materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Pavement Repair Over Culverts (Concrete)	Cubic Yard (Cubic Meter)
Pavement Repair Over Culverts (Asphalt)	Ton (Metric Ton)

## **SECTION 616 AUTOMATIC FLOODGATES**

**616.01 Description.** This item shall consist of furnishing and installing automatic floodgates for closing corrugated metal pipes, according to these specifications, and at the locations shown on the plans or as directed.

**616.02 Materials.** Automatic floodgates shall be of standard design and shall be made of cast iron complying with AASHTO M 105 for Gray Iron Castings. The gates shall be carefully machined, water-tight, entirely automatic in their operation, and shall meet the approval of the Engineer. They shall be sensitive to a difference in water level and must be hinged so as to seat accurately.

**616.03 Construction Requirements.** The floodgate shall be attached to the section of corrugated metal pipe before the pipe is placed and the pipe must be so laid that the flap valve, without pressure from either side, will seat against the flange.

**616.04 Method of Measurement.** Automatic Floodgates will be measured by the unit.

**616.05 Basis of Payment.** Work performed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Automatic Floodgates of the size specified, which price shall be full compensation for furnishing and installing

the gate and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
__" (___mm) Automatic Floodgates	Each

**SECTION 617  
GUARDRAIL**

**617.01 Description.** This item shall consist of furnishing and installing complete sections of steel plate guardrail, including line posts, blockouts, terminal anchor posts, and guardrail anchor posts of the type shown on the plans. The guardrail shall be constructed at the locations shown on the plans or designated by the Engineer, in conformity with the detailed requirements of the plans, and according to these specifications.

The item “Thrie Beam Guardrail Terminal” shall consist of furnishing and installing complete sections of steel plate thrie beam guardrail connecting to the concrete parapet wall, and thrie beam guardrail transition sections connecting W-beam guardrail sections to thrie beam guardrail sections. This item shall also include line posts, blockouts, connector plates, special end shoes, and all hardware and materials necessary to construct the thrie beam guardrail complete from the W-beam guardrail connection to the connection with the concrete parapet wall. The thrie beam guardrail terminal shall be constructed at the locations shown on the plans or designated by the Engineer, in conformity with the detailed requirements of the plans, and according to these specifications.

The item “Guardrail Terminal (Type 2)” shall consist of furnishing and installing an acceptable crashworthy end terminal for W-beam guardrail at the locations shown in the plans or as directed by the Engineer. The guardrail terminal shall be specifically designed as a W-beam guardrail terminal, and shall provide an anchor against which the full tensile strength of the rail can be developed for downstream hits while remaining crashworthy for end-on impacts. The guardrail terminal shall satisfy the National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH) for a test level 3

(TL-3) terminal. The guardrail terminal shall be of a configuration that will be compatible with the site geometry shown on the plans. Guardrail terminals that require additional grading or require anchoring outside the limits of the site shown on the plans will be acceptable; however, the cost of any additional site work shall be included in the price bid for the particular type of guard rail terminal used. Guard rail terminals shown on the plans shall be 50 feet (15 meters) in length. Any additional length of guardrail needed to fulfill the 50 feet (15 meters) requirement shall be included in the price bid for the particular type of guardrail terminal used.

**617.02 Materials.** All materials used in this construction shall comply with the following requirements:

**(a) Line Posts.** Guardrail line posts and blockouts shall be of either wood or steel, unless a specific type is indicated on the plans. As an alternate, plastic blockouts may be used where permitted on the plans. Plastic blockouts shall be listed on the Department's Qualified Products List.

**(1) Wood Posts.** Wood posts and blockouts shall be treated timber. All posts shall be of seasoned straight Southern Pine or Douglas Fir of the West Coast Region complying with Section 817. The posts shall conform to the dimensions shown on the plans. Posts shall be pressure treated by a standard empty cell or full cell process according to AWPA (U1) practice with creosote to retain a minimum of 12 pounds per cubic foot (190 kg/cu m) of wood, or with pentachlorophenol or chromated copper arsenate to retain a minimum of 0.6 pounds of active chemical per cubic foot of wood (9.6 kg per cu m).

**(2) Steel Posts.** Steel line posts and blockouts shall consist of structural shapes of the section shown on the plans or as otherwise specified and may be fabricated by the electrical resistance process complying with ASTM A 769. The steel shall comply with AASHTO M 270, Grade 36 (250). Posts and blockouts shall be galvanized according to AASHTO M 111.

**(3) Line Posts for Thrie Beam Guardrail Terminal.** Thrie beam guardrail and transition guardrail line posts and blockouts shall be of either wood or steel as shown on the plans. Concrete line posts or blockouts are not permitted. Thrie beam guardrail and transition guardrail blockouts shall be either steel tubing used

with steel posts or wood blockouts used with wood posts as indicated on the plans.

Steel posts shall conform to Subsection 617.02(a)(3). Structural steel tubing for blockouts in thrie beam guardrail section with steel posts shall be fabricated from ASTM A500 Grade B Steel.

**(b) Terminal Anchor Posts.**

(1) Terminal anchor posts shall be of the type and dimensions shown on the plans.

(2) Concrete for the anchor shall comply with Section 802 for Class M Concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance sampling and testing in Subsection 802.06.

(3) The steel anchor posts shall consist of structural shapes of the section shown on the plans, or as otherwise specified, and shall comply with AASHTO M 270, Grade 36 (250). The upper 15" (380 mm) of the anchor assembly shall be galvanized according to AASHTO M 111.

**(c) Guardrail Anchor Posts.**

(1) Concrete for the posts shall comply with Section 802 for Class A Concrete.

(2) Reinforcing steel shall comply with Section 804.

(3) Premolded joint filler shall comply with Subsection 501.02(h)(1)b Type 2.

**(d) Guardrail.** Guardrail material including hardware shall comply with AASHTO M 180, Class A, Type II. Chipped or damaged galvanizing shall be repaired as specified in AASHTO M 36.

**(e) Connector Plate.** Connector plates shall conform to AASHTO M270, Grade 36 (Grade 250), and shall be galvanized after fabrication. Galvanizing shall conform to Subsection 807.19. The connector plate shall be bolted to the special end shoe using 7/8" diameter (M22) high strength bolts, with heads placed on the traffic face. Bolts, nuts, and washers shall be galvanized and shall conform to Subsection 807.06.

**(f) Guardrail Terminal (Type 2).** The Contractor shall furnish a certification from the manufacturer or supplier that the guardrail terminal meets the requirements of NCHRP Report 350 or MASH for a TL-3 terminal. All materials shall be new. Rail elements and posts shall meet the requirements above. All steel components shall be galvanized. All parts shall be clearly identified for proper assembly and replacement.

The Contractor shall provide the Engineer with copies of all necessary manufacturer's details and installation manuals prior to the installation of the guard rail terminal on the project. These materials shall remain the property of the Department.

**617.03 Construction Requirements.** The alignment and location of guardrail shall be according to the plans, or as directed. When it is necessary to install posts in paved shoulders, the damage to the pavement caused by the installation shall be repaired. Depressed or heaved pavement shall be filled or cut out and filled with in kind material and finished to the line and grade shown on the plans or as directed by the Engineer. The Contractor may elect to cut out a section of pavement before installing the post and replacing the cut-out section as specified above. The repair or replacement of damaged pavement will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for Guardrail, Terminal Anchor Posts, Guardrail Anchor Posts, Thrie Beam Guardrail Terminals, and Guardrail Terminals (Type 2).

**(a) Line Posts.** Line posts shall be spaced as shown on the plans and set plumb in hand or mechanically dug holes, or by driving. The manner of driving shall be such as to avoid battering or distorting of posts. Post holes shall be backfilled with moist sand and thoroughly compacted as placed. Chipped or damaged galvanizing on steel posts shall be repaired in the field as specified in Subsection 617.02(d).

**(b) Terminal Anchor Posts.** Terminal anchor posts shall be constructed according to the plans. The guardrail may be bolted to the angle at the terminal anchor and the two assemblies positioned to proper alignment before placing concrete, or it may be bolted to the terminal anchor angle after the anchor posts have been placed and

the concrete sufficiently set, as approved by the Engineer. Welding shall comply with Section 807.

Unless specifically authorized by the Engineer, side forms shall not be used. Concrete shall be placed directly against bottom and sides of the excavation for the anchor. Mixing, placing, and curing concrete shall comply with Section 802.

**(c) Guardrail Anchor Posts**

**(1) Excavation and Backfill.** Excavation for post construction shall be done only to the extent necessary for construction. All loose material shall be removed from the excavated hole before placing the concrete for the lower portion of the post.

**(2) Forms.** Forms shall be of metal or wood, free from warp and of sufficient strength to resist springing during the process of depositing concrete. They shall be securely staked, braced, set, and held firmly to the required line and grade. All forms shall be cleaned and oiled before concrete is placed against them.

**(3) Placing and Finishing.** Concrete for the post shall be placed and finished according to Section 802.

**(d) Guardrail.** Guardrail shall be constructed according to the plans and in a manner resulting in a smooth, continuous installation. Fittings shall be secured to the posts and terminal anchors in a workmanlike manner. Laps shall be as shown on the plans.

**(e) High Strength bolts** shall be installed according to Subsection 807.71.

**(f) Guardrail Terminal (Type 2).** The guardrail terminal shall be fabricated and installed in accordance with the plans and the details provided by the manufacturer. Any damage caused by the Contractor to the materials required for the guardrail terminal shall be repaired or replaced immediately at no cost to the Department.

**617.04 Method of Measurement.** **(a)** Guardrail will be measured by the linear foot (meter) complete in place. As indicated on the plans, Sections 1 and 4 represent end sections and they will each be considered as 25' (7.5 m) in length. Intermediate sections will be measured along the roadway face of the guardrail from centerline of post to centerline of post.



(b) Terminal Anchor Posts will be measured by the unit.

(c) Guardrail Anchor Posts will be measured by the unit.

(d) Thrie Beam Guardrail Terminals will be measured by the unit. Each unit shall consist of thrie beam guardrail, the thrie beam connection to the concrete parapet wall, and the thrie beam transition to the W-beam guardrail.

(e) Guardrail Terminal (Type 2) will be measured by the unit.

**617.05 Basis of Payment.** (a) Guardrail completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Guardrail of the type called for and furnished, which price shall be full compensation for furnishing materials and erecting guardrail and line posts; for excavation and backfill; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) Terminal anchor posts completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Terminal Anchor Posts of the type called for and furnished, which price shall be full compensation for excavation and backfill; furnishing, preparing, and erecting parts and materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(c) Guardrail anchor posts completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Guardrail Anchor Posts, which price shall be full compensation for excavation and backfill; for furnishing materials, including concrete, reinforcing steel, bolts, nuts, washers, joint materials, forms, and bracing materials; for mixing, placing, finishing, and curing concrete; for the removal and disposal of excess materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(d) Thrie Beam Guardrail Terminals completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Thrie Beam Guardrail Terminal, which price shall be full compensation for furnishing all hardware and materials necessary to erect thrie beam guardrail terminals, thrie beam guardrail, thrie beam guardrail transitions, blockouts and line posts; for connector plates, special end shoes and required hardware; for

excavation and backfill; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(e) Guardrail Terminal (Type 2) completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Guardrail Terminal (Type 2), which price shall be full compensation for furnishing all materials; for any additional length of guardrail needed to complete the 50 foot (15 meter) meter requirement; for all additional grading or site work necessary for the proper installation of the type of terminal used; and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Guardrail (Type___)	Linear Foot (Meter)
Terminal Anchor Posts (Type___)	Each
Guardrail Anchor Posts	Each
Thrie Beam Guardrail Terminal	Each
Guardrail Terminal (Type 2)	Each

**SECTION 618  
GUARD CABLE**

**618.01 Description.** This item shall consist of furnishing and erecting guard cable in conformity with the lines and grades shown on the plans or as designed by the Engineer.

**618.02 Materials.** All materials used in this construction shall comply with the following requirements:

(a) **Posts.** Posts may be either wood or steel unless a specific type is indicated on the plans.

Wood posts shall be treated timber. All posts shall be of seasoned straight Southern yellow pine or Douglas Fir of the West Coast Region complying with Section 817 and the classification shown on the plans. The posts shall conform to the dimensions shown on the plans. Posts shall be pressure treated by the standard empty cell or full cell process according to AWPA practice with creosote to retain a minimum of 12 pounds per cubic foot (190 kg/cu m) of wood, or with pentachlorophenol or chromated

copper arsenate to retain a minimum of 0.6 pounds per cubic foot (9.6 kg/cu m) of wood.

Steel posts shall consist of structural shapes of the section shown on the plans. In lieu of the structural shapes specified, the Contractor may furnish comparable posts of welded beam construction fabricated by the electric-resistance welding process of ASTM A 769. The steel shall comply with AASHTO M 270, Grade 36 (250). Posts shall be galvanized according to AASHTO M 111.

**(b) Guard Cable.** Guard Cable shall be one of the following:

- Zinc coated steel wire strand cable, 1/2" (12 mm) in diameter, seven wire strand, common, Siemens-Martin or high strength grade, Class A coating, complying with ASTM A 475.
- Aluminum-zinc alloy coated steel wire strand cable, 1/2" (12 mm) in diameter, seven wire strand, Siemens-Martin or high strength grade, complying with ASTM A 474.

**(c) Anchors and Fittings.** Turnbuckles shall comply with AASHTO M 269 or FF-T-791b, Type I, Form 1, Class 2. Clips shall comply with FF-C-450d Type I, Class 1 or 2. Thimbles shall comply with FF-T-276b Type II or III. Eyebolts, anchors, stub ends, and other miscellaneous fittings shall comply with AASHTO M 102 or M 269 or M 183.

All fittings shall be galvanized according to AASHTO M 232, M 111, or ASTM B 695 Class 40 or 50.

**(d) Bolts, Nuts, and Washers.** Bolts, nuts, and washers shall conform to the plans and shall be steel complying with ASTM A 307, ASTM A325, or ASTM A449 (Heavy Hex), , galvanized according to AASHTO M 232. Threads on bolts and nuts shall conform to Unified Coarse Thread Series Class 2A, ANSI B 1.1 (Metric Coarse Thread Series, ANSI B 1.13M, 6g tolerance).

**(e) Delineators.** Delineators shall consist of white or yellow reflectors complying with Subsection 728.02.

A Type 1 (White or Yellow) delineator shall be a single 3" x 8" (75 x 200 mm) vertical rectangle with 3/4" (20 mm) corner radii and

two 13/64" (6 mm) diameter mounting holes spaced 6" (150 mm) on center.

A Type 2 delineator shall consist of the mounting of white delineators on both sides as shown on the plans.

The delineator shall be fabricated from 0.080" (2.0 mm) aluminum and shall comply with Section 723. Reflective sheeting shall comply with Section 728.

**(f) Delineator Post Extensions.** Metal delineator post extensions shall comply with Subsection 728.02 for U-Section channel. Wood line posts may be lengthened as shown on the plans for attachment of the delineators.

**618.03 Construction Methods.** The alignment and location of guard cable shall be according to the plans or as directed by the Engineer.

Posts shall be spaced as shown on the plans and set plumb in hand or mechanically dug holes, or by driving. The manner of driving shall be such as to avoid battering or distorting of posts. Post holes shall be backfilled with moist sand and thoroughly compacted as placed. Chipped or damaged galvanizing on steel posts shall be repaired in the field as stipulated in AASHTO M 36.

Guard cable shall be strung directly from the reel and shall be pulled tight after the initial anchoring. The cable shall then be attached to the second anchor assembly with all turnbuckles fully opened. The cables shall be completely anchored before being attached to the line posts.

Delineator post extensions shall be attached to the guard cable line posts and spaced as shown on the plans. White and/or yellow delineators shall be mounted on the delineator post extensions as required by the direction of traffic as shown on the plans.

**618.04 Method of Measurement.** Guard Cable will be measured by the linear foot (meter) complete in place. The measurement will be to the nearest linear foot (meter) and will be made from center of end post to center of end post. Guard Cable Anchor will be measured by the unit which will include all fittings, hardware, and the anchor device between the center of the post and into the ground.

**618.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Guard Cable and per each for Guard Cable Anchor, which price shall be full compensation for furnishing all materials; for installing posts, guard cable, and delineators; for excavation and backfill; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Guard Cable	Linear Foot (Meter)
Guard Cable Anchor	Each

**SECTION 619  
FENCES**

**619.01 Description.** This item shall consist of furnishing and erecting wire fence, chain link fence, and gates according to the plans and these specifications, and in reasonably close conformity to the lines, grades, and alignment shown on the plans or as directed. Types of wire fence specified will be as follows:

(a) Type A fence shall be constructed with woven and barbed wire mounted on wood or steel posts utilizing a selected grade of materials.

(b) Type B fence shall be constructed with barbed wire mounted on wood or steel posts utilizing a selected grade of materials.

(c) Type C fence shall be constructed with woven and barbed wire mounted on wood or steel posts utilizing a commercial grade of materials.

(d) Type D fence shall be constructed with barbed wire, mounted on wood or steel posts, utilizing a commercial grade of materials.

**619.02 Materials. (a) General.** The materials used shall be new and shall comply with the requirements for the class and type of material specified. All steel items shall meet the requirements of Subsection 106.01.

(1) Concrete for setting posts shall comply with Section 802 for Class M Concrete or may be a bagged commercial concrete mix which meets the strength requirements of Class M Concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

(2) Timber preservative shall comply with the applicable requirements of the current AWPA book of standards.

(3) Wood posts and braces shall be pressure treated, seasoned, sound, and reasonably straight southern pine or Douglas Fir of the West Coast Region. The posts shall be round and free from excessive end splits. Before pressure treatment, the posts and braces shall have the bark removed, the knots trimmed flush, and the ends cut square. Posts that are to be driven shall have the small end tapered.

(4) Metal posts and braces shall be of good commercial quality iron or steel and may be tubular, T, U, Y, or other shape manufactured for use as fence posts or braces. The minimum weight per foot (meter) and the length shall be according to the plans.

**(b) Types A and B Wire Fence.**

(1) Wood posts and braces of the size and length shown on the plans shall be treated by a standard empty cell or full cell process according to AWPA practice using creosote and retaining a minimum of 8 pounds per cubic foot (125 kg/cu m) of wood; or using pentachlorophenol, or chromated copper arsenate and retaining a minimum of 0.4 pounds per cubic foot (6 kg/cu m) of wood.

(2) Woven Wire farm fence shall be AASHTO M 279 design number 1047-6-11, Grade 60. Smooth line wire shall be 9 gage. Both woven wire and smooth line wire shall comply with AASHTO M 279, Class 3 galvanizing.

As an alternate to the woven wire farm fence specified above, AASHTO M 279 design number 1047-6-12½, Grade 125, shall be used, with each wire consisting of high tensile wire, complying with AASHTO M 279, with a minimum zinc coating at 0.90 oz/ft<sup>2</sup> (275 g/m<sup>2</sup>) for 12½ gage wire and 0.95 oz/ft<sup>2</sup> (290

g/m<sup>2</sup>) for 10½ gage wire. As an alternate to the smooth line wire specified above, 10½ gage, Grade 125 high tensile wire shall be used, with each wire complying with AASHTO M 279, with a minimum zinc coating at 0.95 oz/ft<sup>2</sup> (290 g/m<sup>2</sup>).

(3) Barbed wire shall be 12½ gage with four point barbs and shall conform to AASHTO M 280, Class 3 galvanizing.

As an alternate to the barbed wire specified above, the wire may consist of two strands of high tensile wire, each having the same galvanizing and breaking strength as Class 3, 12½ gage wire, and complying with the remaining requirements of AASHTO M 280 for a four point barb.

The minimum gage of the high tensile barbed wire shall be as follows:

Strand wire gage	15½
Barb wire gage	17

(4) Staples used to attach the wire fencing to wood posts shall be galvanized 9 gage, 1½" (38 mm) in length.

(5) Steel line posts shall be galvanized and comply with AASHTO M 281. Tubular steel posts shall comply with Grade 1 or Grade 2 of AASHTO M 181, or an approved alternate of Grade 2. Alternates to Grade 2 steel posts shall equal or exceed the performance criteria of AASHTO M 181 as determined by the Engineer of Materials.

(6) Hardware and fittings shall comply with ASTM F 626. Any miscellaneous hardware or fittings not mentioned in ASTM F 626 shall be galvanized according to the applicable requirements of AASHTO M 111 or M 232.

**(c) Types C and D Wire Fence.**

(1) Wood posts and braces of the size and length shown on the plans shall be pressure treated with creosote, pentachlorophenol, or chromated copper arsenate.

(2) Metal posts, braces, and fittings, shall be galvanized or painted. Metal posts for each section of fence between property lines shall be all galvanized or all painted.

(3) Woven wire farm fence shall be AASHTO M 279 design number 939-6-12½, and conform to commercial galvanization. Smooth line wire shall be 9 gage and conform to commercial galvanization.

(4) Barbed wire shall be 12½ gage with four point barbs on 4" to 5" (100 mm to 125 mm) centers and shall conform to commercial galvanization. A 15½ gage high tensile wire may be used in lieu of 12½ gage wire.

(5) Staples used to attach the wire fencing to wood posts shall be galvanized 9 gage, 1½" (38 mm) in length.

**(d) Chain Link Fence.**

(1) Material for chain link fence shall comply with AASHTO M 181 Type I, Class D; Type II; or Type III. Steel members for posts, rails, expansion sleeves, and gate frames may be either Grade 1 or Grade 2. The shape, size, and length of posts and rails, and the height, gage, and mesh size of fabric shall be as shown on the plans. Alternates to Grade 2 steel members shall equal or exceed the performance criteria of AASHTO M 181 as determined by the Engineer of Materials.

(2) Hardware and Fittings shall comply with ASTM F 626. Any miscellaneous hardware or fittings not mentioned shall be galvanized according to AASHTO M 111 or M 232.

Aluminum alloy fabric shall be used only with aluminum posts. Aluminum coated steel fabric and galvanized steel fabric, Class D, shall be used only with Grade 1 or Grade 2 steel posts.

**(e) Gates.**

(1) Frames for gates shall be galvanized steel or aluminum of the type and length shown on the plans. Frames shall be Grade 1 or Grade 2. They shall be fastened at the corners by clamps and braces or welded. If steel is used the entire weld shall be galvanized. Commercial gates may be used if they are equal to or better than the planned gates as determined and approved by the Engineer.

(2) The gate fabric shall be of the same type material and be in accordance with the same specifications as the adjoining fence.



**619.03 Construction Requirements. (a) General.** The fence shall be erected parallel to and at a specified distance from the right-of-way line, or as directed. The fence grade shall generally follow the ground contour, but shall present a uniform appearance. Minor grading along the fence line may be necessary to obtain the desired uniformity in fence grade. The fence alignment may be adjusted by the Engineer to preserve trees, land monuments, property corner markers, and the position of right-of-way monuments in place or planned. The Contractor may clear trees from a strip approximately 10' (3 m) wide adjacent to and within the right-of-way to accommodate fence erection equipment. Grubbing or scalping of the cleared strip shall not be permitted to prevent damage to trees, shrubs, grass, and other vegetation designated to remain. Clearing shall be performed according to Section 201.06.

**(b) Wire Fence.** Line posts and pull assemblies shall be spaced as shown on the plans. Wood line, corner, gate, and pull posts may be driven in place provided the driving does not damage the post; or they may be set in dug holes and backfilled with earth thoroughly compacted as placed; or set in concrete. Metal corner, gate, end, and pull posts shall be set in concrete. Wire shall not be stretched onto posts set in concrete until seven days after placement of posts. Posts shall be set plumb.

The Contractor has the option of using wood or steel posts and braces unless otherwise specified, but shall use the same material on the entire project. Wood end, corner, and pull posts may be used with steel line posts.

When solid rock is encountered, the posts shall be set to the required depth for soil unless the penetration into solid rock would exceed 10" (250 mm) for line posts and 16" (400 mm) for end, corner, gate, and pull posts. In such cases, the posts shall be set into the solid rock a minimum depth of 10" (250 mm) for line posts and 16" (400 mm) for end, corner, gate, and pull posts. The hole in the rock shall have a minimum cross section dimension 1" (25 mm) greater than the post to be set. The posts shall be cut before setting to give the proper length above ground surface. The hole shall be filled with Class M Concrete or a grout consisting of 1 part Portland cement and 3 parts concrete sand.

Wire tension braces for wood pull, end, and corner assemblies shall consist of a 9 gage wire passed around the posts to form a double wire. The wire shall be fastened to each post and the ends fastened together to form a continuous wire. The wires shall then be twisted together until the wire is in tension.

Where the new fence joins an existing fence, the two shall be attached in a satisfactory manner, with end posts being set as directed. Where the proposed fence intersects an existing fence, the end post shall be set for the existing fence clear of the proposed fence line as shown on the plans. The wire of the existing fence shall be stapled to the end post. When the point of intersection falls more than 2' (0.6 m) from a post on Type A and B fence, a line post shall be set at the intersection.

Pull post assemblies shall be placed at intervals of not more than 330' (100 m) in straight alignment on level or uniformly sloping ground, and at sharp vertical angle points in the line.

Corner post assemblies shall be placed at all horizontal angle points of 15° or more in the fence. When the distance from a corner post to the next corner or pull post is less than 165' (50 m), one approach span on the corner assembly may be omitted.

End post assemblies at fence ends, gates, bridge abutments, and on banks of streams shall be erected in the same manner as corner construction. Extra length posts shall be provided for crossing small streams, ditches, ravines, or soft ground. Additional depth of set shall be secured in soft ground as directed.

The wire shall be attached to the face of the post away from the highway, except on curves where the fencing shall be attached on the outside of the curve. The wire shall be attached to wood line posts with staples driven at right angles to the grain and at a slight downward angle to attain the best anchorage. The staples shall not be driven tightly against the wire but shall leave just enough free space for adjustment in tension due to changes in temperature. Wire shall be attached to steel line posts with approved galvanized clips. All barbed wire and alternate line wires of woven fabric shall be fastened to each line post. Barbed wire and all line wires of woven fabric shall be fastened to end, corner, and pull posts by wrapping the wire around the posts and tying the wire back on itself with not

less than 3 tightly wrapped twists. Splicing of barbed wire and woven wire shall be done according to the plans.

Tension for stretching the barbed wire and woven wire shall be applied by use of standard wire stretchers manufactured for that purpose. The use of trucks, tractors, and similar equipment will not be permitted in the tensioning operation, except as anchors.

**(c) Chain Link Fence.** All posts shall be set in concrete as shown on the plans, plumb, and true to line and grade. The concrete shall comply with Subsection 619.02, and shall be thoroughly tamped around the posts. The posts shall be equally spaced in the line of fence not to exceed the spacing shown on the plans. The top of the footing shall be domed to drain water away from the post. Concrete in post footings shall be at least 7 days old before stretching and securing fabric to posts, bracing, or hanging of gates.

Top rails, when required, shall pass through post caps and shall be securely fastened to end, brace, pull, and corner posts. Joints in top rails shall be made with expansion sleeve couplings to provide a substantial connection and allow for expansion and contraction of the rail.

Before the fence fabric is placed, the tension wire shall be placed at the proper location; stretched taut; securely anchored to each end, corner, or intermediate brace post; and satisfactorily fastened to each line post.

The fence fabric shall be attached to the face of the post away from the highway, except on curves, where the fabric shall be placed on the outside of the curve.

The end of the fabric shall be attached to the posts by means of a stretcher bar threaded through the end loops of the fabric and secured to the posts with clamps and bolts. The fabric shall be stretched to remove all slack with approved stretching equipment. The stretched fabric shall be secured to line posts, top rail, braces, and tension wire with specified fabric fasteners. Fabric fasteners shall be placed on line posts at not greater than 14" (350 mm) centers and on top rail, braces, and tension wire at not greater than 24" (600 mm) centers. Stretching operations shall be repeated at approximately every 100' (30 m) for each run of fence. The use of

trucks, tractors, and similar equipment will not be permitted in the stretching operation, except as anchors.

Splicing of the fabric shall be done by interweaving a wire picket through each end loop of each piece of fabric in a manner that will neatly and securely fasten the lengths of fabric together.

**(d) Gates.** Gates of the length and type shown on the plans shall be constructed at the locations shown on the plans or as directed.

**619.04 Method of Measurement.** (a) Fence will be measured by the linear foot (meter) in place along the midpoint in height of the fence from outside to outside of the end posts. The lengths of gates will be excluded from this measurement.

(b) Gates will be measured by the unit.

**619.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Wire Fence will be paid for at the contract unit price bid per linear foot (meter) for Wire Fence of the type specified.

(b) Chain Link Fence will be paid for at the contract unit price bid per linear foot (meter) for Steel Chain Link Fence or Aluminum Chain Link Fence of the height specified.

(c) Gates will be paid for at the contract unit price bid per each for Gates of the type and dimensions specified.

The contract unit prices mentioned above shall be full compensation for clearing, grading, setting posts, and erecting fence; for excavation and backfill; for furnishing materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Wire Fence (Type___)	Linear Foot (Meter)
___' (___m) Steel Chain Link Fence	Linear Foot (Meter)
___' (___m) Aluminum Chain Link Fence	Linear Foot (Meter)
___' (___m) Steel Gates	Each
___' (___m) Aluminum Gates	Each

## SECTION 620 SEEDING

**620.01 Description.** This item shall consist of furnishing and applying lime, fertilizer, seed, mulch cover, asphalt, and water according to these specifications at locations shown on the plans or as directed.

The work under this item shall be accomplished as soon as practicable after the grading in an area has been completed in order to deter erosion of the roadway and siltation of streams.

**620.02 Materials. (a)** Lime shall be agricultural grade ground limestone or equivalent as approved by the Engineer.

**(b)** Fertilizer shall be a commercial grade, uniform in composition, free flowing, and suitable for application with mechanical equipment. It shall be delivered to the site in labeled containers conforming to current Arkansas fertilizer laws and bearing the name, trademark, and warranty of the producer.

**(c)** Except as modified herein, the seed shall comply with the current rules and regulations of the Arkansas State Plant Board and the germination test shall be valid on the date the seed is used. It shall have a minimum of 98% pure seed and 85% germination by weight, and shall contain no more than 1% weed seeds. A combined total of 50 noxious weed seeds shall be the maximum amount allowed per pound (110 per kg) of seed with the following exceptions: Johnson grass seed, wild onion seed, wild garlic seed, field bindweed seed, nut grass seed, sickle pod seed, sesbania seed, indigo seed, morning-glory seed, cocklebur seed, ballonvine, crotalaria spp., serrated tussock, and tropical soda apple will not be allowed in any amount. Seed shall be furnished in sealed, standard containers. Seed that has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.

Crimson clover shall be inoculated with an approved culture as recommended by the manufacturer, just prior to seeding.

The Wildflower Mix shall be the following seed varieties and rates:

<u>Common Name</u>	<u>Latin Name</u>	<u>lbs./acre</u>	<u>kg/ha</u>
Black-eyed Susan	<i>Rudbeckia hirta</i>	0.5	0.6
Gay feather	<i>Liatris pycnostachya</i>	0.5	0.6
Purple coneflower	<i>Echinacea purpurea</i>	0.5	0.6
Showy primrose	<i>Oenothera speciosa</i>	0.5	0.6
Lanceleaf coreopsis	<i>Coreopsis lanceolata</i>	1.0	1.1
Plains coreopsis	<i>Coreopsis tinctoria</i>	1.0	1.1
		<b>4.0</b>	<b>4.6</b>

Wildflower seed not regulated by the Arkansas State Plant Board shall have a minimum of 95% pure seed and 65% germination by weight, and shall contain no more than 1% weed seeds.

Seed shall be composed of the varieties and amounts by weight as shown below.

Seed planted between June 16 and August 31 may require more water than that specified in Subsection 620.03(f) in order to survive. Therefore, watering shall continue after germination until growth is established.

The seeding mixture may be altered by the Engineer in selected areas with no adjustment in contract price. The alteration shall be on an equivalent cost basis.

Additional cereal grass seed may not be applied in excess of the rates shown below. The Engineer may permit the application of up to 15 lbs./acre (15 kg/ha) of additional cereal grass seed if the Contractor provides a written request which includes an agreement to mow the cereal grass growth before the seed heads form and prior to acceptance of the project to allow for the germination and growth of the other grasses in the seed mix. All mowing and additional seed will be done at no cost to the Department.

**Seed Variety:**

	<b>lbs/acre</b>	<b>kg/ha</b>
<b>Group I</b>		
<u>Districts 1, 2, 5, 6, and 10</u>		

**March 1 - June 15**

Bermuda Grass (Common) unhulled	5	5
Bermuda Grass (Common) hulled	10	10
Lespedeza (Kobe)	10	10

Wildflower Mix	4.0	4.6
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**June 16 - August 31**

Bermuda Grass (Common) unhulled	5	5
Bermuda Grass (Common) hulled	10	10
Wildflower Mix	4.0	4.6

**September 1 - February 28/29**

Wheat	15	17
Crimson Clover (Dixie)	10	10
Bermuda Grass (Common) unhulled	20	20
Wildflower Mix	4.0	4.6

**Group II**  
Districts 3, 4, 7, 8, and 9

**March 15 - June 15**

Bermuda Grass (Common) unhulled	5	5
Bermuda Grass (Common) hulled	10	10
Lespedeza (Korean)	10	10
Wildflower Mix	4.0	4.6

**June 16 - August 31**

Bermuda Grass (Common) unhulled	5	5
Bermuda Grass (Common) hulled	10	10
Wildflower Mix	4.0	4.6

**September 1 - March 14**

Annual Rye Grass or other Cereal Grasses	10	10
Crimson Clover (Dixie)	10	10
Bermuda Grass (Common) unhulled	20	20
Wildflower Mix	4.0	4.6

(d) Mulch cover shall consist of straw from threshed rice, oats, wheat, barley, or rye; of wood excelsior; or of hay obtained from various legumes or grasses, such as lespedeza, clover, vetch, soybeans, bermuda, carpet sedge, bahia, fescue, or other legumes or grasses; or a combination thereof. Mulch shall be dry and reasonably free from Johnson grass or other noxious weeds, and shall not be excessively brittle or in an advanced state of

decomposition. All material will be inspected and approved prior to use.

(e) **Tackifiers.** Tackifiers used in mulch anchoring shall be of such quality that the mulch cover will be bound together to form a cover mat that will stay intact under normal climatic conditions.

All tackifiers used shall have prior approval or be listed on the Department's Qualified Products List (QPL).

(f) Water shall be of irrigation quality and free of impurities that would be detrimental to plant growth.

**620.03 Construction Requirements. (a) Seedbed Preparation.** Areas to be seeded shall be dressed to the shape and section shown on the plans. If the plans call for replacing topsoil, this shall be done before any preparations for seeding. Before beginning the seedbed preparation, soil samples shall be obtained from each major soil area (such as cut backslope or fill foreslope) by the Engineer for lime requirement analysis.

Lime, at the rate determined by the lime requirement test, shall be uniformly spread on areas to be seeded prior to their being roughened or scarified. The seedbed shall be thoroughly pulverized by means of disk harrows or other approved methods, thoroughly mixing lime and soil to a depth of not less than 4" (100 mm) (2" [50 mm] for slopes 4:1 or steeper) below finish slope elevation. Regardless of the pulverizing method used, the soil shall be broken with the contour of the slope. Objectionable foreign matter shall be removed and the soil left in a suitable horticultural condition to receive the fertilizer and seed. Water may be applied before, during, and after seedbed preparation, as directed by the Engineer, in order to maintain the desired moisture content in the soil.

When no lime is required, seedbed preparation shall be accomplished as specified above regardless of the method used in the distribution of fertilizer, seed, and mulch cover.

(b) **Fertilization.** Fertilizer shall be applied at the rate of 800 pounds per acre (900 kg/ha) of 10-20-10, or the equivalent amount of plant food. Fertilizer shall be uniformly incorporated into the soil alone or in conjunction with the required lime. If the Contractor so elects, the fertilizer may be drilled into the soil or combined with the seed in the hydro-seeding operation.



**(c) Seeding. (1) Broadcasting.** Broadcast sowing may be accomplished by hand seeders or by approved power equipment. Either method shall result in uniform distribution and no work shall be performed during high winds. The area seeded shall be lightly firmed with a cultipacker immediately after broadcasting.

**(2) Drilled in Rows.** When seed is drilled in rows, the rows shall be horizontal (parallel to contour lines). Fertilizer and seed shall not be drilled together and shall not be mixed.

**(3) Hydro-seeding.** If a hydro-seeder is used for seeding, fertilizer and seed may be incorporated into one operation but a maximum of 800 pounds of fertilizer shall be permitted for each 1500 gallons (maximum of 95 kg for each 1500 L) of water. If the Contractor so elects, the fertilizer may be applied during preparation of the seedbed. The area shall be lightly firmed with a cultipacker immediately before hydro-seeding.

**(d) Mulch Cover.** Mulch cover shall be applied at the rate of 4000 pounds per acre (4500 kg/ha) immediately after seeding and shall be spread uniformly over the entire area by approved power mulching equipment. When approved by the Engineer, the Contractor may use hand methods to apply mulch cover to small or inaccessible areas. If the Contractor so elects, an approved mulching machine may be used whereby the application of mulch cover and tackifier may be combined into one operation. If this method is used, no change in application rates will be allowed. In its final position, the anchored mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and reduce the impact of rainfall on the surface of the soil. Care shall be taken to prevent tackifier materials from discoloring or marking structures, pavements, utilities, or other plant growth. Removal of any objectionable discoloration shall be at no cost to the Department.

**(e) Mulch Anchoring.** Immediately following or during the application of the mulch cover on seeded areas, the mulch shall be anchored by one of the following methods:

- **Tracking or Roller Method.** The mulch shall be effectively pressed into the soil using steel cleated track or cleated roller equipment. The anchoring shall be performed so that the grooves formed are perpendicular to the flow of water down

backslopes and foreslopes. The equipment and method used shall produce acceptable results.

- **Asphalt Tackifier.** Asphalt shall be applied at the rate of approximately 0.05 gallon per square yard (0.2 L/sq m). Application shall be made using a pressure distributor to ensure constant and uniform distribution. The use of asphalt may be reduced or eliminated by the Engineer at selected locations.
- **Other Tackifiers.** Tackifiers listed on the QPL shall be applied according to the rates recommended in the QPL.

The method used shall be at the Contractor's option unless otherwise specified or directed. In lieu of separate application of tackifiers, the Contractor may use equipment that combines the application of mulch and tackifier into one operation. Application shall be at the specified rates.

**(f) Water. (1) Initial Application.** From April 1 through December 31, either the day before the seeding is placed or on the day of the seeding operation (either before the seed is placed or after the application of the mulch cover), a minimum of 20.4 M Gallons per acre (188 cu m or 188 kL per ha) of water will be applied to thoroughly moisten the soil to the depth of pulverization and then as necessary to germinate the seed. This quantity may be reduced by the Engineer dependent on the soil moisture conditions immediately prior to the application of the seeding. Failure to apply the initial application of the quantity of water directed by the Engineer will result in a deduction in payment as shown below. Water used for hydro-seeding or tackifier application will not be measured or paid for, and will not be included in the quantity of water required for the initial water application. The initial application of water and deductions for failure to water will not be required from January 1 through March 31.

**(2) Weekly Application.** From April 1 – December 31, unless otherwise directed by the Engineer, the Contractor shall apply water in an amount such that, in conjunction with any rainfall, the seeded and mulched areas will receive an amount equivalent to a minimum of  $\frac{3}{4}$ " (19 mm) of water each week beginning the week after seeding and continuing for a minimum of four (4) weeks ( $\frac{3}{4}$ " [19 mm] of water is equivalent to 20.4 M Gallons per acre [ 188 cu m or 188 kL

per ha]). The Engineer will adjust the amount of water required each week to deduct any rainfall received during the 7 calendar day period prior to the weekly watering. The weekly applications of water and deductions for failure to water will not be required from January 1 through March 31.

**(3) Failure to Water.** Failure to meet the requirements of (1) or (2) above will result in a permanent deduction in payment and/or permanent recovery of payments equal to the minimum bid price established below for each M.G. (kL) not applied as directed in accordance with these specifications. Additional work and materials required due to the Contractor's negligence in maintaining completed work or failure to water grass as directed shall be accomplished at no cost to the Department.

**(4) Watering Equipment.** The Contractor shall have on the project such equipment of adequate capacity and a suitable water supply to achieve the desired moisture level in the soil. The equipment and methods used will be such that the application of water will not cause erosion or excessive movement of the previously placed seed and mulch cover. Any slope that is eroded or any seed or mulch cover that is washed down the slope due to failure to follow the above requirement will be repaired and/or reseeded at no cost to the Department.

The time required for application of water will not be included in the computations of contract time for completion of the project provided all other work under the Contract has been completed.

**(g)** For areas seeded in the September 1-February 28/29 or September 1-March 14 season, final acceptance will be delayed until an acceptable stand of grass of uniform color and density is established to the satisfaction of the Engineer. The soil condition shall be suitable for preparation of the seedbed according to the above requirements in the areas to be seeded during the September 1-February 28/29 or September 1-March 14 season.

**(h)** Before final acceptance, the Contractor shall repair or replace any seeding or mulching that is defective or damaged. If the defect or damage is due to the Contractor's negligence, the work shall be done at no additional cost to the Department. If the damage or defect is not the Contractor's fault, the work will be measured and paid for according to these specifications.

**620.04 Method of Measurement.** (a) Lime will be measured by the ton (metric ton).

(b) Seeding will be measured by the acre (hectare) of actual area covered.

(c) Mulch Cover will be measured by the acre (hectare) of actual area covered.

(d) Water will be measured by the M.G., (1000 gallons) (kiloliter [1,000 L]). Payment will be made to the nearest 100 gallons (100 L), based on calibrated tank or meter measurements.

**620.05 Basis of Payment.** (a) Lime completed and accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Lime, which price shall be full compensation for furnishing, hauling, and placing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) Seeding completed and accepted and measured as provided above will be paid for at the contract unit price bid per acre (hectare) for Seeding, which price shall be full compensation for seedbed preparation; for furnishing and applying fertilizer and seed; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(c) Mulch cover completed and accepted and measured as provided above will be paid for at the contract unit price bid per acre (hectare) for Mulch Cover, which price shall be full compensation for furnishing, hauling, and applying mulch material; for mulch anchoring; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(d) Water applied and measured as provided above will be paid for at the contract unit price bid per M.G. (kiloliter) for Water, which price shall be full compensation for furnishing, hauling, and applying water as directed; and for all labor, equipment, tools, and incidentals necessary to complete the work. Water used for hydro-seeding will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Seeding.

A minimum bid price shall be entered in the proposal for the item "Water", in accordance with the table below. Any unit bid price submitted in an amount less than the specified minimum will be automatically adjusted to the specified minimum to determine the correct total bid. This adjustment to the specified minimum will be automatically made, without any counter-adjustments in prices for other items.

Failure to water in accordance with these specifications or as directed will result in a loss to the Department of vegetative growth and vitality which is difficult to calculate. A permanent deduction in payment and/or permanent recovery of payments equal to the minimum bid price will be made as an item deduction for each M.G. (kL) not applied as directed in accordance with these specifications for damages sustained by the Department.

<u>Total Plan Quantity for Seeding</u>	<u>Minimum Bid Price</u>
Less than 5 acres (2 hectares)	\$10.00 per M.G. (\$4.00 per kL)
Greater than or equal to 5 acres (2 hectares)	\$5.00 per M.G. (\$2.00 per kL)

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Lime	Ton (Metric Ton)
Seeding	Acre (Hectare)
Mulch Cover	Acre (Hectare)
Water	M.G. (Kiloliter)

## **SECTION 621 TEMPORARY EROSION CONTROL ITEMS AND DEVICES**

**621.01 Description. (a) Temporary Seeding.** This item shall consist of the application of seed, fertilizer, and water according to these specifications to areas shown on the plans or as directed.

**(b) Mulch Cover.** This item shall consist of the application of mulch cover as a deterrent to soil erosion. The Engineer may make a determination to place mulch cover, without seeding, on areas that

require erosion control for a short period of time; when erosion control is necessary during the midwinter season when seed will not germinate; or because of the nature of material used for embankment construction. Mulch cover, including mulch anchoring when required, shall be applied to areas shown on the plans, or as directed by the Engineer.

**(c) Erosion Control Matting.** This item shall consist of the temporary placement of erosion control matting at locations shown on the plans or as directed by the Engineer. It will generally be used in diversion ditches at the ends of berms, or at other locations where the flow of water is concentrated. Areas receiving matting shall be shaped and seeded, when required, before placement of the matting.

**(d) Baled Straw Filter Barrier.** This item shall consist of baled straw staked and butted together to form a continuous barrier for the purpose of impeding or re-directing the flow of storm water as necessary to prevent its discharge off site or to a Water of the State.

**(e) Silt Fence.** This item consists of placing and securing a geotextile fabric to an existing support system or constructing a self-supporting geotextile fence where shown on the plans or as directed by the Engineer for the purposes of impeding the flow of water carrying silt toward existing streams and/or across adjacent property; redirecting the flow of silt-laden water to a sediment basin; and/or routing clean water through the construction area.

**(f) Sand Bag Ditch Check.** Where shown on the plans or as directed by the Engineer this item shall consist of preparing and placing sand bags in roadside ditches to impede run-off velocity of water and to prevent scouring and eroding of soil until permanent erosion control items can be placed.

**(g) Diversion Ditch.** Where shown on the plans or as directed by the Engineer this item shall consist of excavating or grading for diversion ditches to control soil erosion at selected locations. Diversion ditches will generally be excavated above the backslopes of cuts, along the top of embankments, or across foreslopes and backslopes to divert the run-off to vegetated areas, slope drains, downslope protection locations, or sediment basins. Sediment laden water shall not be discharged directly into natural drainage channels.

**(h) Sediment Basin.** This item shall consist of excavating and grading a storage area to detain sediment-laden runoff from

disturbed areas long enough to allow sediment to settle out. Sediment basins shall be placed at locations shown on the plans or as directed by the Engineer.

**(i) Drop Inlet Silt Fence.** This item shall consist of placing and securing geotextile to an adequate frame around a drop inlet to impede silt from entering the inlet. Drop inlet silt fence shall be placed at locations shown on the plans or as directed by the Engineer.

**(j) Rock Ditch Checks.** This item shall consist of constructing small dams across swales or ditches to slow concentrated storm water runoff to a non-erosive velocity. Ditch checks shall be constructed at locations shown on the plans or as directed by the Engineer.

**(k) Sediment Removal and Disposal.** This item shall consist of removing and disposing of silt collected in erosion and sediment control devices as directed by the Engineer.

**(l) Mulch Control Netting.** This item shall consist of furnishing and installing mulch control netting to be used over mulch cover in areas shown on the plans or designated by the Engineer. This is not a substitute for mulch anchoring or mulch cover. It is to be used where additional or long term control is needed for the mulch cover.

**(m) Slope Drains.** This work shall consist of installing a pipe and dumped riprap to convey concentrations of runoff from the top of a disturbed slope to the bottom and discharge the runoff onto either a stabilized area, sediment basin, or dumped rip-rap as directed by the Engineer. Slope drains shall be placed at locations shown on the plans or as directed by the Engineer.

**(n) Wattles.** This item shall consist of furnishing, installing, maintaining, and removing wattles at locations as directed by the Engineer for the purpose of controlling erosion and sedimentation.

**(o) Triangular Silt Dikes.** This item shall consist of furnishing, installing, maintaining, and the subsequent removal of a geotextile and urethane foam barrier designed to remove suspended soil particles from water passing through the barrier.

**621.02 Materials. (a)** Seed shall be of the fast germinating and growing variety such as common rye grass, the cereal grasses (wheat, barley, oats), or Brown Top Millet, complying with the

requirements of the Arkansas State Plant Board and Subsection 620.02(c). Fertilizer and water shall comply with Section 620.

(b) Mulch cover and tackifier, if applicable, shall comply with Section 620.

(c) Erosion Control Matting shall comply with Section 626.

(d) Straw for baled straw filter barrier shall consist of bales of rice, oats, barley, wheat, or rye straw, or of available grasses, free of an excessive amount of noxious weeds. Bales shall be a minimum of 30" (750 mm) in length. Straw in a state of decomposition will not be acceptable.

(e) Geotextile fabric for silt fence shall comply with the requirements of Section 625 for Type 3 or Type 4 or as shown on the plans. Supports for the fabric shall be of any material of sufficient strength and durability to support the fabric when loaded with silt for the entire time the barrier is needed for service.

(f) Sand for sand bags shall consist of a sandy type soil or clean sand that meets the approval of the Engineer. Bags for sand shall be of a tightly woven burlap or other material that is sufficiently durable to remain intact for the time intended.

(g) Geotextile for drop inlet silt fences shall be of the type shown on the plans and comply with Section 625. Framing shall be as shown on the plans and be of sufficient strength and durability to support the geotextile for the time needed.

(h) Material for rock ditch checks shall comply with Section 207. Rock having a different gradation may be used when determined by the Engineer to be suitable for the purpose intended.

(i) Dumped Riprap and geotextile for sediment basin spillway outlets shall comply with Section 816. Pipe culvert for a basin outlet shall comply with Subsection 606.02(c). Used pipe meeting these requirements may be used when determined by the Engineer to be suitable for the purpose intended. Rock filter shall comply with Subsection 207.02 for Stone Backfill.

(j) Mulch Control Netting shall be a uniformly extruded, rectangular, photodegradable plastic mesh with a minimum weight of 0.23 ounce per square yard (8 g/sq m) and a maximum mesh



opening of 2" x 2" (50 mm x 50 mm). Staples or wood stakes for use with mulch control netting shall be according to Section 626.

(k) Pipe for slope drains shall be 12" (300 mm) in diameter and shall comply with Subsection 606.02 or Type C corrugated polyethylene pipe complying with AASHTO M 294. Used pipe meeting these requirements may be used when determined by the Engineer to be suitable for the purpose intended. Dumped riprap shall comply with Section 816.

(l) Water shall comply with Section 620.

(m) Wattles shall consist of an elongated tube of netting filled with weed free organic material (coir, wood fibers, mulch, straw, or a combination of the previous materials) or rolls of organic material reinforced with biodegradable netting, in accordance with the Table 621-1. Wattles shall be installed in accordance with the size shown on the detail sheet or as directed by the Engineer.

**Table 621-1**  
**Wattles**

<b>Wattle Type</b>		<b>Material</b>
Coir	Core	100% blended bristle and mattress grade coir fiber
	Netting	Woven knotted coir or knotless polypropylene net
Excelsior	Core	Excelsior fiber with interlocking barbs and 80% being 6" in length or longer
	Netting	Polyester with 1" triangular shaped openings
Straw	Core	Compacted straw such as rice straw
	Netting	Polyethylene, polypropylene, or polyester netting
Mulch	Core	Well decomposed organic material, 99% passing 2" Sieve
	Netting	HDPE 3/8" knitted mesh netting
Rolled	Core	70% straw fiber, 30% coconut fiber
	Netting	Leno woven jute netting or biodegradable equal. Biodegradable netting must be used with this option

Hardwood stakes shall have dimensions of 1½ in. x 1½ in. and sufficient length to provide 2' embedment into the ground. If a rocky soil is encountered, the stake embedment shall be approved by the Engineer.

(n) Triangular Silt Dikes shall be supported and shall have a height of at least eight to ten inches (8-10") in the center with equal sides and a sixteen to twenty inch (16-20") base. The outer cover shall be a woven geotextile fabric placed around the inner material and allowed to extend beyond both sides of the triangle 24-36 inches. The geotextile fabric shall be mildew resistant, rot proof and resistant to ultraviolet radiation meeting the requirements for silt fence in AASHTO M 288. The edges shall be treated to prevent unraveling. Seams and stress points shall be reinforced. The fabric cover and apron shall be a continuous wrapping of the fabric: the apron shall be a continuous extension of the upstream face. The triangular shaped inner material shall be urethane foam. Standard length of each silt dike will be seven feet (7') unless otherwise indicated on the plans.

**621.03 Construction Requirements. (a) General** The Contractor shall actively maintain the areas or items constructed under this subsection from the time of their completion until the Engineer determines the items are no longer required. Additional work and materials required because of loss from erosion or other causes beyond the Contractor's control will be paid for unless they were required due to Contractor's negligence, in which case the maintenance shall be at no cost to the Department.

Temporary erosion control items and devices shall be removed, or may remain in place as directed by the Engineer, after final stabilization has been achieved but must be removed before the Notice of Termination for the Construction Storm Water Permit has been submitted. After items have been removed, the affected areas shall be graded to conform to the adjacent contours, unless otherwise directed by the Engineer. Following this removal and grading, permanent stabilization shall be established in these areas.

Disposal, when required, shall be according to the requirements of Sections 110 and 201. Salvageable materials will become the property of the Contractor.

**(b) Temporary Seeding.** The area designated or directed to be temporarily seeded does not have to be brought to typical section or a garden-like condition, but shall be lightly tilled.

Rye or the cereal grasses shall be planted at the rate of 100 pounds per acre (110 kg/ha) between August 15 and January 20.

Brown Top Millet shall be planted at a rate of 50 pounds per acre (55 kg/ha) between January 21 and August 14. The seeding mixture may be altered by the Engineer in selected areas with no adjustment in contract price. The alteration will be made on an equivalent cost basis. Fertilizer shall be applied at the rate of 500 pounds per acre (560 kg/ha) of 10-20-10 or the equivalent amount of plant food.

The Engineer may adjust the seasonal limitations specified above when immediate erosion control measures are required and other methods are not considered practicable. The decision to adjust seasonal limitations will be based on the practicality of planting seed at that particular time, with consideration being given to the geographic location of the project and the period of time remaining before permanent erosion items can be applied.

From April 1 through December 31, either the day before the temporary seeding is placed or on the day of the temporary seeding operation (either before the seed is placed or after the application of the mulch cover) an application of water will be applied, in accordance with Subsection 620.03(f)(1). No subsequent weekly waterings will be required for Temporary Seeding.

Failure to meet this application of water requirement will result in a permanent deduction in payment and /or permanent recovery of payments equal to the minimum bid price established in Subsection 620.05(d) for each M.G. (kL) not applied as directed in accordance with these specifications. Equipment and methods used to place the water shall be in accordance with Subsection 620.03(f)(4).

(c) Mulch cover shall be applied according to Section 620.

(d) Erosion control matting shall be applied according to Section 626.

(e) Bales for baled straw filter barriers shall be installed so that the bindings are oriented around the sides of the bales and not along the tops and bottoms. The bales shall be keyed into the ground a minimum of 4" (100 mm) and securely held in place by staking, wiring, and/or other methods that will prevent floating and/or displacement. No gaps shall be left between bales. The number of bales required and the specific arrangement of them will vary with the conditions at each site. Bales that become displaced shall be retrieved and re-installed, if suitable. Bales that become

unserviceable in their original location shall be removed and replaced.

(f) Geotextile fabric for silt fence shall be attached to the supporting system in such manner that it will remain attached and fully supported for the entire time the barrier is needed for service. The fabric toe shall be buried to secure the base as shown on the plans. Splices shall be securely fastened. Re-anchoring of the toe of the installed silt fence and re-securing the geotextile fabric to the supports shall be considered normal maintenance and will be considered included in the unit price bid for silt fence.

After permanent stabilization has been completed, or simultaneously with the permanent stabilization, the silt fence and the silt trapped by it shall be removed and disposed of as directed by the Engineer. Disposal shall be according to the requirements of Sections 110 and 201. When directed by the Engineer, silt fences shall be left in place.

(g) For sand bag ditch checks, the sacks shall be filled approximately 3/4 full, shall weigh a minimum of 55 pounds (25 kg), and shall be securely closed.

Sand bags shall be placed in the ditches at locations shown on the plans or as directed by the Engineer. They shall be laid in horizontal courses and successive courses shall break joints with preceding ones. The sacks shall be rammed and packed against each other and tamped on the surface to secure a uniform surface. The overflow area in the center of the ditch check shall be constructed lower than the sides. The number of bags required and the arrangement at each installation will vary with on-site conditions.

(h) Excavation and grading for diversion ditches shall be according to the dimensions and at the locations shown on the plans or as directed by the Engineer.

(i) Geotextile for drop inlet silt fences shall be attached to the supporting system in such manner that it will remain attached and fully supported for the entire time the barrier is needed for service. The fabric toe shall be buried to secure the base as shown on the plans. Splices shall be securely fastened.

(j) Rock ditch checks shall be constructed as shown on the plans or as directed by the Engineer. The overflow area in the center of the ditch check shall be constructed lower than the sides.

(k) Sediment basins shall be constructed to the dimensions shown on the plans or as directed by the Engineer. The soil used in basin construction shall be compacted and stabilized. Dumped riprap and geotextile for a sediment basin with a spillway outlet shall be placed on the spillway as shown on the plans. For sediment basins with a pipe outlet, the rock filter material shall be placed around a perforated riser pipe that is connected with an elbow to a non-perforated corrugated metal pipe. Sufficient rock filter shall be used to cover the perforations and stabilize the riser. An anti-seep collar shall be installed.

Sediment basins shall not be obliterated until final stabilization has been achieved. The soil used to create the basin, the sediment trapped in the basin, and the dumped riprap and rock filter for the outlet may be used to fill the basin; however, all fill material used shall be compacted and stabilized. The area shall be graded to conform to the adjacent contours, unless otherwise directed by the Engineer.

(l) Sediment collected in the various erosion and sediment control devices shall be removed when needed and as directed by the Engineer. Sediment basins and ditch checks shall have sediment removed when their capacity is reduced by half. Silt fences shall have sediment removed when a deposit covers 1/3 the height of the structure. Sediment removed shall be deposited and stabilized as described in Section 110. Sediment will normally be incorporated back into the embankment construction as directed by the Engineer.

(m) Mulch control netting shall be installed over the mulch with the longitudinal length parallel to the slope. Adjacent netting widths shall be overlapped by not less than 4" (100 mm). Remaining fabric areas shall be stretched, then secured by pinning to the ground with approximately 1 staple per square yard (square meter) of area. Upslope ends, edges, bottom, and overlaps shall be stapled at 2 foot (0.6 meter) intervals.

(n) Slope drains shall be constructed as shown on the plans or as directed by the Engineer. Pipe for slope drains shall be installed

down the slope as shown on the plans and securely held in place by anchor stakes or other devices as approved by the Engineer.

(o) Wattles shall be placed on the ground and securely held in place by stakes as shown on the detail sheet. The number of wattles required will vary with the conditions at each site; therefore, a series of wattles shall either be butted together or overlapped as directed by the Engineer. A continuous segment of wattle shall be used in a ditch application.

Accumulated sediment shall be removed when it covers one-half the height of the wattle. Sediment removed shall be deposited and stabilized as described in Section 110. Payment for this work will be made under the item "Sediment Removal and Disposal." Repair of or complete replacement of torn or damaged wattles shall be performed as required or as directed by the Engineer. Wattles shall be temporarily removed and replaced as required to facilitate construction operations.

When the required work has been completed and the area has been stabilized and approved by the Engineer, the wattle netting is to be cut and the core material shall be spread out on the surrounding ground area. If non-biodegradable netting is used in the wattles, the netting shall be removed from the site. If biodegradable netting is used, it can remain in place under the organic core material. Upon completion of the spreading of the core material, the area is to be approximately level so that no barrier to water flow will exist.

(p) Install, align, and locate the triangular silt dikes as shown on the plans, or as directed by the Engineer. All triangular silt dikes shall be placed on the contour and in a row with ends tightly abutting the adjacent triangular silt dike. Filter material shall lap over the ends 6 inches to cover dike to dike junctions; each junction shall be secured with wire staples.

The approach apron shall be followed by the sewn seam and front side of the dike section. The exiting apron will lie underneath the dike section and extend out beyond the discharge side.

When triangular silt dikes are installed across surface drainage ditches, the highest point of the triangular silt dike in the center of the ditch must be lower than the lowest point of the triangular silt

dike at the end. This will direct water over the center of the triangular silt dike and not around the ends.

When installed as diversion devices, triangular silt dikes shall be placed along the contour or on a 1-2% gradient to a planned discharge point.

Accumulated sediment shall be removed when it covers one half the height of the triangular silt dike. During removal of sediment, the operator must exercise care within the range of the front apron to avoid damage to the device. The range of the apron is approximately eighteen to twenty four inches (18-24") from the base of the barrier. Sediment removed shall be deposited and stabilized as described in Section 110. Payment for this work will be made under the item "Sediment Removal and Disposal."

Inspect all triangular silt dikes after each rainfall event and/or each seven day period. Triangular silt dikes shall be temporarily removed and replaced as required to facilitate construction operations. Any deficiencies or damage shall be repaired at no cost to the Department. Repair of, or complete replacement of torn or damaged triangular silt dikes shall be performed as required or as directed by the Engineer at no additional cost to the Department.

**621.04 Method of Measurement.** (a) Temporary Seeding will be measured by the acre (hectare) of actual area covered.

(b) Mulch Cover will be measured according to Section 620.

(c) Erosion Control Matting will be measured according to Section 626.

(d) Baled Straw Filter Barriers will be measured by the bale in place as authorized by the Engineer.

(e) Silt Fence will be measured by the linear foot (meter) complete in place.

(f) Sand Bag Ditch Checks will be measured by the bag.

(g) Diversion Ditches will be measured by the linear foot (meter).

(h) Sediment Basins will be measured by the cubic yard (cubic meter) of volume contained in the basin below the spillway elevation or the top of the riser pipe. This volume will be calculated by measuring the length, width, and average depth or by using the

average end area method. Dumped riprap, geotextile, and rock filter for spillway outlets will be measured according to Sections 816, 625, and 207 respectively. Pipe for sediment basins will be measured by the linear foot (meter) along the center of the pipe and will include riser, elbow, and pipe outlet. Rock filter for sediment basins will be measured by the ton (metric ton).

Obliteration of Sediment Basin will be measured by the cubic yard (cubic meter). The quantity for purposes of payment will be the same quantity as was determined for the original construction of the basin, and no further measurement will be made.

(i) Drop Inlet Silt Fence will be measured by the linear foot (meter) in place along the midpoint in height of the outside perimeter of the completed structure.

(j) Rock Ditch Checks will be measured by the cubic yard (cubic meter) in place. The volume will be calculated by measuring the average length, width, and depth or by using the average end area method.

(k) Sediment Removal and Disposal will be measured by the cubic yard (cubic meter) of sediment removed. The volume will be calculated by measuring the length, width, and the average depth or by using the average end area method.

(l) Mulch Control Netting will be measured by the square yard (square meter) of actual area covered.

(m) Dumped Riprap for slope drains will be measured according to Section 816. Pipe for slope drains will be measured by the linear foot (meter) along the center of the pipe and will include elbows and tees.

(n) Water will be measured according to Section 620.

(o) Wattles will be measured by the linear foot complete in place; measurement will be made along the centerline of the top of each wattle. The overlap length will be paid for at the contract unit price.

(p) Triangular Silt Dikes will be measured by the linear foot, complete in place, with measurement being made along the centerline of the top of the barrier.



**621.05 Basis of Payment.** (a) Temporary seeding completed and accepted and measured as provided above will be paid for at the contract unit price bid per acre (hectare) for Temporary Seeding.

(b) Mulch cover will be paid for under Section 620.

(c) Erosion control matting will be paid for under Section 626.

(d) Baled straw filter barrier completed and accepted and measured as provided above will be paid for at the contract unit price bid per bale for Baled Straw Filter Barrier.

(e) Silt Fence completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Silt Fence.

(f) Sand bag ditch checks completed and accepted and measured as provided above will be paid for at the contract unit price bid per bag for Sand Bag Ditch Checks.

(g) Diversion ditches completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Diversion Ditch.

(h) Sediment basins completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Sediment Basins. Dumped riprap and geotextile for sediment basins will be paid for under Sections 816 and 625 respectively. Pipe culvert for sediment basins completed and accepted and measured as above will be paid for at the contract unit price bid per linear foot (meter) for Pipe Culvert for Sediment Basins. Rock filter for sediment basins completed accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Rock Filter for Sediment Basins.

Obliteration of sediment basin completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Obliteration of Sediment Basin, which price shall be full compensation for all work required to obliterate the sediment basin including furnishing, placing and compacting fill material; seeding; and applying mulch cover to the area.

(i) Drop inlet silt fence completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Drop Inlet Silt Fence.

(j) Rock ditch checks completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Rock Ditch Checks.

(k) Work involved in the removal and disposal of sediment from erosion and sediment control devices completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Sediment Removal and Disposal.

(l) Mulch control netting completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Mulch Control Netting.

(m) Dumped riprap for slope drains will be paid for under Section 816. Pipe for slope drains completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Pipe for Slope Drains.

(n) Water will be paid for under Section 620. A permanent deduction in payment and/or permanent recovery of payments equal to the minimum bid price contained in Subsection 620.05(d) will be made as an item deduction for each M.G. (kL) not applied as directed in accordance with these specifications. Water used for hydro-seeding will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Temporary Seeding.

(o) Wattles completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot for Wattle, which price shall be full compensation for furnishing all materials; for initial wattle installation, including hardwood stakes (installation and removal); for routine inspection and maintenance of wattles; for temporarily removing and replacing wattles as required to facilitate construction operations; for removing the wattles (if directed); and for all labor, equipment, tools, and incidentals necessary to complete the work.

(p) Triangular Silt Dike work completed and accepted under this item and measured as provided above will be paid for at the contract

unit price bid per linear foot for Triangular Silt Dike, which price shall be full compensation for furnishing, placing, maintaining, temporarily removing and replacing as required to facilitate construction operations, and removal of the Triangular Silt Dike and for all other materials, labor, tools, equipment, and incidentals necessary to complete the work.

The contract unit prices mentioned above shall be full compensation for furnishing all materials; for site preparation; for acceptable maintenance of the completed items; for subsequent removal of the items when applicable; for permanent stabilization of the areas disturbed by the removal of these items, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Other temporary erosion control measures may be ordered by the Engineer to establish control of soil erosion or sedimentation. These items will be measured and paid for according to the applicable portions of these specifications.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Temporary Seeding	Acre (Hectare)
Baled Straw Filter Barrier	Bale
Silt Fence	Linear Foot (Meter)
Sand Bag Ditch Checks	Bag
Diversion Ditch	Linear Foot (Meter)
Drop Inlet Silt Fence	Linear Foot (Meter)
Rock Ditch Checks	Cubic Yard (Cubic Meter)
Sediment Basin	Cubic Yard (Cubic Meter)
Rock Filter for Sediment Basin	Ton (Metric Ton)
Pipe Culvert for Sediment Basin	Linear Foot (Meter)
Obliteration of Sediment Basin	Cubic Yard (Cubic Meter)
Sediment Removal and Disposal	Cubic Yard (Cubic Meter)
Mulch Control Netting	Square Yard (Square Meter)
Pipe for Slope Drains	Linear Foot (Meter)
Wattle ( _”)	Linear Foot (Meter)
Triangular Silt Dike	Linear Foot (Meter)

## SECTION 622 SOD MULCH

**622.01 Description.** This item shall consist of furnishing and applying lime, fertilizer, sod mulch, seed and mulch cover when required, and water according to these specifications at locations shown on the plans, or as directed.

The work under this item shall be accomplished as soon as practicable after the grading in an area has been completed in order to deter erosion of the roadway and siltation of streams.

**622.02 Materials.** (a) Lime shall comply with Subsection 620.02(a).

(b) Fertilizer shall comply with Subsection 620.02(b).

(c) Sod mulch shall consist of cuttings and root systems of live, growing Bermuda grass and shall be procured from areas where the soil is fertile as indicated by vigorous growth. The grass shall have a healthy virile root system of dense, thickly matted roots throughout the sod for a thickness of at least 3 inches (75 mm). The sod shall be reasonably free from noxious weeds or undesirable grasses and shall not contain any matter injurious to its growth or hardiness when transplanted. All sources of sod mulch shall be approved by the Engineer.

(d) Seed for overseeding sod mulch shall comply with Subsection 620.02(c).

(e) Mulch cover for overseeding sod mulch shall comply with Subsection 620.02(d).

(f) Tackifiers for mulch cover shall comply with Subsection 620.02(e).

(g) Water shall be according to Subsection 620.02(f).

**622.03 Construction Requirements.** (a) **Preparation of Areas Receiving Sod Mulch.** The areas to be sodded shall be brought to a reasonably smooth and uniform surface to conform to the finished grade and cross section shown on the plans. If the plans call for the item replacing topsoil, this shall be done before any other preparations for receiving sod mulch.

The area shall be thoroughly pulverized by means of disk harrows or other approved methods to a depth of not less than 3" (75 mm). Regardless of the pulverizing method used, the soil shall be broken with the contour of the slope. In areas consisting of shale or rock fragments, disking will be waived but lateral furrows 2" to 3" (50 mm to 75 mm) deep at 36" (1 m) intervals shall be constructed with the contour of the slope and sod mulch placed to provide a uniformly smooth surface susceptible to being mowed.

Objectionable foreign matter shall be removed and the soil left in a suitable horticultural condition to receive the sod mulch.

Water may be applied before, during, and after preparation as directed by the Engineer to maintain the desired moisture content in the soil. Watering shall be according to Section 620.

**(b) Preparation of Areas Producing Sod Mulch.** The area from which sod mulch is to be secured shall be closely mowed and raked to remove all weeds and long standing stems. This operation may be dispensed with at the discretion of the Engineer when the grass source has been pastured, or for any other reason is free of weeds, long standing stems, or other debris.

Before disking the mulch, soil samples shall be obtained from each major soil area or sod field by the Engineer for lime requirement analysis.

On the basis of soil analysis tests, lime shall be applied at 1/3 the rate determined per hectare (acre) by the lime requirement test for each 1" (25 mm) of depth sod mulch is excavated.

Fertilizer shall be applied at the rate of 270 pounds per acre (300 kg/ha) of 10-20-10, or the equivalent amount of plant food, for each 1" (25 mm) of depth sod mulch is to be excavated.

After mowing and raking, the required lime and fertilizer shall be uniformly spread over the sod mulch area. The grass shall then be disked thoroughly until the sod has been well mixed with lime and fertilizer to the depth the sod mulch is to be removed. Sod mulch shall be excavated to a minimum depth of 3" (75 mm) and to a maximum depth of 6" (150 mm). Immediately after disking, the sod mulch shall be cast into windrows. Care shall be exercised that only topsoil is included in the material excavated with the sod.

The sod mulch shall be procured only when the soil is in a moist, friable condition.

**(c) Method of Placement.** Sod mulch shall not be cut in the Spring until the Bermuda grass begins to show growth. Sod Mulch shall be hauled and placed before reduced viability has taken place. The sod mulch shall be spread uniformly upon the prepared area to the required approximate depth shown on the plans or directed by the Engineer.

After the sod mulch has been spread and shaped, the entire area shall be satisfactorily compacted by use of rollers, cultipackers, or other approved equipment. Any section not true to lines and typical cross section shall be corrected by the addition of sod material or by reshaping the materials previously placed.

The sod mulch shall be thoroughly watered immediately after being placed. The Contractor shall maintain growth areas from time of placement for a period of at least 3 weeks or until final acceptance of the project, whichever is greater. The time required for watering grass will not be included in computations for time required to complete the project provided all other work under the Contract has been completed. Additional watering to encourage growth beyond the 3-week period shall be applied as directed.

**(d) Restoration.** Additional work and materials required because of loss through erosion will be paid for under the pertinent contract items. Additional work and materials required due to the Contractors negligence in maintaining completed work shall be accomplished at no cost to the Department. The sod mulch source field shall be finished according to the agreement between the Contractor and Owner. A copy of the agreement will be provided to the Engineer before sod is removed. The agreement will stipulate the final condition of the source field. All restoration of the source field shall be done at no cost to the Department.

**(e) Overseeding.** Sod mulch placed after July 31 shall be overseeded as soon after placement as possible within the seasonal limitations specified in Subsection 620.02(c). If packing or hardening of the sod mulch has occurred prior to the time of overseeding, a surface preparation of light harrowing or other method approved by the Engineer shall be applied before seeding. No fertilizer will be applied to the areas requiring overseeding. The

applicable requirements of Subsections 620.03(c), (d), (e), and (f) shall govern the construction methods for overseeding.

**622.04 Method of Measurement.** (a) Lime will be measured according to Section 620.

(b) Sod Mulch will be measured by the cubic yard (cubic meter) in approved vehicles at the point of delivery on the road.

At the Contractor's option, solid sodding complying with Section 624, may be substituted for sod mulch. Measurement will be made at the planned rate of sod mulch over the actual area covered by solid sodding.

(c) Overseeding Sod Mulch will be measured by the acre (hectare) of actual area covered.

(d) Mulch Cover will be measured according to Section 620.

(e) Water will be measured according to Section 620.

**622.05 Basis of Payment.** (a) Lime will be paid for under Section 620.

(b) Sod mulch completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Sod Mulch, which price shall be full compensation for preparing the areas receiving and the areas producing sod mulch; for furnishing fertilizer and sod mulch material; for hauling, spreading, finishing, and maintaining; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(c) Overseeding sod mulch completed and accepted and measured as provided above will be paid for at the contract unit price bid per acre (hectare) for Overseeding Sod Mulch, which price shall be full compensation for needed seedbed preparation; for furnishing and applying seed; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(d) Mulch cover will be paid for under Section 620.

(e) Water will be paid for under Section 620. Water for moistening the sod field and for hydro-seeding will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for Sod Mulch and Overseeding Sod Mulch.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Sod Mulch	Cubic Yard (Cubic Meter)
Overseeding Sod Mulch	Acre (Hectare)

## **SECTION 623**

### **SECOND SEEDING APPLICATION**

**623.01 Description.** This item shall consist of furnishing and applying seed and fertilizer on all seeded and sod mulched areas of the project during the planting season following the original seeding or sod mulch placement, according to these specifications and as directed.

The Contractor will not be required to hold a project over to the following planting season in order to complete this item when all other items of the Contract have been completed and accepted.

**623.02 Materials.** The seed and fertilizer shall comply with the applicable requirements of Subsection 620.02(b) and (c).

**623.03 Construction Requirements.** The seed and fertilizer may be placed with a hydro-seeder or broadcast with hand seeders or approved power equipment.

When an area is seeded during the Spring planting season or sod mulched before August 1, 20 pounds per acre (20 kg/ha) of Crimson Clover (Dixie) and 400 pounds per acre (450 kg/ha) of 6-24-24 fertilizer or the equivalent amount of plant food at these proportions shall be placed between September 1 and October 15.

When an area in Districts 5, 8, 9, 10, and the northern six counties of District 4 is seeded during the Fall planting season or sod mulched between August 1 and October 15, 35 pounds per acre (40 kg/ha) of Korean Lespedeza, 10 pounds per acre (10 kg/ha) of unhulled Bermuda Grass, 5 pounds per acre (5 kg/ha) of hulled Bermuda Grass, and 400 pounds per acre (450 kg/ha) of 6-24-24 fertilizer or the equivalent amount of plant food at these proportions shall be placed between March 1 and April 30 of the following year.



When an area in the remainder of the State is seeded during the Fall planting season or sod mulched between August 1 and October 15, 35 pounds per acre (40 kg/ha) of Kobe Lespedeza, 10 pounds per acre (10 kg/ha) of unhulled Bermuda Grass, 5 pounds per acre (5 kg/ha) of hulled Bermuda Grass, and 400 pounds per acre (450 kg/ha) of 6-24-24 fertilizer or the equivalent amount of plant food at these proportions shall be placed between March 1 and April 30 of the following year.

The seeding mixture may be altered by the Engineer in selected areas with no adjustment in contract price. The alteration will be made on an equivalent cost basis.

**623.04 Method of Measurement.** Second Seeding Application will be measured by the acre (hectare) of actual area covered.

**623.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per acre (hectare) for Second Seeding Application, which price shall be full compensation for furnishing and applying seed and fertilizer; for water for hydro-seeding; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Second Seeding Application	Acre (Hectare)

## **SECTION 624 SOLID SODDING**

**624.01 Description.** This item shall consist of furnishing and placing approved Bermuda sod, fertilizer, and water according to these specifications at locations shown on the plans, or as directed.

**624.02 Materials.** (a) The Bermuda sod shall be composed of either field grown grass or approved nursery grown grass and shall consist of a densely rooted growth of grass substantially free from noxious weeds and undesirable grasses.

The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh, and uninjured at the time of placing. It shall have a soil mat of sufficient thickness adhering

firmly to the roots to withstand all necessary handling. It shall be placed as soon as possible after being cut and shall be kept moist from the time it is cut until it is placed in its final position.

The source of field grown sod shall be inspected and approved by the Engineer before being cut for use in the work. After approval, the area from which the sod is to be harvested shall be closely mowed and raked as necessary to remove excessive top growth and debris.

Approved devices, such as sod cutters, shall be used for cutting the sod and due care shall be exercised to retain the native soil intact. The sod shall be cut in uniform strips. The width of the sod furnished for use on the project shall be satisfactory to the Engineer. Rolled sod may be backed with a netting material for added strength in handling if necessary.

(b) Fertilizer shall be in accordance with Subsection 620.02(b).

(c) Water shall be in accordance with Subsection 620.02(f).

**624.03 Construction Requirements. (a) Preparation of Bed.**

The area to be sodded shall be dressed to the shape and section shown on the plans and the top and bottom of slopes shall be rounded to a radius of approximately 3' (1 m) unless otherwise directed. The finished slopes shall be free of objectionable foreign matter and the top 1" (25 mm) of soil shall be loosened and finely divided. When directed, areas consisting of poor quality soil shall be loosened roughly and covered with a layer of topsoil not less than 2" (50 mm) in depth. Water may be applied before, during, and after slope preparation, as directed by the Engineer, in order to maintain the desired moisture content in the soil.

(b) **Fertilization.** Immediately before placement of sod, fertilizer shall be broadcast at the rate of 250 pounds per acre (280 kg/ha) (approximately 1 pound per 19 square yards [1 kg/35 sq m]) of 10-20-10, or the equivalent amount of plant food, and incorporated into the top 1" (25 mm) of soil.

(c) **Placement of Sod.** The bed shall be in a firm but uncompacted condition with a relatively fine texture at the time of sodding. Sod shall be moist and shall be placed on a moist earth bed. Sod strips shall be laid along contour lines, by hand, commencing at the base of the area to be sodded and working

upward. The transverse joints of sod strips shall be broken, and the sod carefully laid to produce tight joints. At the top of slopes the sod shall be turned into the embankment slightly and a layer of earth placed over it and compacted to conduct surface water over and onto the sod. The sod shall be firmed, watered, and refirmed immediately after it is placed. The firming shall be accomplished by use of a lawn roller or approved tamper, with care being taken to avoid tearing end strips of sod.

When sodding is completed, the sodded areas shall be cleared of loose sod, excess soil, or other foreign material; a thin application of topsoil shall be scattered over the sod as a top dressing; and the areas thoroughly moistened. Water shall be applied at a minimum rate of 20.4 M Gallons per acre (188 cu m or 188 kL per ha) or as directed by the Engineer for a period of at least 3 weeks. The Engineer will adjust the amount of water required each week to deduct any rainfall received during the 7 calendar day period prior to the weekly watering. The weekly applications of water and deductions for failure to water will not be required from January 1 through March 31. The time required for application of water will not be included in the computation of contract time for completion of the project provided all other work under the Contract has been completed.

Failure to meet this water application requirement will result in a permanent deduction in payment and /or permanent recovery of payments equal to the minimum bid price established in Subsection 620.05(d) for each M.G. (kL) not applied as directed in accordance with these specifications. Equipment and methods used to place the water shall be in accordance with Subsection 620.03(f)(4). The Contractor shall maintain sodded areas from the time of completion until final acceptance of the project by the Engineer.

**(d) Restoration.** Additional work and materials required because of the Contractor's negligence in maintaining the work shall be accomplished at no cost to the Department.

When sod is other than nursery supplied, the source field shall be finished according to the agreement between the Contractor and Owner in a condition, after removal of sod, which is acceptable to the property owner and conducive to re-establishment of turf. A copy of the agreement will be provided to the Engineer before sod is removed. The agreement will stipulate the final condition of the

source field. All restoration of the source field shall be done at no cost to the Department.

**624.04 Method of Measurement.** (a) Solid Sodding will be measured by the square yard (square meter) of actual area covered.

(b) Water will be measured according to Section 620.

**624.05 Basis of Payment.** (a) Solid sodding completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Solid Sodding, which price shall be full compensation for bed preparation; for furnishing and applying fertilizer, topsoil, and sod; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) Water will be paid for under Section 620.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Solid Sodding	Square Yard (Square Meter)

## **SECTION 625 GEOTEXTILE FABRIC**

**625.01 Description.** This item shall consist of furnishing and installing a geotextile fabric of the type specified at the locations shown on the plans or as directed by the Engineer.

**625.02 Materials.** Geotextile fabric shall be a woven or non-woven synthetic fiber fabric listed on the Department’s Qualified Products List and complying with AASHTO M 288, as follows:

Type 1 shall comply with the requirements for Subsurface Drainage, Class 2. This geotextile is used by placing against a soil to allow for long-term passage of water into a subsurface drain system retaining the in-situ soil.

Type 2 shall comply with the requirements for Subsurface Drainage, Class 3. This geotextile is used by placing against a soil to allow for long-term passage of water into a subsurface drain system retaining the in-situ soil.

Type 3 shall comply with the requirements for Temporary Silt Fence, Supported Silt Fence. This geotextile is used as a vertical, permeable interceptor designed to remove suspended soil from overland water flow and shall be supported between posts with wire or polymeric mesh.

Type 4 shall comply with the requirements for Temporary Silt Fence, Unsupported Silt Fence(Self-Supporting). This geotextile is used as a vertical, permeable interceptor designed to remove suspended soil from overland water flow.

Type 5 shall comply with the requirements for Permanent Erosion Control, Class 1. This geotextile is used between energy absorbing armor systems and in the in-situ soil to prevent soil loss resulting in excessive scour and to prevent hydraulic uplift pressures causing instability of the permanent erosion control system.

Type 6 shall comply with the requirements for Permanent Erosion Control, Class 2. This geotextile is used between energy absorbing armor systems and in the in-situ soil to prevent soil loss resulting in excessive scour and to prevent hydraulic uplift pressures causing instability of the permanent erosion control system.

Type 7 shall comply with the requirements for Paving. This geotextile is used as a paving fabric, saturated with asphalt cement, between pavement layers.

Type 8 shall comply with the requirements for Separation, Class 2. This geotextile is used to prevent mixing of a subgrade soil and an aggregate cover material (subbase, base, select material, etc.). May also be used beneath pavements where separation of two dissimilar materials is required but water seepage through the geotextile is not a critical function.

Type 9 shall comply with the requirements for Separation, Class 3. This geotextile is used to prevent mixing of a subgrade soil and an aggregate cover material (subbase, base, select material, etc.). May also be used beneath pavements where separation of two dissimilar materials is required but water seepage through the geotextile is not a critical function.

Type 10 shall comply with the requirements for Stabilization, Class 1. This geotextile is used in wet, saturated conditions to provide the coincident functions of separation and filtration. In

some installations, the geotextile can also provide the function of reinforcement.

**625.03 Construction Requirements.** Types 1, 2, 5, and 6 geotextile shall be installed in such a manner that all splice joints are provided with a 12" (300 mm) minimum lap. Types 5 and 6, when placed under water, and Types 8, 9, and 10 geotextiles shall be installed in such a manner that all splice joints are provided with a 1 m (3') minimum lap. Types 3, 4, and 7 shall be spliced as shown in the plans.

Care shall be taken during the placement and installation of the material to prevent damage to the fabric. Damages to Types 1 and 2 geotextiles shall be repaired by placing a geotextile patch over the damaged area, extending 12" (300 mm) beyond the perimeter of the damaged area. Damage to Types 5, 6, 8, 9, and 10 geotextiles shall be repaired by placing a geotextile patch over the damaged area extending 3' (1 m) beyond the perimeter of the damaged area.

**625.04 Method of Measurement.** Geotextile Fabric will be measured by the square yard (square meter). Laps and material used for patching damaged areas will not be measured.

**625.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Geotextile Fabric of the type specified, which price shall be full compensation for furnishing and placing materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Geotextile Fabric (Type___)	Square Yard (Square Meter)

**SECTION 626  
EROSION CONTROL MATTING**

**626.01 Description.** This item shall consist of furnishing, placing and maintaining erosion control matting according to these specifications at locations shown on the plans, or as directed.

**626.02 Materials.** Materials shall be furnished according to AHTD Class 1, Class 2, and Class 3. All materials shall be listed on the QPL.

The Class of matting shall be as shown on the plans and/or as specified in the project specifications. The type matting used within a particular Class shall be at the option of the Contractor, unless otherwise specified. Any matting from a higher numbered class may be used in lieu of the matting specified, but at no additional cost to the Department.

**626.03 Construction Requirements.** The matting shall be applied after the area has been properly shaped, fertilized, and seeded as specified on the plans.

The materials shall be applied according to the manufacturer's recommendations. Size and gage of staples, staple spacing, overlap of materials, direction of matting, etc., shall follow the manufacturer's instructions for installation for the site conditions. The Contractor shall supply the Engineer with manufacturer's guidelines before installation.

The Contractor shall maintain the matting areas until all work on the entire project has been completed and accepted.

**626.04 Restoration.** Additional work and materials required because of loss through erosion will be paid for under the pertinent contract items. Additional work and materials required due to the Contractor's negligence in maintaining the completed work shall be accomplished at no cost to the Department.

**626.05 Method of Measurement.** Matting will be measured by the square yard (square meter) of actual area covered.

**626.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Erosion Control Matting of the Class specified, which price shall be full compensation for furnishing all labor, materials, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Erosion Control Matting (Class_____)	Square Yard (Square Meter)

## SECTION 627 VACANT

### SECTION 628 TOPSOIL FURNISHED AND PLACED

**628.01 Description.** This item consists of furnishing and placing topsoil on completed slopes and ditches according to these specifications and at locations shown on the plans or as directed by the Engineer.

**628.02 Materials.** Topsoil may be obtained from sources outside the right-of-way limits or from areas within the project limits that will be occupied by cuts and/or embankments. When topsoil is furnished from sources outside the right-of-way, the Contractor shall be responsible for locating and obtaining the material and for performing all work, including erosion control, prevention of water pollution, and restoration, according to the specifications. The cost of such work will be considered included in the contract unit price bid for Topsoil Furnished and Placed. At the request of the Engineer, the Contractor shall furnish copies of agreements with the property owners.

Topsoil from all sources shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth and shall be reasonably free from subsoil and stumps, roots, brush, stone, clay lumps, or similar objects larger than 2" (50 mm) in greatest diameter. In no case shall topsoil be excavated more than 12" (300 mm) from the original ground level. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth, such as grass and weeds, shall not be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. Topsoil may contain a reasonable amount of waste from clearing operations, such as small twigs and roots, that can be expected to reach early decay.

**628.03 Construction Operations. (a) Removing, Storing, and Handling Topsoil.** Topsoil stripped from within the project shall be moved to areas on the right-of-way, or other approved locations, and stockpiled. When measurement is to be by the cross section method,



the stockpiles shall be uniformly shaped and susceptible to ready measurement by the cross section method. Stockpiles shall be located so that they will not interfere with any proposed construction nor constitute drainage, traffic, or other hazards, either to the project, the general public, or adjacent property. Storage should be in such locations that will afford easy access for loading, hauling, and replacement. The stored topsoil shall be protected from contamination.

If the condition of the soil is unsuitable due to excessive moisture, frost, or other conditions, the Contractor shall cease work under this item until the soil is in a suitable condition.

Topsoil stripped from within the project limits shall be removed prior to the taking of original cross sections. The Contractor shall schedule the work in coordination with the Resident Engineer so as to minimize any delay between the stripping of the topsoil, the taking of original cross sections, and the beginning of excavation and/or embankment construction. Failure of the Contractor to properly schedule the work will not be considered as grounds for extension of time nor for additional payment due to any resulting delays.

**(b) Placing Topsoil.** Topsoil shall be distributed over the completed slopes and ditches to a depth as shown on the plans or designated by the Engineer. Spreading and dressing of the topsoil layer shall be uniform insofar as possible. After spreading, any remaining large roots, branches, or other foreign substances shall be removed to leave a smooth and clean appearance.

Light rolling, disking, or other type manipulation, including sprinkling, shall be applied as necessary to cause the newly spread layer to pulverize, mix, and adhere to the slopes. Topsoil shall be placed on areas that are to receive seed or sod mulch as soon as practicable after the earthwork is completed, but shall not be placed until after final cross sections are taken. The Contractor shall schedule the work in coordination with the Resident Engineer so as to minimize any delay between the completion of the earthwork, the taking of final cross sections, and the placement of topsoil. Failure of the Contractor to properly schedule the work will not be considered as grounds for extension of time nor for additional payment due to any resulting delays.

(c) **Restoration.** Additional work and materials required because of loss through erosion will be paid for under the appropriate contract item. Additional work and materials required due to the Contractor's negligence in maintaining the completed work, including failure to apply and maintain seeding, mulch cover, sod mulch, and/or solid sod as required, shall be accomplished at no cost to the Department.

The storage sites for topsoil within the right-of-way shall be dressed to conform to the adjacent area after the storage piles have been removed.

If the Contractor elects to obtain topsoil from areas within the project limits that are to be occupied by embankments, additional borrow material required to replace the topsoil will be measured and paid for under the appropriate item.

**628.04 Method of Measurement.** Topsoil furnished from outside the right-of-way will be measured by the cubic yard (cubic meter) in vehicles at the point of delivery for use on the project. Topsoil obtained from within the project limits will be measured by the cubic yard (cubic meter) either in stockpiles by the cross section method or in vehicles at the point of delivery for spreading. No adjustment will be made for swell.

**628.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Topsoil Furnished and Placed, which price shall be full compensation for furnishing, hauling, stockpiling, moving, and placing topsoil; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Topsoil Furnished and Placed	Cubic Yard (Cubic Meter)

## SECTION 629

### GABIONS

**629.01 Description.** This item shall consist of the construction of interconnected rectangular wire-mesh baskets filled with coarse nondegradable stone to be used as retaining walls according to these specifications and conforming to the lines, grades, dimensions, locations, and design shown on the plans, or as directed.

**629.02 Materials. (a)** All wire for gabion baskets shall meet the requirements of Subsection 106.01. Wire for gabion baskets shall be 11 gage (3.0 mm), or equivalent, with a tensile strength between 60,000 to 85,000 psi (415 and 585 MPa). The minimum zinc coating of the wire shall be 0.80 oz./sq. ft (245 g/sq m) of uncoated wire surface complying with AASHTO T 65. Lacing wire shall comply with the same specifications as wire used in the mesh and shall be 13½ gage (2.2 mm). All perimeter edges (mesh edge and selvaige rod wires) of the mesh forming the gabion shall be securely selvaged with wire of 9 gage (3.8 mm) or greater. The wire mesh shall be fabricated in such a manner as to be nonraveling as defined by the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire in a section of mesh is cut. Openings of the mesh shall be approximately 4½" (115 mm) in the longest dimension by approximately 3¼" (80 mm).

**(b)** Gabion baskets shall be supplied as specified on the plans. Gabions shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into a rectangular basket of the required size. Gabions are to be of single unit construction with the base, ends, and sides either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection are at least equal to that of the mesh.

**(c)** Stone for filling gabion baskets shall be obtained from an approved source and shall consist of sandstone, limestone, or other hard and durable stone that will be resistant to the action of air and water. The stone shall consist of field stone or rough unhewn quarry stone, angular, and with fractured faces. The stone shall weigh not less than 150 pounds per solid cubic foot (2400 kg per solid cu m) with a percent of wear not greater than 45 by the Los Angeles Test (AASHTO T 96). Based on any one hauling unit shipment or

delivery, the maximum piece size shall be not greater than 8" (200 mm) in any dimension. The minimum stone size shall be 4" (100 mm) except for dirt and fines accumulated from quarrying or loading operations, which shall not exceed 5%.

**629.03 Construction Requirements. (a) Excavation.** The existing material shall be excavated to the required depth. Soft and yielding material shall be removed and replaced with suitable material and the entire subgrade shall be thoroughly compacted.

**(b) Backfilling.** The area under the gabion walls shall be backfilled with granular material and thoroughly compacted.

**(c) Gabion Baskets.** Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately 6" (150 mm) spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil spacing of 5" (125 mm). Empty gabion units shall be set to line and grade as shown on the plans or as directed by the Engineer. Gabion baskets shall be securely fastened to all adjacent gabion baskets to the satisfaction of the Engineer. It is not intended that the fastenings to adjacent gabions equal the strength of the baskets themselves. A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.

The gabion baskets shall be filled with stone carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. After a gabion basket has been filled, the lid shall be bent over until it meets the sides and edges. The lid shall then be secured to the sides, ends, and diaphragms with wire ties or connecting wire in the manner described above.

**(d) Filter Fabric.** A filter fabric is to be placed on top and back of filled gabion baskets as shown on the plans.

**(e) Backfill.** The area behind gabion walls is to be backfilled with embankment material as approved by the Engineer. Care shall be taken so as not to damage filter fabric when placing backfill.

**629.04 Method of Measurement.** Gabions will be measured by the cubic yard (cubic meter) of gabion baskets in place using the specified dimensions.

**629.05 Basis of Payment.** Work completed and accepted under this item and measured as provided above will be paid for at the

contract unit price bid per cubic yard (cubic meter) for Gabions, which price shall be full compensation for furnishing materials; for assembling and securing baskets; for placing stone in baskets; and for all equipment, tools, and incidentals necessary to complete the work. Excavation, material for backfill, and filter fabric will be paid for under other appropriate contract items.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Gabions	Cubic Yard (Cubic Meter)

## **SECTION 630 ROCK BUTTRESS**

**630.01 Description.** This item shall consist of the construction of a rock buttress as shown on the plans or as directed by the Engineer according to these specifications and to the lines, grades, and dimensions shown on the plans or as directed by the Engineer.

**630.02 Materials.** Stone used for construction of the rock buttress shall be obtained from an approved source and shall consist of sandstone, limestone, syenite, novaculite, or other hard and durable stone. Shale, slate, or similar materials shall not be used. The stone shall be greater than 1½" (40 mm) and less than 30" (750 mm) in any dimension. The stone shall be reasonably well graded and angular, with fractured faces on at least 75% of the surface and shall not contain more than 10% overburden or fines less than 1½" (40 mm) in maximum cross-section. The stone shall weigh not less than 150 pounds per solid cubic foot (2400 kg per solid cu m) and shall have a percent of wear not greater than 45 by the Los Angeles Test (AASHTO T 96) and when subjected to 5 cycles of the Soundness Test (Sodium Sulfate, AASHTO T 104) shall have a loss not to exceed 12 percent. The stone shall have an absorption rate (AASHTO T 85) of less than 3 percent. Relatively thin, layered rock shall not be used for the mass of the rock buttress, but may be used to face the outside surfaces of the buttress.

**630.03 Construction Methods.** Before placing the rock buttress, a trench shall be excavated and shaped as indicated on the plan drawings or as directed. The rock shall be dumped or placed

substantially to the shape indicated on the plan drawings. During stone placement operations, larger rock shall be pushed to the lower portion of the rock buttress. Objectionable voids between large rocks shall be filled with smaller stones or suitable granular material to provide adequate bearing surfaces for adjacent rocks.

Care shall be exercised to place rock along the outside face that will present a reasonably pleasing appearance.

Backfill shall be according to Subsection 210.09.

**630.04 Method of Measurement.** Rock Buttress completed and accepted will be measured by the cubic yard (cubic meter) in place. The volume will be computed by the average end area method.

**630.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Rock Buttress, which price shall be full compensation for furnishing and hauling material; for placing and compacting the rock; for backfilling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Required excavation for the trench will be measured and paid for as provided in Section 210 for the appropriate classification of excavation.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Rock Buttress	Cubic Yard (Cubic Meter)

**SECTION 631  
CONCRETE BARRIER WALL**

**631.01 Description.** This item shall consist of the construction of a concrete barrier wall according to these specifications and conforming to the lines, grades, dimensions, and locations shown on the plans or as directed.

**631.02 Materials.** (a) The concrete used shall comply with the requirements for Class S or S(AE) Concrete as provided in Section 802, or for paving concrete as provided in Section 501. The maximum allowable slump shall be 4 inches (100 mm). The maximum water/cement ratio shall not be exceeded. The Contractor

shall perform quality control and acceptance sampling and testing in accordance with Subsection 802.06.

When an extrusion machine is used, the Contractor may modify the concrete mix design, upon approval of the Engineer, to improve workability while maintaining the above strength requirements.

- (b) Anchor bolts shall be as specified on the plans.
- (c) Reinforcing steel shall comply with Section 804.
- (d) Premolded joint filler shall comply with Section 802.

**631.03 Construction Requirements. (a) Excavation.** Any existing shoulder or embankment slopes shall be excavated to the required depth. All soft and yielding material shall be removed and replaced with suitable material and the entire subgrade shall be thoroughly compacted.

**(b) Removal & Reconstruction.** Any existing shoulder material and concrete slope paving shall be removed only to the extent required for construction. After completion of concrete construction and backfilling, the shoulders and concrete slope paving shall be replaced with the same kind and quality of materials removed. Where it is necessary to remove a portion of the existing shoulder, concrete slope paving, curb, and/or approach slab gutter to comply with details shown on the plans, such work will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Concrete Barrier Wall.

Reconstructed approach curb and/or gutter shall comply with details shown on the plans and where adjacent to the barrier wall shall be placed integrally with the barrier wall footing. The gutter shall be constructed to the limits shown on the plans and shall be equivalent to the existing approach gutter thickness. This work will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Concrete Barrier Wall.

**(c) Forms.** Forms shall be of metal or wood, free from warp, and of sufficient strength to resist springing during the process of placing concrete. They shall be securely staked, braced, set, and held firmly to the required line and grade. All forms shall be cleaned and oiled before concrete is placed against them. Weep hole pipe of the size

shown on the plans shall be set in the forms true to line and grade as indicated.

In lieu of the conventional stationary forms, concrete median barrier wall may be constructed by using an extrusion machine or other equipment specifically designed for constructing cast-in-place barrier, provided that the finished barrier is well consolidated and true to line and grade.

**(d) Placing, Finishing, and Curing.** The concrete for the footing shall be deposited in the form upon the wetted subgrade and vibrated and spaded until mortar entirely covers the surface. The concrete in the riser shall be deposited in the forms and vibrated until mortar entirely covers the surface after which it shall be finished smooth and even by means of a wood float.

Face forms shall be removed within 24 hours and the face finished by rubbing with a wetted cement mortar brick or wood float until it is smooth. Plastering will not be permitted but minor defects shall be filled with a 1:2 cement mortar (1 part Portland cement to 2 parts concrete sand) float applied with a wood float.

As an alternate to rubbing concrete surfaces, the Contractor may apply a broomed finish to extruded concrete surfaces or use a textured coating finish complying with Subsection 802.19.

When completed, the concrete shall be cured as specified in Section 501 except a membrane curing compound shall only be permitted on extruded concrete surfaces with a broomed finish.

**(e) Surface Test.** Completed concrete barrier wall shall present a smooth, uniform appearance in the final position, conforming to the horizontal and vertical lines shown on the plans. Before the concrete is given the final finish, the surface of the top and face of the barrier wall shall be true to line and grade. The maximum variation in 10' (3 m) shall not exceed ¼" (6 mm).

**(f) Joints.** Joints shall be constructed at such intervals and locations and shall comply with the requirements and dimensions as shown on the plans.

**(g) Backfilling.** After the forms have been removed, the voids left shall be backfilled with suitable material and firmly compacted. The excavated areas around the completed structure shall then be backfilled to the required elevations with suitable material, deposited



in layers not to exceed 6" (150 mm). Compaction shall be accomplished with approved mechanical tampers until it is as firm and unyielding as the surrounding material.

**631.04 Method of Measurement.** Concrete Barrier Wall will be measured by the linear foot (meter).

**631.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Concrete Barrier Wall (Median Type\_\_), Concrete Barrier Wall (Parapet Type\_\_), or Concrete Barrier Wall (Pier Protection Type\_\_), which price shall be full compensation for excavation and backfill; for furnishing materials including concrete, reinforcing steel, bolts, nuts, washers, dowels, joint materials, and weep hole pipe; for performing mix designs and quality control and acceptance sampling and testing; for replacing shoulder materials, concrete slope protection, approach curbs, and gutters, and the preparation and placing of all other materials; for preparing the subgrade and forming; for mixing, placing, finishing, and curing concrete; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete Barrier Wall (Median Type__)	Linear Foot (Meter)
Concrete Barrier Wall (Parapet Type__)	Linear Foot (Meter)
Concrete Barrier Wall (Pier Protection Type__)	Linear Foot (Meter)

**SECTION 632  
CONCRETE ISLAND**

**632.01 Description.** This item shall consist of the construction of concrete islands according to these specifications and in conformity with the locations, lines, and grades shown on the plans or as directed.

**632.02 Materials.** The concrete used shall comply with Section 802 for Class A or S Concrete or Section 501 for paving concrete.

The maximum allowable slump shall be 4 inches (100 mm). The maximum water/cement ratio shall not be exceeded. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

**632.03 Construction Requirements.** Unless the island is to be constructed on an existing base or pavement, the subgrade shall be shaped and compacted to the required grade and section. All soft and yielding areas shall be removed and replaced with suitable material and compacted. Any portion of the subgrade that is not accessible to normal compaction equipment shall be thoroughly compacted with manually operated mechanical tampers. Before depositing the concrete, the subgrade shall be cleared of all foreign materials that may have fallen on it and shall be in a moist condition.

When the island is being constructed on an existing base, the base shall be shaped and compacted as necessary to provide a firm foundation true to the required grade and section. The base shall be in a moist condition and free of loose material when depositing concrete.

When the island is to be constructed on an existing asphalt or concrete pavement, the pavement shall be cleaned of all loose material and moistened immediately before placing concrete. Any pot holes or other defects shall be repaired so as to provide a firm foundation for the island. At the Contractor's option and expense, pot holes and other defects may be cleaned of loose material and filled with concrete at the same time as the island concrete is placed.

After the concrete has been deposited and spread, it shall be thoroughly consolidated and finished to a uniform line and grade free of humps and depressions.

A space not less than ½" (12 mm) wide shall be left between the island and adjacent structures, except that no space shall be left between the sides of the island and adjacent curbs. The space shall be filled with approved joint filler complying with AASHTO M 213.

When completed, the concrete shall be cured as specified in Section 501.

**632.04 Method of Measurement.** Concrete Island will be measured by the square yard (square meter).

**632.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Concrete Island, which price shall be full compensation for excavating and preparing the subgrade, existing base, and/or pavement; for furnishing, transporting, and placing all materials; for the preparation and processing of all materials; for all mixing, spreading, vibrating, finishing, and curing; and for all labor, equipment, tools, and incidentals necessary to complete the work. Work involved in preparing the subgrade, existing base, and/or existing pavement will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Concrete Island.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete Island	Square Yard (Square Meter)

### **SECTION 633**

#### **CONCRETE WALKS, CONCRETE STEPS, AND HAND RAILING**

**633.01 Description.** This item shall consist of the construction of concrete walks, concrete steps, and/or hand railing according to these specifications and in conformity with the locations, lines, and grade shown on the plans or as directed.

**633.02 Materials.** The concrete shall comply with the requirements for Class M Concrete as provided in Section 802. The maximum allowable slump shall be 4 inches (100 mm). The maximum water/cement ratio shall not be exceeded. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

Steel pipe and fittings for hand railing shall be commercially available hot-dip galvanized Schedule 40 steel pipe meeting the requirements of Subsection 106.01. As an alternate, hand railing sections may be hot dipped galvanized after fabrication. Plates shall comply with AASHTO M 270 (Grade 36) and shall be galvanized

according to AASHTO M 111. Nuts, bolts, and washers shall comply with ASTM A 307, Grade A, or AASHTO M 314, Grade 36, and shall be galvanized according to AASHTO M 232 or, ASTM B695 Class 40 or 50. After galvanizing, the nuts shall be free running on the bolts.

**633.03 Construction Requirements. (a) Subgrade.** The subgrade shall be excavated or filled to the required grade. Soft and yielding material shall be removed and replaced with suitable material and the entire subgrade shall be thoroughly compacted with approved mechanical equipment.

**(b) Forms.** Forms shall be constructed of metal or wood, free from warp, and of sufficient strength to resist springing during the process of depositing concrete. They shall be securely staked, braced, set, and held firmly to the required line and grade. Forms shall be cleaned and oiled before concrete is placed against them.

**(c) Placing and Finishing.** The concrete shall be deposited in the forms upon the wetted subgrade to such depth that when it is compacted and finished, the top shall be at the required elevation. It shall be thoroughly consolidated and the edges along the forms spaded to prevent honeycomb. The top shall then be struck off with a straightedge and tamped or vibrated sufficiently to flush mortar to the surface, after which it shall be given a Class 6 finish according to Section 802.19. Edges shall be rounded with a ¼" (6 mm) radius, including edges at joints.

A weakened plane shall be formed to a depth of 1" (25 mm) and the edges shaped using a ¼" (6 mm) wide jointing tool. These joints shall be formed at intervals not greater than the width of the walk being constructed, or as directed.

Forms shall be removed from exposed surfaces of steps within 24 hours, and the surfaces finished by rubbing with a wetted cement mortar brick or wood float until it is smooth. Plastering will not be permitted, but minor defects shall be filled with a 1:2 cement mortar (1 part Portland cement to 2 parts concrete sand) applied with a wood float.

When completed, the concrete shall be cured as specified in Section 501, except that only clear curing compound may be used.

**(d) Backfilling.** After the forms have been removed, the spaces on each side of the walks or steps shall be backfilled with suitable material, which shall be firmly compacted by means of approved mechanical equipment and neatly graded.

**(e) Expansion Joints.** A space not less than ½" (12 mm) wide shall be left between the sidewalks and adjacent structures. This space shall be filled with approved joint filler complying with AASHTO M 213. No space or joint filler is required between the sides of the walks and adjacent curbs.

Transverse expansion joints shall be placed at a maximum interval of 45' (13.7 m). Transverse joints shall be constructed using a joint filler complying with AASHTO M 213.

**(f) Hand Railing.** Railing shall be erected in a workmanlike manner, straight and true to line and grade. The posts shall be set in concrete or bolted down by use of steel plates as shown in the plans. The joining of rails between posts by means of sleeves, couplings, or welding will not be permitted.

All joints shall be welded with ¼" (6 mm) fillet welds according to Subsection 807.26. Field galvanizing shall be performed using materials listed on the Department's Qualified Products List and shall be applied in accordance with the manufacturer's recommendations.

**633.04 Method of Measurement.** Concrete Walks and Steps will be measured by the square yard (square meter). The area measured for steps will be that of the treads only.

Hand Railing will be measured by the linear foot (meter) in place. The measurement will include the distance from the centers of each end post of each separate section of railing, within the limits shown on the plans or as designated by the Engineer.

**633.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Concrete Walks or Concrete Steps, which price shall be full compensation for furnishing materials including joint filler; constructing the concrete walks or concrete steps; for excavation and backfilling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Hand railing, completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Hand Railing, which price shall be full compensation for furnishing, preparing, hauling, and erecting all material; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete Walks	Square Yard (Square Meter)
Concrete Steps	Square Yard (Square Meter)
Hand Railing	Linear Foot (Meter)

**SECTION 634  
CURBING**

**634.01 Description.** This item shall consist of the construction of integral curb, concrete curb, or concrete combination curb and gutter according to these specifications and in conformity with the locations, lines, and grades shown on the plans or as directed.

**634.02 Materials.** The concrete shall comply with the requirements for Class A or S Concrete as provided in Section 802, or for paving concrete in Section 501. The maximum allowable slump shall be 4 inches (100 mm). The maximum water/cement ratio shall not be exceeded. The Contractor shall perform quality control and acceptance sampling and testing in accordance with Subsection 802.06.

When an extrusion machine is used, the Contractor may modify the concrete mix design, upon approval of the Engineer, to improve workability while maintaining the above strength requirements.

Material for joint filler shall comply with AASHTO M 213.

**634.03 Construction Requirements. (a) Subgrade.** The subgrade shall be shaped to the required depth below the finished surface, according to the dimensions shown on the plans, and shall be compacted to a firm, even surface. When possible, the subgrade shall be shaped and compacted at the same time and in the same manner as the subgrade for the pavement slab. All soft and yielding areas shall be removed and replaced with suitable material and compacted.

When the curb is to be constructed on a concrete surface previously placed, the area of the concrete surface shall be roughened sufficiently to secure a good bond.

**(b) Forms.** Forms shall be constructed of metal or wood, free from warp, and of sufficient strength to resist springing during the process of depositing concrete. They shall be securely staked, braced, set, and held firmly to the required line and grade. Forms shall be cleaned and oiled before concrete is placed against them. Face forms or templates matching the shape of the planned curb will be required when a curb machine is not used.

**(c) Placing and Finishing. (1) Integral Curb.** After the concrete pavement has been struck off, the curb forms shall be clamped or otherwise securely fastened in place to the slab form and additional concrete for the curb shall then be deposited and thoroughly tamped. The concrete shall be placed within 30 minutes after the pavement slab has been finished and care shall be taken to secure monolithic construction. The concrete shall be spaded or vibrated sufficiently to eliminate voids and shall be tamped to bring the mortar to the surface. It shall then be finished smooth and even with a wood float and given a Class 2 or 6 finish according to Section 802.19. The edges shall be rounded with an approved finishing tool to the radius shown on the plans.

The curb may be placed after completion of the pavement provided dowels are placed in the pavement of the size, type, and spacing shown on the plans. No additional cost to the Department shall result from placing the curb by this method.

**(2) Concrete Curb or Concrete Combination Curb and Gutter.** The concrete shall be deposited in the forms upon the wetted subgrade and vibrated and spaded until mortar entirely covers the surface, after which it shall be finished smooth and even by means of a wood float and given a Class 2 or 6 finish according to Section 802.19. Edges shall be rounded as shown on the plans while the concrete is still plastic. Face forms shall be removed from curbs within 24 hours and the face finished by rubbing with a wetted cement mortar brick or wood float until it is smooth. Plastering will not be permitted but minor defects shall be filled with a 1:2 cement mortar (1 part Portland cement to 2 parts concrete sand) applied with a wood float.

**(d) Joints.** Expansion joints for concrete curb or concrete combination curb and gutter shall be installed at stationary structures such as catch basins, drop inlets, etc., and at ends of curb returns. Where curb and gutter is constructed adjacent to or on rigid pavements, the location and width of joints shall coincide with those in the pavement, where practicable. Expansion joints shall have a thickness of ½" (12 mm) and shall be filled with joint filler shaped to the cross section of the curb and constructed at right angles to the curb line.

Contraction joints for concrete curb or concrete combination curb and gutter shall be 1/8" to 3/8" x 1½" (3 mm to 10 mm x 38 mm) and shall be constructed at 15' (4.5 m) intervals. They shall be constructed at right angles to the centerline and perpendicular to the surface of the curb and gutter. Where curb and gutter is constructed adjacent to or on rigid pavements, the location and width of joints shall coincide with those in the pavement, where practicable. Contraction joints shall be formed by sawing, unless otherwise specified, and filled according to the requirements for Joint Seals as specified in Section 501, or with a commercially available silicone product approved by the Engineer. When the plans show the horizontal surface of the gutter to be overlaid by the surface course, that surface shall be sawed and sealed before the surface course is applied.

**(e) Surface Tests.** Before the concrete is given the final finishing, the surface of the gutter and the top of the curb shall be true to line and grade. The maximum variation in 10' (3 m) shall not exceed 3/8" (10 mm).

**(f) Curing.** When completed, the concrete shall be cured as specified in Section 501.

**(g) Backfilling.** After the concrete has set sufficiently, the space behind the curb shall be refilled to the required elevation with suitable material, which shall be firmly compacted by means of approved mechanical equipment and neatly graded.

**634.04 Method of Measurement.** Curbing will be measured by the linear foot (meter) along the face of the curb at the gutter line, excluding the curb and/or curb and gutter within the limits of drop inlets and drop inlet extensions as shown in the standard drawings.



**634.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for the respective types or sizes of Integral Curb, Concrete Curb, or Concrete Combination Curb and Gutter, which price shall be full compensation for furnishing materials, including joint filler; for forms; for mixing, placing, and finishing concrete; for performing mix designs and quality control and acceptance sampling and testing; for excavation and backfilling; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Integral Curb (Type__)	Linear Foot (Meter)
Concrete Curb (Type__)	Linear Foot (Meter)
Concrete Combination Curb and Gutter (Type__)(__'__" [__ mm])	Linear Foot (Meter)

## **SECTION 635 ROADWAY CONSTRUCTION CONTROL**

**635.01 Description.** When this item is included in the proposal, it shall consist of furnishing and maintaining all lines, grades, and measurements necessary for the proper execution of the roadway work under the Contract, all according to the plans and specifications.

**635.02 Materials.** The Contractor shall furnish all stakes, templates, straightedges, surveying equipment, and other devices necessary for establishing, setting, checking, marking, and maintaining points, lines, grades, and layout of the work called for on the plans and in the specifications.

**635.03 Construction Requirements. (a) Department Responsibilities.** The Department will establish the bench marks and horizontal control points referenced on the plans, certified correct by the Engineer, and furnish the data to the Contractor at the beginning of work. The Department will establish and stake and/or monument the right-of-way limits as shown on the plans. The Engineer will verify the locations, flow lines, and lengths of all pipe

culverts and box culverts and furnish this information to the Contractor.

Any additional information provided by the Department shall be verified by the Contractor before use and the Contractor shall accept full responsibility for any costs incurred as the result of the use of such additional information. Any checking performed by the Department will not relieve the Contractor of the responsibility for the final results.

The Department will be responsible for taking all measurements to establish both current estimate and final estimate pay quantities, including any horizontal and vertical control points necessary to complete such measurements. When making these measurements, the Engineer may use any points, stakes, lines, or elevations that have been set by the Contractor. Borrow pit layout and cross-sectioning of borrow pits will be the responsibility of the Department, except that the Department will not measure borrow pits when Compacted Embankment is included in the Contract and direct payment for borrow is not made. The Department will determine earthwork quantities according to Section 210.

**(b) Contractor Requirements.** Roadway Construction Control shall include use by the Contractor of the plans and the vertical and horizontal control points established by the Department as described above to perform all required construction surveying and layout. The Contractor shall make all necessary calculations and set all stakes including, but not limited to: centerline stakes; offset stakes; reference point stakes; additional bench marks as needed; slope stakes; pavement lines; curb lines; grade stakes; roadway drainage; pipe culverts; box culverts; underdrains; clearing and grubbing limits; guardrail; fence; blue tops for subgrade, subbase, and base courses; and any other points, lines, or elevations deemed necessary for proper control of the work.

All additional control points established by the Contractor shall be occupied, measured, and adjusted with direct survey measurements to the project control provided by the Engineer. These additional control points shall not be independent of the control provided by the Engineer. The additional control point horizontal coordinates shall have a positional accuracy of 20mm +20ppm

(1:50,000) and the elevations shall meet NGS 3rd order accuracy relative to the nearest control points provided by the Engineer.

On projects that include an ACHM overlay and/or Asphalt Surface Treatment, the Contractor shall mark the stationing by setting a stake at least every 200 feet (50 m) along the roadway. These stakes shall be placed on the shoulder or slope so that they will not interfere with the construction operations, but will be usable for determining locations along the roadway.

On projects with widening sections where a grade line is not shown on the plans, the Contractor shall profile the existing pavement at the centerline and edges of pavement. This profile data shall be furnished to the Department for the Department's use in the establishment of the finished grade line. This finished grade line will be furnished to the Contractor for use in computing and setting all grades required to construct the finished roadway section.

The Contractor shall be responsible for joining the work to contiguous roadways and/or bridges in an acceptable manner. This shall include making minor adjustments to the plan grade and/or typical section as necessary to construct a smooth transition from the new work to match the existing roadway.

The Contractor shall provide sufficient qualified personnel to complete the work accurately. The supervision of the Contractor's surveying and layout personnel shall be the responsibility of the Contractor, and any errors resulting from the operations of such personnel shall be adjusted or corrected by the Contractor at no cost to the Department.

The Contractor shall maintain adequate survey notes as the work progresses and make them available to the Engineer on request. Copies of survey notes designated by the Engineer shall be provided for the Department's permanent project records.

The Contractor shall be responsible for the accuracy and uniformity of the construction stakes, lines, grades, and layouts. Any errors in the work constructed due to errors in the Contractor's Roadway Construction Control shall be adjusted or corrected by the Contractor at no cost to the Department.

**635.04 Method of Measurement.** Roadway Construction Control will be measured as a complete unit.

**635.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract lump sum price bid for Roadway Construction Control, which price shall be full compensation for furnishing and maintaining all necessary lines, grades, and measurements; and for furnishing all engineering personnel, equipment, materials, tools, and incidentals necessary to complete the work.

No adjustments in the lump sum price bid will be made for Roadway Construction Control required due to normal increases or decreases in Contract quantities. However, if the amount of Roadway Construction Control required is increased or decreased in connection with a Change Order, compensation will be adjusted accordingly.

Partial payments for Roadway Construction Control will be made in proportion to the amount of work accomplished on this item.

No additional payment will be made for re-staking needed to maintain the control.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Roadway Construction Control	Lump Sum

**SECTION 636  
BRIDGE CONSTRUCTION CONTROL**

**636.01 Description.** When this item is included in the proposal, it shall consist of furnishing and maintaining all lines, grades, and measurements necessary for the proper execution of the work under the Contract, all according to the plans and specifications.

**636.02 Materials.** The Contractor shall furnish all stakes, templates, straightedges, surveying equipment, and other devices necessary for establishing, setting, checking, marking, and maintaining points, lines, grades, and layout of the work called for on the plans and in the specifications.

**636.03 Construction Requirements. (a) Department Responsibilities.** The Department will establish the bench marks and horizontal control points referenced on the plans, certified

correct by the Engineer, and furnish the data to the Contractor at the beginning of work. The Department will establish and stake and/or monument the right-of-way limits as shown on the plans.

Any additional information provided by the Department shall be verified by the Contractor before use and the Contractor shall accept full responsibility for any costs incurred as the result of the use of such additional information. Any checking performed by the Engineer will not relieve the Contractor of the responsibility for the final results.

The Department will be responsible for taking all measurements to establish both current estimate and final estimate pay quantities, including any horizontal and vertical control points necessary to complete such measurements. When making these measurements, the Engineer may use any points, stakes, lines, or elevations that have been set by the Contractor.

**(b) Contractor Requirements.** Bridge Construction Control shall include use by the Contractor of the plans and the vertical and horizontal control points established by the Department as described above to provide all required bridge construction surveying and layout. The Contractor shall make all necessary calculations and set all stakes including, but not limited to: centerline stakes; offset stakes; reference point stakes; control points; additional bench marks as needed; bridge piers, abutments, and footings; pile cutoff; pile layout; caps; bridge seats; anchor bolt layout; beam grades; girder or beam profiles; deck grades; screed elevations; and any other points, lines, or elevations deemed necessary for proper control of the work.

All additional control points established by the Contractor shall be occupied, measured, and adjusted with direct survey measurements to the project control provided by the Engineer. These additional control points shall not be independent of the control provided by the Engineer. The additional control point horizontal coordinates shall have a positional accuracy of 20mm +20ppm (1:50,000) and the elevations shall meet NGS 3rd order accuracy relative to the nearest control points provided by the Engineer.

The Contractor shall be responsible for joining the work to contiguous roadways and/or bridges in an acceptable manner. This shall include making minor adjustments to the grade and/or typical

section as necessary to provide a smooth connection between the new work and the existing construction.

The Contractor shall provide sufficient qualified personnel to complete the work accurately. The supervision of the Contractor's surveying and layout personnel shall be the responsibility of the Contractor, and any errors resulting from the operations of such personnel shall be adjusted or corrected by the Contractor at no cost to the Department.

The Contractor shall maintain adequate survey notes as work progresses and make them available to the Engineer on request. Copies of survey notes designated by the Engineer shall be provided for the Department's permanent project records.

The Contractor shall be responsible for the accuracy and uniformity of all construction stakes, lines, grades, and layouts. Any errors in the work constructed due to errors in the Contractor's Bridge Construction Control shall be adjusted or corrected by the Contractor at no cost to the Department.

**636.04 Method of Measurement.** Bridge Construction Control will be measured as a complete unit.

**636.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract lump sum price bid for Bridge Construction Control, which price shall be full compensation for furnishing and maintaining all necessary lines, grades, and measurements; and for furnishing all engineering personnel, equipment, materials, tools, and incidentals necessary to complete the work.

No adjustments in the lump sum price bid will be made for Bridge Construction Control required due to normal increases or decreases in Contract quantities. However, if the amount of Bridge Construction Control required is increased or decreased in connection with a Change Order, compensation will be adjusted accordingly.

Partial payment for Bridge Construction Control will be made in proportion to the amount of work accomplished on this item.

No additional payment will be made for re-staking needed to maintain the control.

Payment will be made under:

**Pay Item**

Bridge Construction Control

**Pay Unit**

Lump Sum

**SECTION 637  
MAILBOXES**

**637.01 Description.** This item shall consist of furnishing and erecting mailbox posts and installing existing mailboxes on the new posts according to the plans and these specifications. When required, it shall also include furnishing and installing new mailboxes.

**637.02 Materials.** The mailbox post shall be either metal or coniferous wood and shall be the size shown on the plans. Wood posts shall be pressure treated with creosote, pentachlorophenol or chromated copper arsenate. Metal posts shall be either galvanized or painted.

Mailbox support hardware, including shelf, platform and bracket shall be as shown on the plans. Anti-twist plate, clamps, spacers, nuts, bolts, and washers shall be painted or galvanized steel.

New mailboxes, when specified on the plans or directed by the Engineer, shall comply with the U.S. Postal Service and shall be the same size as the existing mailbox.

**637.03 Construction Methods.** Mailboxes shall be located on the right-hand side of the roadway in the direction of the delivery route. The bottom of the box shall be set at an elevation 3'-6" (1 m) above the roadway surface. The roadside face of the box shall be 6" (150 mm) from the edge of the shoulder or 6" (150 mm) from the face of the curb. Where a mailbox is located at a driveway entrance, it shall be placed on the far side of the driveway in the direction of the delivery route. Where a mailbox is located at an intersecting road, it shall be located a minimum of 100' (30 m) beyond the center of the intersecting road in the direction of the delivery route. If requested by the local postmaster, height and placement of mailboxes may vary slightly as directed by the Engineer.

No more than two mailboxes may be mounted on one post. Post spacing for multiple mailbox installations shall be a maximum of 36" (1 m).

The mailbox post shall be embedded a minimum of 24" (600 mm) into the ground. A metal post shall have an anti-twist plate that extends no more than 10" (250 mm) below the ground surface.

The existing mailbox shall be separated from the existing post and attached to the new post. If the existing mailbox is damaged beyond repair by the Contractor, the mailbox shall be replaced at no cost to the Department. If the existing mailbox cannot physically be removed from the existing post and re-used, the mailbox shall be replaced under the item Mailboxes. When a mailbox is replaced, the Contractor shall be responsible for placing identification markings on the new mailbox corresponding to the markings on the original mailbox.

Unless otherwise specified, all existing mailbox supports shall be removed and replaced with new supports. If directed by the Engineer the existing mailbox shall be restored under the Contract item Remove and Restore Mailboxes.

**637.04 Method of Measurement.** Mailbox Supports, Mailboxes, and Remove and Restore Mailboxes will be measured by the unit.

**637.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Mailbox Supports of the type specified, for Mailboxes, or for Remove and Restore Mailboxes, which price shall be full compensation for furnishing all materials: for setting posts; for removing and reattaching existing mailboxes; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Mailbox Supports (single)	Each
Mailbox Supports (double)	Each
Mailboxes	Each
Remove and Restore Mailboxes	Each



## SECTION 638

### PAINTING OF MISCELLANEOUS STEEL

**638.01 General.** Miscellaneous steel is normally all metal used on the project except that used in bridges. When painting of miscellaneous steel is specified, the Contractor may, at Contractor option, elect to use either the paint system specified for painting bridges on the project or the paint system specified in this Section. Existing bridge steel may also be painted by this system when specified in the plans and cleaned according to Subsection 820.05(b).

The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent pollution of rivers, streams, or impoundments. Painting and cleaning operations conducted over or in the vicinity of public waters shall be controlled to prevent materials or waste, considered a contaminant by the ADEQ, from falling into the water. Any material or waste that falls into the water or onto areas where there is a likelihood that it will be picked up by rising water levels shall be retrieved and properly disposed of in approved locations.

The Contractor shall protect pedestrian, vehicular, or other traffic against damage or disfigurement by drift, spatters, splashes, and smirches of paint or paint materials.

**638.02 Aluminum Epoxy Paint System.** This system shall consist of a two component, high solids, high build aluminum epoxy coating that will provide long term protection even when applied over marginally prepared steel. Marginally prepared steel is defined as steel that has been cleaned according to SSPC-SP 2 (Hand Tool Cleaning), SSPC-SP 3 (Power Tool Cleaning), or SSPC-SP 7 (Brush-Off Blast Cleaning). The coating shall be a one-coat system that is self priming, compatible with existing topcoats, and capable of being satisfactorily applied over tightly adhered rust.

The volume of the solids in the mixed material shall be 85% or greater when measured according to ASTM D 2697. The coating shall be capable of being applied in a single coat of at least 5 mils (125  $\mu\text{m}$ ) dry film thickness without sagging and shall have a minimum theoretical application rate of 1 gallon per 1,400 square feet (1 L/34 sq m) at 1 mil (25  $\mu\text{m}$ ) dry film thickness. Lead and chromium pigments will not be permitted. The paint manufacturer

shall provide certification that the paint provided meets the preceding requirements. Thinning will be allowed according to manufacturer's recommendations. The paint shall be one listed on the QPL.

**638.03 Materials. (a) Qualitative Requirements.** All coating systems shall meet the following general requirements:

(1) **Condition in Container.** Neither the paint nor the paint components shall show excessive settling, curdling, livering, caking, or color separation in a freshly opened can and shall be easily mixed to a smooth homogeneous state using a power mixer.

(2) **Brushing or Spraying Properties.** Paints shall brush or spray easily, possess good leveling properties, and show no running or sagging tendencies when applied by brush.

(3) **Appearance.** Paints shall dry to a smooth finish, free from roughness, grit, unevenness, and other surface imperfections.

**638.04 Paint Film Thickness.** The minimum dry film thickness of the coat shall be 5 mils (125  $\mu\text{m}$ ). Upon completion of the paint coat, a dry film thickness gauge shall be used by the Engineer for verification of paint thickness. Dry film thickness will be determined by methods described by the Steel Structures Painting Council. Any paint coat found to be deficient in paint thickness shall be repainted at no cost to the Department.

**638.05 Application of Paint.** Paint shall be applied according to the manufacturer's recommendations including mixing, weather limitations, thinning, spraying, brushing, or rolling. The steel shall receive one coat applied either in the shop or in the field; however, any damaged paint shall be re-cleaned, if necessary, and re-painted prior to final acceptance. The color shall be Aluminum unless otherwise specified.

**638.06 Removal of Unsatisfactory Paint.** If any painting application produces a coat that is unsatisfactory to the Engineer, the paint shall be removed and the metal thoroughly cleaned and repainted.

**638.07 Cleaning Surfaces. (a) General.** Surfaces of metal to be painted shall be thoroughly cleaned by removing rust, loose mill scale, dirt, oil or grease, and other foreign substances. Unless

cleaning is accomplished by blast cleaning, all weld areas shall be neutralized with a proper chemical before cleaning is begun, after which it shall be thoroughly rinsed with water.

As a minimum, miscellaneous steel shall be cleaned by the Hand Tool (SSPC-SP 2), Power Tool (SSPC-SP 3), or Brush-Off Blast (SSPC-SP 7) cleaning methods as defined by the Structural Steel Painting Council. When applicable, bridge steel will be cleaned according to Subsection 820.05(b).

**(b) Hand Tool Cleaning.** The removal of rust, scale, and dirt shall be accomplished by the use of metal brushes, scrapers, chisels, hammers, or other effective means. Oil and grease shall be removed by the use of a suitable effective solvent. Bristle or wood fiber brushes shall be used for removing loose dust. Hand tool cleaning of structural steel surfaces shall provide a surface preparation conforming to SSPC-SP 2, Hand Tool Cleaning.

**(c) Surfaces Inaccessible After Fabrication.** The inside surfaces of boxed members and other surfaces that will be inaccessible to the cleaning operation after fabrication shall be cleaned before assembly.

**638.08 Shop Painting.** When shop painting is used, miscellaneous steel shall be painted before it is shipped from the plant.

Surfaces not in contact but that will be inaccessible after assembly or erection shall be painted before leaving the plant. Shop contact surfaces shall not be painted. Field contact surfaces shall receive a shop coat of the paint system. Field contact surfaces not painted with the shop coat shall be given a coat of approved lacquer or other protective coating if it is expected that there will be a prolonged period of exposure before erection.

Surfaces that will be in contact with concrete shall not be painted. Paint inadvertently sprayed on such surfaces need not be removed.

Miscellaneous steel that is to be welded shall not be painted before welding is complete. Steel that is to be field welded shall be given one coat of boiled linseed oil or other approved protective coating for 3" (75 mm) either side of the field weld. The remainder of the member may be given the specified shop coat of the paint system.

Unless otherwise specified, surfaces of iron and steel castings, either milled or finished, shall be given one coat of the paint system.

With the exception of abutting joints and base plates, machine finished surfaces shall be coated with a graphite dry film lubricant or other approved coating. The coating shall be applied as soon as practicable after being accepted and before removal from the shop.

When steel is painted in the shop, erection and weight marks shall be painted upon surface areas that have previously been painted with the shop coat. Material shall not be loaded for shipment until it has thoroughly dried, and in no case less than 24 hours after the paint has been applied.

**638.09 Field Painting.** When erection work is complete, any adhering rust, scale, dirt, grease, or other foreign materials shall be removed as specified in Subsection 638.07.

On field bolts, welds, and surfaces where the shop paint has worn off or has otherwise become defective, the area shall be cleaned and thoroughly covered with one coat of field paint.

Contact surfaces to be bolted and surfaces that will be in contact with concrete shall not be painted. Surfaces that will be inaccessible after erection shall be painted before erection. Small cracks and cavities that were not sealed in a water-tight manner shall be filled with an additional application of paint.

The following provision shall apply to the application of field paint: To secure a maximum coating on edges of plates, shapes, bolts, and other parts subjected to special wear, the edges shall first be coated with a longitudinal motion and the bolts with a rotary motion followed immediately by the general painting of the whole surface, including the edges and bolts.

The Contractor shall, at no cost to the Department, take all precautions necessary to prevent dust and dirt from coming in contact with surfaces to be painted or with freshly painted surfaces.

The application of the field paint shall be deferred until the adjoining concrete work has been placed and finished. If concreting operations damage the paint applied in the shop, the damaged area shall be cleaned and re-painted.

**638.10 Method of Measurement and Basis of Payment.** Painting miscellaneous steel will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for the various items of the Contract.

## **SECTION 639**

### **GUARDRAIL MOVED AND RECONSTRUCTED**

**639.01 Description.** This item shall consist of the moving and reconstructing of existing guardrail and the installation of back-up plates on the reconstructed rail according to the Standard Drawings and these specifications at the locations shown on the plans or as directed by the Engineer.

**639.02 Materials.** Posts and rail that are not in a serviceable condition shall be replaced with new posts or rail of the same size and type of material removed. New posts, rail, and back-up plates shall comply with Section 617.

**639.03 Construction Methods.** The guardrail shall be removed and reconstructed as shown on the plans or as directed by the Engineer. The posts shall be thoroughly tamped into place and the rail firmly attached to the posts according to the standard drawings and specifications.

If the reconstructed rail is galvanized steel, any damaged areas shall be repaired according to Subsection 807.88.

All new material, including back-up plates, required to place the reconstructed guardrail in a satisfactory condition shall be furnished by the Contractor. The Contractor shall have the option of using new guardrail in lieu of reconstructing used guardrail.

If the Contractor elects to use new guardrail, the existing guardrail that is in a serviceable condition, as determined by the Engineer, shall become the property of the Department. The guardrail and posts shall be carefully removed to avoid damage and stacked in a neat stack at the project site. The guardrail and posts that are in a good condition will be picked up by Department forces. The remainder will become the property of the Contractor.

**639.04 Method of Measurement.** Guardrail Moved and Reconstructed will be measured by the linear foot (meter) complete in place. End sections will each be considered as 25 feet (7.5 m) in length. Intermediate sections will be measured along the roadway face from centerline of post to centerline of post.

**639.05 Basis of Payment.** Work completed and accepted under this item and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Guardrail Moved and Reconstructed, which price shall be full compensation for moving and reconstructing existing guardrail; for furnishing and installing additional materials, including back-up plates; for disposing of unusable materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Guardrail Moved and Reconstructed	Linear Foot (Meter)

**SECTION 640**  
**MODIFYING DROP INLETS AND JUNCTION**  
**BOXES**

**640.01 Description.** This item shall consist of modifying existing drop inlets and/or junction boxes by removing the top and the walls to the dimensions shown on the plans, raising the walls if necessary, and constructing a new top and walls of the design shown on the plans.

**640.02 Materials.** New materials used in the grade adjustment shall comply with Subsection 609.02. The Department will perform all concrete acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

**640.03 Construction Requirements.** Construction methods, as modified below, shall comply with Subsection 609.03, except that painting of existing rings and covers or grates and frames will not be required.

The existing rings and covers or grates and frames shall be removed in a manner to avoid breaking or cracking and cleaned of

old mortar before resetting at the specified elevation. Structures damaged because of the Contractor's negligence shall be repaired or replaced at no cost to the Department.

The existing top and walls shall be removed carefully to prevent damage to the walls that are to remain. Unless noted on plans to raise drop inlet or junction box, the existing flow line is to be maintained when the new top and walls are constructed. Any damage to the remaining walls shall be repaired to make them as strong and stable as before the removal in a manner approved by the Engineer. Any portions of pipe or box culvert requiring removal for the proposed modifications shall be done carefully to prevent damage or fracture of the structure to remain in place. Any damage due to the Contractor's negligence shall be repaired at no cost to the Department. The new walls or top for the structure shall be placed in a manner to bond them to the existing walls either by keying to the walls, placement of concrete grout or incorporating steel from the walls.

The area around the finished drop inlet or junction box shall be backfilled and compacted with material approved of by the Engineer. All debris from the existing top, walls, forms or other trash shall be removed and disposed of by the Contractor in accordance with Section 202.

**640.04 Method of Measurement.** Modifying Drop Inlets and Modifying Junction Boxes will be measured by the unit.

**640.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Modifying Drop Inlets or Modifying Junction Boxes, which price shall be full compensation for all excavation and backfill; for removing the existing top; lowering or raising the walls as required; reconstructing the top and walls; removal and disposal of all debris; compacting backfill material; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Modifying Drop Inlets	Each
Modifying Junction Boxes	Each

## SECTION 641 WHEELCHAIR RAMPS

**641.01 Description.** This item shall consist of the construction of wheelchair ramps in accordance with these specifications and the Standard Drawings at the locations shown on the plans or as directed by the Engineer.

**641.02 Materials.** The concrete used shall meet the requirements for Class M Concrete as provided in Section 802. The maximum allowable slump shall be 4 inches (100 mm). The maximum water-cement ratio for the mix selected shall not be exceeded. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

The cast-in-place tactile panels used shall be composed of a vitrified polymer composite material. The color of the tactile panels shall conform to Federal Color No. 33538, and shall be homogeneous throughout the product. The tactile panels shall be cast into the wet concrete. Surface applied products shall not be allowed. The cast-in-place tactile panels shall meet the size and spacing requirements shown in the plans.

**641.03 Construction Requirements.** When a wheelchair ramp is to be constructed on an existing sidewalk, any items that are planned to be retained but are damaged during the removal or construction operations shall be repaired at no cost to the Department.

Wheelchair Ramps shall be constructed in accordance with Subsection 633.03 and the Standard Drawing WR-1.

The concrete island portion of the ramps shall be constructed in accordance with Subsection 632.03 and Standard Drawing DR-1.

The cast-in-place tactile panels shall be installed into the wet concrete per the manufacturer's specifications and in accordance with Standard Drawing WR-1.

**641.04 Method of Measurement.** Wheelchair Ramps will be measured by the square yard (square meter).

**641.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit



price bid per square yard (square meter) for Wheelchair Ramps of the type specified, which price shall be full compensation for excavation and backfilling; for furnishing materials including joint filler; for constructing the wheelchair ramp, including the concrete island; for furnishing and placing cast-in-place tactile panels; and for all equipment, tools, labor, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Wheelchair Ramps (Type __)	Square Yard (Square Meter)

**SECTION 642  
RUMBLE STRIPS**

**642.01 Description.** This item shall consist of constructing rumble strips on asphalt shoulders or Portland cement concrete shoulders according to these specifications and conforming to the details shown on the plans.

**642.02 Equipment.** The equipment used for cutting rumble strips shall consist of a rotary-type cutting head of such size to produce cuts of the dimensions shown on the plans. The cutting tool shall be equipped with guides to provide consistent alignment for each cut in relation to the roadway and to provide uniformity and consistency throughout the project. The cutting head shall have the cutting tips arranged in a pattern that will produce a relatively smooth cut (approximately 1/16" [2 mm] between peaks and valleys). The cutting head(s) shall be suspended from the power unit in a manner that will allow the tool to self-align itself with the slope of the shoulder and/or any irregularities in the shoulder surface.

**642.03 Construction Requirements.** (a) **Rumble Strips in Asphalt Shoulders.** The rumble strips shall be cut in the existing shoulders at the locations shown on the plans or as designated by the Engineer. Prior to commencement of the work, the Contractor shall demonstrate to the Engineer the ability to achieve the desired results without damaging the existing pavement.

At the end of each working day, all equipment shall be removed roadway or parked no closer than 30' (15 m) from the traveled lane. The pavement shall be thoroughly cleaned by sweeping or flushing. All excess material shall be disposed of in a manner approved by the Engineer.

**(b) Rumble Strips in Portland Cement Concrete Shoulders.** The Contractor shall have the option of cutting the rumble strips according to the above requirements or forming the rumble strips in the fresh concrete according to the requirements of Section 506.

**642.04 Method of Measurement. (a) Rumble Strips in Asphalt Shoulders.** Rumble Strips in Asphalt Shoulders will be measured by the linear foot (meter) longitudinally along the shoulder on which the rumble strips are constructed.

**(b) Rumble Strips in Portland Cement Concrete Shoulders.** Rumble Strips in Portland Cement Concrete Shoulders will be measured by the linear foot (meter) longitudinally along the shoulder on which the rumble strips are constructed.

**642.05 Basis of Payment. (a) Rumble Strips in Asphalt Shoulders.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Rumble Strips in Asphalt Shoulders, which price shall be full compensation for constructing the rumble strips; for cleaning the pavement; for disposing of excess material; and for all labor, equipment, tools and incidentals necessary to complete the work.

**(b) Rumble Strips in Portland Cement Concrete Shoulders.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Rumble Strips in Portland Cement Concrete Shoulders, which price shall be full compensation for constructing the rumble strips; for cleaning the pavement; for disposing of excess material; and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Rumble Strips in Asphalt Shoulders	Linear Foot (Meter)
Rumble Strips in Portland Cement Concrete Shoulders	Linear Foot (Meter)

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**DIVISION 700**  
**TRAFFIC CONTROL FACILITIES**

**SECTION 701**  
**ACTUATED CONTROLLER**

**701.01 Description.** This item shall consist of furnishing and installing an actuated controller and other associated equipment according to these specifications and at the locations shown on the plans or as directed.

**701.02 Materials. (a) General.** The controller, cabinet, and all accessories in the cabinet shall be furnished by one supplier. All controllers on a project shall be made by one manufacturer, shall be menu driven, and shall comply with the latest NEMA TS 1 or TS 2–Type 2 specifications as specified in the Contract Summary of Quantities. The supplier shall test the controller and all accessories in the cabinet as a unit before shipment to the Contractor.

The Contractor shall submit to the Engineer for approval two copies of the applicable brochures containing design criteria for the components. The specific items proposed for use shall be clearly marked in the brochures. If more than one item is submitted at one time for Department review, a list shall be attached showing each item for which Department approval of design characteristics is being requested. The Engineer will provide written approval of the design characteristics.

**(b) Controller Design Requirements.**

**(1) Consistency of Intervals.** The length of any interval, position, period, or unit extension shall not change by more than 5% of its value if the voltage of the power supply varies between the limits of 95 to 135 volts.

**(2) Power.** The controller and associated equipment shall be designed for use on 120 volt, 60 Hz alternating current.

**(3) Mechanism.** The timing circuits shall consist entirely of solid state electronic circuitry. No vacuum or gaseous tubes shall be used in any timing circuits.

Switching functions shall be accomplished by solid state electronic circuitry. No electromechanical devices such as

camshafts and rotary, stepping, or line switches shall be used for switching functions.

Functional operating circuits and their associated components shall be grouped in plug-in, printed circuit assemblies. Similar assemblies shall be interchangeable between controllers.

The components shall be amply de-rated regarding heat-dissipating capacity and rated voltage so that, with maximum ambient temperature and maximum applied voltage, material shortening of life or shift in values shall not occur.

**(4) Interval Sequence.** The controller shall provide and be set up for the proper intervals and interval sequence as provided on the plans.

**(5) Interval Setting and Adjustment.** The controller shall provide for the setting up of each interval or period by means of thumbwheel dials, pins, or keyboard entry. There shall be, at a minimum, the following settings for each phase:

- Initial
- Extension (gap)
- Maximum (maximum green or extension limit)
- Yellow Change
- Red Clearance
- Walk
- Pedestrian Clearance

The settings shall be calibrated in seconds and shall give a clear visual indication of the length of each interval or period. The timing setting devices and setting displays shall be on the front of the controller and easily identifiable. It shall not be necessary to remove or change wires or contacts or to use any tools in making interval adjustments.

Indications shall be provided for at least the following functions, but not limited thereto:

- Phase or phases in service.
- Phase or phases next to be serviced.
- Presence of vehicle call, including memory and detector actuation.
- Presence of a pedestrian call.
- The interval(s) timing and controller conditions.

**(6) Pedestrian Interval.** Unless otherwise noted, pedestrian intervals shall be push button actuated and concurrently timed with the associated phase.

**(c) Cabinet.**

**(1) General.** The controller shall be furnished completely housed in an aluminum alloy or stainless steel cabinet. The cabinet shall be of clean-cut design and appearance. The size of the cabinet shall be such as to provide ample space for housing the controller and associated electrical devices that are to be furnished with it, together with other auxiliary devices herein specified. A hinged door shall be provided, permitting complete access to the interior of the cabinet. When closed, the door shall fit closely to gasket materials, making the cabinet weather-resisting and dust tight. The door hinges and pins shall be of non-corroding material. The cabinet shall be equipped with an interior fluorescent light that switches on automatically when the cabinet door is opened.

The cabinet shall contain a mounting table, sliding ways, or other suitable support for the controller.

Cabinets shall not be painted unless otherwise specified.

Minimum cabinet size – The cabinet shall be large enough to allow trouble shooting of all terminal facilities while the intersection is in operation without removing any equipment from the cabinet. Stacking equipment or mounting active equipment (detectors, radios, conflict monitor, etc.) on the door is not permitted. Cabinet size shall be based as a minimum upon the number of phases specified in the unit item table shown below. In addition minimum cabinet volume and the minimum number of load sockets shall be equal to or greater than the following:

**Table of Minimum Cabinet Requirements\***

No. Phases	Class	Det. Inps.	Load Sockets			Depth inches (mm)	Width inches (mm)	Height inches (mm)
			Phase (N)	OL	Ped			
2	G	4	2		2	16" (400)	25" (630)	41" (1040)
3	M	8	3	3**	2	17" (430)	30" (760)	49" (1240)
4	M-36	8	4	2**	2	17" (430)	36" (910)	49" (1240)
5	M-36	16	5	4**	3	17" (430)	36" (910)	49" (1240)
6	P-38	24	6	2**	4	26" (660)	38" (960)	55" (1400)
7	P-38	24	7	1**	4	26" (660)	38" (960)	55" (1400)
8	P-38	24	8		4	26" (660)	38" (960)	55" (1400)
>8 or "spec."	R-44	24	12	12-N ***	4	26" (660)	44" (1120)	77" (1960)

\* Where additional Pedestrian phases are required, Overlap (OL) sockets may be utilized for Pedestrian Signal outputs unless required as part of the specified phasing. Intersections with overlaps, more than 2 rings, or other than standard quad left phasing may require additional load sockets. Addition of other auxiliary equipment may require the use of a larger cabinet.

\*\*Detector inputs (Det. Inps.) are total including Pedestrian.

\*\*\*Where designated as "Special" (spec.) phasing, N refers to number of phases.

**(2) Locks.** The main cabinet door shall have a tumbler lock keyed for a Corbin No. 2 key. The auxiliary door shall be equipped with a lock for a standard police key. When the door is closed and latched, with the key removed, the door shall lock. The Contractor shall furnish two keys for each lock to the City or County.

**(3) Door Stop.** The cabinet shall be equipped with a door stop assembly.

**(4) Mounting.** The cabinet shall be furnished with all the necessary mounting hardware for field mounting of the cabinet as specified or as shown on the plans.

**(5) Fan and Ventilation.** Each cabinet shall be provided with louvered vents and a permanent, washable, removable electrostatic filter with an aluminum frame, mounted in the front door. The filter shall meet the “American Society of Heating, Refrigeration, and Air Conditioning Engineers” (ASHRAE) testing requirements as follows:

Arrestance 90%  
Dust Holding Capacity 85 grams at 0.5 water gauge

The cabinet shall also be equipped with an electric fan assembly with a minimum capacity of 100 cubic feet per minute (2.8 cubic meters per minute).

The fan shall be mounted in the top of the cabinet in a manner to prevent rain from entering the cabinet. The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 90° F (32° C) and 150° F (66° C).

**(6) Grounding.** A copper equipment grounding buss shall be provided in each cabinet. The ground buss shall be grounded to the cabinet and shall provide at least 14 terminals. The ground side of the power supply shall be bonded directly to a ground rod in the cabinet or pole base with a #8 AWG solid copper wire. The wire path shall be as direct as possible and the wire shall contain no splices. The ground rod shall be as shown on the plans or as directed by the Engineer. The cabinet ground wire shall be connected to the ground rod by means of an approved thermal fusion type weld.

**(7) Wiring.** Panel wiring shall be neat and firm, and the panel shall mount at least:

- Terminal for power supply line.
- Terminal for neutral side of power supply line.
- Terminals for conductors of traffic signal cable: one for each signal circuit and one or more terminals for the common conductors.



The controller equipment and terminals shall be so arranged within the cabinet that they will not interfere with the entrance and connection of the incoming conductors.

All terminals shall be suitably identified and shall be permanently associated with the terminal block. Not more than 3 conductors shall be brought to any 1 terminal screw. No electrically alive parts shall extend beyond the protection afforded by the barrier.

Electrical connections from the controller to the outgoing and incoming circuits shall be made by inserting a multi-terminal plug (Type MS) into the plug receptacle incorporated in the controller. The controller shall be replaceable with a similar unit without the necessity of disconnecting and reconnecting the individual wires leading therefrom.

The controller cabinet shall be wired such that during flash operation, power to the load switches cannot back-feed to the load switch power buss.

**(8) Surge Protection.** The cabinet AC service must be provided with a series hybrid type protector (EDCO Model SHA-1250 or equal) with the following terminals:

- Main Line (AC line first stage terminal).
- Main Neutral (AC Neutral input terminal).
- Equipment Line In (AC line second stage input terminal, 10 amps).
- Equipment Neutral Out (Neutral terminal to protected equipment).
- Ground (Earth connection).

Each messenger wire of interconnect cable shall also be provided with a series hybrid type surge protector connected between the interconnected line and the AC return.

Each loop detector input circuit (at cabinet entry point) shall be provided with a series hybrid type surge protector capable of protecting the detector against differential surges between the loop leads and common mode surges between leads and ground.

Each solid state load switch shall be provided with a series hybrid type surge protector capable of protecting the load switch against common mode surges.

**(d) Cabinet Auxiliary Equipment.**

**(1) Conflict Monitor.** The conflict monitor shall be a solid state device capable of detecting conflicting signal displays and/or improper power supply voltage from the controller. The conflict monitor shall comply with the latest NEMA TS 1 or TS 2-Type 2 specifications for MMU operation according to the type of controller specified in the Summary of Quantities. All conflict monitors on a project must be made by one manufacturer.

When TS 2-Type 2 is required, in addition to the standard features required by TS 2 specifications, error sensing of 24 vdc cabinet supplies and controller power supplies shall also be provided. The conflict monitor shall communicate through or to the local controller for logging event monitoring. The monitor shall record in non-volatile memory, a minimum of 100 events with time/date and nature of event. The unit shall interface to a standard PC through an RS232 port. The agency maintaining the equipment and the Engineer shall each be provided with one copy of the software.

**(2) Solid State Load Switch.** The solid state load switches shall be used for opening and closing traffic signal circuits. The assemblies shall be external to the controller and shall be jack mounted. The load switches shall comply with the latest NEMA specifications. The cabinet shall be furnished with load switch sockets wired to provide all necessary signal output circuits plus any future expansion noted on the plans. There shall be at least one pedestrian load switch socket provided for each vehicle through phase.

**(3) Solid State Flasher.** The cabinet shall be furnished with a two-circuit solid state flasher. It shall be used for the alternate opening and closing connections between the applied power and the signal lamps required for flashing operations. The unit shall commence flashing operation when AC power is applied to the input terminals. It shall provide 50 to 60 flashes per minute on each output circuit and have equal on and off time. The flasher shall comply with the latest NEMA specifications.

**(4) Flash Transfer Relays.** Electromechanical or solid state relays may be used for opening and closing traffic signal field circuits.

Relays used for this purpose shall be covered, insulated, or located so that electrically alive parts are not readily exposed.

**(5) Flash Sequence Programming.** A programming means shall be provided to alter whether flashing yellow or red appears on the output field terminals to the signal heads. Programming may be accomplished with tools such as a screwdriver and wrench.

**(6) Harness Wiring.** All cabinet wiring harnesses shall be neat, firm, and routed to minimize crosstalk and electrical interference. Printed circuit mother boards may be used to reduce cabinet wiring.

Wiring containing AC shall be routed and bundled separately by function, or shielded separately by function, from all low voltage control circuits. All conductors and live terminals or parts that could be hazardous to maintenance personnel shall be covered with suitable insulating materials.

All vehicle detectors shall input the controller separately unless otherwise noted on the plan sheets. Controller and cabinet shall be wired to terminal facilities for the minimum number of detector inputs as indicated on the table "Minimum Cabinet Requirements" above, including Pedestrian Push Buttons. Odd numbered Pedestrian Inputs may be shared as vehicle detector inputs unless utilized in the intersection operation. Controller shall be factory programmed to actuate the appropriate phase as shown on the plan sheets. A chart or table of detector number (as indicated on the plan sheet(s)) to controller input shall be provided to the Engineer prior to requesting time settings and placing the intersection into operation. All wiring harnesses required for expansion to the full capabilities of the controller for the number of phases specified in the unit item table shall be installed. A minimum of one single channel detector harness or detector rack position (whichever shall apply) for each phase shall be installed with a minimum of one wired in place on each NEMA input. Terminal facilities as well as lightning suppression shall also be installed for each detector harness.

Optical isolators with a visual indication of an incoming call shall be provided for all external input devices, including Pedestrian Push Buttons. Auxiliary Isolator/Indicators are not required on devices located within the controller cabinet that have self-contained isolators and indicators on the front panel.

**(7) Power Panel.** The cabinet shall have a power distribution panel containing a 50 amp radio interference suppressor, a 30 amp main circuit breaker, and a 15 amp auxiliary equipment circuit breaker.

**(8) Police Panel.** The main door of the cabinet shall have a small police panel door. Behind this door shall be a panel with a signal flash switch and a manual control switch and cord.

In the flash position, the signals flash switch shall cause the intersection to be placed in flashing operation. Stop time shall not be applied to the controller in the manual flash position.

**(9) Maintenance Panel.** There shall be a maintenance panel on the inside of the main door containing the following:

- Convenience outlet with GFI protection. (Note: The outlet may be mounted on the door panel or inside the cabinet).
- Signals switch.
- Controller switch.
- Detector Test Switches

Detector test switches shall be wired to each controller input required for vehicle detectors and pedestrian push switches. Test switches shall consist of momentary, normally open, push switches.

Separate non-GFI protected duplex receptacle(s) shall be provided for power supplies or other auxiliary equipment which must connect to 120 VAC line voltage. This is in addition to the GFI provided receptacle provided above.

**(10) Wiring Diagrams and Controller Manual.** Three copies of the cabinet wiring diagram and one copy of the controller manual shall be supplied with each cabinet. One diagram and the manual shall be placed in a heavy duty clear plastic pouch and attached to the cabinet door. This pouch shall be of such design and material that it provides adequate storage and access to the wiring diagram and manual. One diagram shall

be delivered to the City or County before final inspection of the intersection. One diagram shall be given to the Engineer.

**(11) Time of Day Clock.** All controllers shall have internal time of day programming with an internal time clock.

**(e) Certification.** The supplier shall provide to the Contractor a certification of compliance with the above requirements and that the controller and conflict monitor comply with the latest NEMA specifications. This certification shall be transferred to the Department.

**(f) Mounting Pad.** When required, the mounting pad shall be constructed as shown on the plans or as directed by the Engineer.

**701.03 Construction Requirements.** The controller shall be mounted as shown on the plans or as directed and shall in no case be located less than 3' (1 m) from the pavement edge.

The Contractor shall furnish and properly install each cabinet and controller with accessory equipment and perform the necessary splicing and connections, testing of circuits, adjustments, and such other operations as may be necessary to ensure that each complete traffic signal installation, with all of its components, be completely integrated and tested as a unit so that the desired control of the intersection is attained, complete, and in the best of working order, to the satisfaction of the Engineer. The Contractor shall meet with the City or County and provide them with instructions on the adjustments of the controller and provide consultation for replacement parts stocking.

**701.04 Method of Measurement.** Actuated Controllers will be measured by the unit. One unit shall include the controller; the controller cabinet; the pad on which the cabinet is installed, when required; and all hardware required for installing the cabinet.

**701.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Actuated Controller of the phases and the NEMA TS type specified, which price shall be full compensation for furnishing the Actuated Controller and mounting the controller cabinet; for installing, wiring and testing the controller; for excavation and backfilling; for construction of the mounting pad;

and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Actuated Controller TS 1 (___Phases)	Each
Actuated Controller TS 2-Type 2 (___Phases)	Each

## **SECTION 702 PRE-TIMED CONTROLLER**

**702.01 Description.** This item shall consist of furnishing and installing pre-timed, solid state, digital timed, multial traffic signal controllers according to these specifications and at the locations shown on the plans or as directed.

**702.02 Materials. (a) General.** The controller, cabinet, and all accessories in the cabinet shall be supplied to the Contractor by one supplier and shall comply with the latest NEMA specifications. All controllers on a project must be made by one manufacturer. The supplier must test the controller and all accessories in the cabinet as a unit before shipment to the Contractor.

The Contractor shall submit to the Engineer for approval two copies of the applicable brochures containing design criteria for the components. The specific items proposed for use shall be clearly marked in the brochures. If more than one item is submitted at one time for Department review, a list shall be attached showing each item for which Department approval of design characteristics is being requested. The Engineer will provide written approval of the design characteristics.

### **(b) Controller Design Requirements.**

**(1) Functional Requirements.** The controller shall be designed to operate as a pre-timed isolated intersection controller or an interconnected multial controller.

The controller operation shall be completely solid state. The controller shall have the capability of maintaining time settings with the loss of applied AC power.

The controller shall be capable of providing a minimum of 3 different cycles, 3 offsets per cycle, 4 splits per cycle, and 3 signal plans with individual control of at least 24 signal output driving circuits in each of the intervals. These functions shall be accomplished by a microprocessor to implement the control logic and modular construction with keyboard entry of operating data.

**(2) Cycle Lengths.** The controller shall be capable of operating on a minimum of 3 manually or remotely selectable dials, each programmable to a maximum length of 255 seconds in 1 second increments. The duration of each cycle shall be entered into the controller memory by a front panel control.

Dial transfer from one dial to another shall occur at the end of the timing interval in effect at the time of request for transfer. Intervals may be programmed to inhibit transfer. Dial transfer shall cause no irregular interval timing or out of step operation of the controller.

**(3) Offsets.** Each dial shall be capable of being programmed with up to 3 offsets. Each offset shall be remotely or manually selectable.

Offsets shall be programmable from 0 to 255 seconds in 1-second increments. An offset shall be the time from the receipt of a synchronization pulse to the beginning of the dwell interval. Offset timing may be in terms of percent of cycle as well as seconds. It shall be possible to program the signal display interval in which a re-synchronization dwell occurs. It shall also be possible to program the maximum time duration of the dwell per dial. The maximum time duration shall be set independently for each dial.

**(4) Interval Timing.** The controller shall allow signal sequences to be programmed up to 24 intervals. Each interval can be 0.0 to 12.7 seconds in length in 0.1 second steps or 0 to 127 seconds in 1 second steps. Interval times are entered through the front panel. Interval timing may be in percent of cycle or in seconds.

Interval times may be entered for up to 24 intervals for each of the cycle lengths. No intervals shall be required to be set to zero time as the signal sequence can be programmed to the exact number of timing intervals without the necessity of establishing

dummy intervals. Intervals programmed to zero time shall be skipped.

**(5) Sequence Control.** Each controller shall have a programmable sequence and display control element. This element shall allow for programming at least 24 signal output driving circuits in 24 different interval display combinations.

The sequence control element shall be a non-volatile memory device (programmable read only memory, PROM) mounted for ease of removal.

**(6) Front Panel Displays and Features.** The front panel display shall be either an LED or LCD Decimal Digital Display that will display intervals, interval durations, cycles, offsets, and dwell maximum duration.

Ranges

- Cycle 0-255 seconds
- Offset 0-255 seconds
- Interval 1-24
- Interval time 0-127 seconds
- Dwell 0-99.9 seconds

The indicators on the front panel shall be as follows:

- Clock. A timing indicator shall be provided on the front panel of the controller. This timing indicator shall pulse each second as long as the controller is timing. Pulsing shall be inhibited when the controller is dwelling, in manual synchronization, and/or in manual operation.
- Stop-Timing. An indicator on the front panel shall show that the unit is in the stop timing mode.
- Offset. Indicators shall show the offset that is currently being selected.
- Dial. Indicators shall show which of the dials is currently active.

**(7) Remote Operations.** The controller shall be capable of remote operation from a master controller of the same design that allows for 3 cycles, 3 offset per cycle operation.

The unit can be installed in a standard multidial, 3 cycle, 3 offset system that utilizes a solid state master controller and



120 VAC interconnection or other type of interconnection that outputs Dial 2, Dial 3, Offset 1, Offset 2, Offset 3, and Flash.

The controller shall work in systems when a momentary (0.5 to 2.0 second) absence of offset input is identified as a synchronization pulse.

The controller shall operate in interconnected systems with centrally located offset interruptions.

**(c) Cabinet.** The cabinet shall comply with Subsection 701.02(c).

**(d) Cabinet Auxiliary Equipment.** The Cabinet Auxiliary Equipment shall comply with Subsection 701.02(d).

**(e) Certification.** The supplier shall provide a certification to the Contractor of compliance with the above requirements and that the controller and conflict monitor comply with the latest NEMA specifications. This certification shall be transferred to the Department.

**(f) Mounting Pad.** When required, a mounting pad shall be constructed as shown on the plans or as directed by the Engineer.

**702.03 Construction Requirements.** The solid state controller shall be mounted as shown on the plans or as directed by the Engineer, and shall in no case be located less than 3' (1 m) from the pavement edge.

The Contractor shall furnish and properly install each cabinet and controller with accessory equipment and perform any and all necessary splicing and connections, testing of circuits, adjustments, and such other operations as may be necessary to ensure that each complete traffic signal installation, with all of its components, be completely integrated and tested as a unit so that the desired control of the intersection is attained, complete, and in proper working order and to the satisfaction of the Engineer. The Contractor shall meet with the City or County and provide them with instructions on the adjustments of the controller and provide consultation for replacement parts stocking.

**702.04 Method of Measurement.** Pre-Timed Controllers (Local, Local/Master) will be measured by the unit. One unit shall include the controller; the controller cabinet; the pad on which the cabinet is installed, when required; and all hardware required for installing the cabinet.

**702.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Pre-Timed Controller (Local, Local/Master), which price shall be full compensation for furnishing the cabinet and controller; for mounting the controller cabinet; for installing, wiring, and testing the controller; for excavation and backfilling; for construction of the mounting pad; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Pre-Timed Controller (Local, Local/Master)	Each

**SECTION 703  
FLASHING BEACON CONTROLLER**

**703.01 Description.** This item shall consist of furnishing and installing solid state flashing beacon controllers according to these specifications and at the locations shown on the plans or as directed.

**703.02 Materials.** Single or two circuit flashers, whichever is specified, shall be provided with a dust-tight and weatherproof aluminum alloy or stainless steel cabinet. Cabinets shall not be painted unless otherwise specified.

The cabinet shall be adaptable for mounting the flashing unit conveniently and easily. The door on the controller cabinet shall be provided with a standard locking device. The Contractor shall furnish two keys for the lock to the City or County.

The flashing unit shall be a solid state, plug-in type flasher requiring no lubrication. The flashing unit shall include a radio interference suppressor. A 30 amp circuit breaker shall be installed in the controller cabinet.

Each flashing unit shall be designed for a minimum 10 amp load with an operating voltage of 115 VAC, 60 Hz. The flasher shall be capable of providing 50-60 flashes per minute. The illuminated period of each flash shall not be less than 1/2 and not more than 2/3 of the total cycle. The unit shall be compact and readily accessible inside the cabinet.

A timing device regulating periods when the controller is operative shall be provided when specified.

The Contractor shall submit to the Engineer for approval two copies of the applicable brochures containing design criteria for the components. The specific items proposed for use shall be clearly marked in the brochures. If more than one item is submitted at one time for Department review, a list shall be attached showing each item for which Department approval of design characteristics is being requested. The Engineer will provide written approval of the design characteristics.

**703.03 Construction Requirements.** The flashing unit, with cabinet, shall be mounted as shown on the plans or as directed.

**703.04 Method of Measurement.** Flashing Beacon Controllers will be measured by the unit.

**703.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Flashing Beacon Controller, which price shall be full compensation for furnishing, installing, and wiring the controller; for mounting the cabinet; and for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Flashing Beacon Controller	Each

**SECTION 704  
LOOP DETECTOR**

**704.01 Description.** This item shall consist of furnishing and installing vehicle detectors and/or rack mounted vehicle detectors, loop wiring and/or preformed detector loops, and necessary feeder wire according to these specifications and at the locations shown on the plans or as directed.

**704.02 Materials. (a) General.** Each loop detector shall be composed of all components necessary to provide for the detection

of vehicles constituting one traffic phase and shall include an electrical surge protection device.

Each vehicle detector shall be supplied complete with comprehensive instructions. The instructions shall be placed in the controller cabinet.

The term "vehicle detector" as used in these specifications shall refer to the pulse amplifying unit located in the controller cabinet.

The term "loop wiring" as used in these specifications shall refer to the sensing element and single conductor wire from the sensing element to the feeder wire. The wire shall be 14 gage stranded copper wire and shall be insulated with RHH or RHW USE rated insulation not less than 0.045" (1.1 mm) thick.

The term "feeder wire" as used in these specifications shall refer to the shielded 1, 2, or 4 pair 14 gage stranded copper wire extending from the detector unit to the loop wiring at the curb or pavement edge. The wire in each pair shall be twisted and each pair shall be shielded. Each loop shall have a separate feeder wire unless noted otherwise on the plans.

All vehicle detectors at a given intersection shall be housed inside the controller cabinet for that intersection.

The Contractor shall submit to the Engineer for approval two copies of the applicable brochures containing design criteria for the components. The specific items proposed for use shall be clearly marked in the brochures. If more than one item is submitted at one time for Department review, a list shall be attached showing each item for which Department approval of design characteristics is being requested. The Engineer will provide written approval of the design characteristics.

**(b) Vehicle Detector Requirements.** Vehicle detectors shall:

- be designed to operate satisfactorily in temperatures ranging from -30° F to +140° F (-34° C to +60° C),
- be designed to operate satisfactorily on line voltage ranging from 100 to 130 VAC,
- operate on 115 VAC, 60 Hz power,
- be so designed that the detector, operating in the pulse mode, will ignore a vehicle parked over a loop or

portion thereof in 30 to 180 seconds. After ignoring the parked vehicle, the remainder of that loop shall detect additional vehicles,

- be capable of giving detection signals persisting for up to 5 minutes if a vehicle stops and remains over the loop when operating in the presence mode,
- be capable of detecting vehicles ranging in size from a motorcycle to a large tractor trailer,
- be designed to run feeder wire in common conduit with signal and interconnect cable without interference, and
- be capable of driving 1 or 2 loops over a feeder length totaling up to 600 feet (180 m).
- be equipped with optical coupled or relay output circuits.
- be equipped with transformer isolation for loops.
- be equipped with high intensity LED indicators.
- be equipped with continuous loop monitor
- be equipped with time delay (where specified in the plans)

“With Count” specified detectors shall meet the above requirements and the “Count Output” function shall provide a separate pulse for each vehicle entering the loop detection zone to a separate controller input (in addition to the standard detector output).

**(c) Electrical and Mechanical Requirements.** The vehicle detector unit shall be:

- plug connected to controller terminal facilities,
- completely self contained, self tuning, and shall not require external power supplies other than line voltage, and
- of a design suitable for shelf mounting inside the controller cabinet.

**(d) Preformed Detector Loops.** This item shall be constructed utilizing an approved preformed loop listed on the Department’s Qualified Products List.

The preformed detector loop shall be constructed of #20 AWG (minimum) stranded copper wire, encapsulated in a flexible sealant inside a reinforced 250 psi (1724 kPa) rubber hose or approved

tubing. No wire splices will be allowed in the loop assembly. Hose for the loop and lead-in shall be one continuous piece except for the required tee connectors. Encapsulated wire shall have two (2) turns for loops with a perimeter greater than 40' (12 m); or three (3) turns for perimeter less than or equal to 40' (12 m). Quadrupole loops shall be two turn (2-4-2) configuration.

**(e) Rack Mounted Vehicle Loop Detectors.** Rack mounted vehicle detectors shall consist of the following principal components: two (2) or four (4) channel vehicle detector (card rack type); power supply unit (card rack type); and card rack (for plug-in modules). The components shall have the features shown below.

**(1) Vehicle Detectors – Rack Mount.** The single module will operate the detectors from a 24 VDC supply. Each detector shall meet the requirements of (b) above and the following:

- Connectors shall consist of double sided edge card connectors.
- “With Count” detectors shall provide two standard detector outputs and two count outputs to insert into a four channel rack position.

**(2) Power Supply Unit.** The power supply unit shall be a card rack type with an input voltage of 90 – 135 VAC, 60 Hz. Output voltage shall be unregulated DC. The unit shall contain high intensity LED indicators and one power switch that switches input line voltage for all channels. The unit module shall be fully compatible with the rack mounted vehicle detectors and other associated equipment.

**(3) Card Rack.** The vehicle detector card rack shall be constructed of lightweight anodized aluminum with mounting flanges to allow mounting of the rack either above or below the controller cabinet shelf. Each rack shall accommodate a minimum of two – 4 channel power supply units and up to eight – 2 channel detector units. Each rack shall be able to hold a maximum module size of 4.5" x 6.875" (115 mm x 175 mm). The connector wire shall be #22 AWG-Type UL 1015-1050C. The rack unit shall be fully compatible with the digital loop detectors and other associated equipment.

**704.03 Construction Requirements. (a) General.** The vehicle detectors, loop wiring, and feeder wire shall be installed as shown

on the plans or as directed by the Engineer. The loop wiring shall be installed in a sawed slot 1/4" to 3/8" (6 mm to 10 mm) wide, 2 1/2" (65 mm) minimum depth in asphalt or 1 1/2" (40 mm) in concrete, or as indicated on the plans. In no case shall the wire be less than 1/4" (32 mm) below the final pavement surface. Before sealing the slot, the wire shall be held down by backer rod wedges inserted into the slot at a maximum of 2' (0.6 m) intervals.

Loop wiring shall be tested by the Contractor according to the procedures outlined on the plans.

There shall be no splices in the feeder wire or the loop wiring.

The backer rod and sealant used shall be listed on the QPL. The installation procedures shall be according to the manufacturer's recommendations.

**(b) Preformed Detector Loops.** Preformed Detector Loop shall be designated by the perimeter size and configuration. The Contractor shall be responsible for determining the length of lead-in from loop to connection with feeder wire. Lead-in from feeder wire to the loop shall be considered incidental to the Preformed Detector Loop.

The preformed loop shall be placed in a saw-cut slot of sufficient width (approximately 1/2" [6 mm] to 3/4" [19 mm] in width) to a depth such that the top of loop is a minimum of 4" (100 mm) below the final surface, for the entire length of the trench. The maximum width of any loop trench shall be 1 1/2" (38 mm). The minimum width shall be 1/8" (3 mm) larger than the outer diameter of the preformed loop. Larger widths shall be used for couplings, tees, and ells but not to exceed the maximum width. The corners of the trench should be chiseled to remove the sharp edge. The Engineer may approve other methods of trenching.

Where the road surface is to be overlaid, the preformed detector loops shall be installed prior to final surface. The Contractor shall seal and compact the loop trench completely with a material and/or sealant recommended by the loop manufacturer. The recommended material shall be able to repair asphalt and concrete roads and not require removal and/or replacement if the pavement is to be overlaid. Where surface is not to be overlaid, an approved sealer shall be applied to backfill the preformed loop trenches as needed to a minimum depth of 3/8" (10 mm). The approved material shall

have a minimum settlement period of 14 days prior to each backfill application.

The connection of the loop lead-in to the feeder wire shall be soldered and completely sealed in an approved manner against entry of moisture into the splice, jacket of loop and feeder wire. The preformed detector loop shall be tested for meg and continuity according to the procedures outlined on the plans and each feeder wire shall be clearly labeled with the phase designation.

**(c) Rack Mounted Vehicle Detectors.** Wiring diagrams for the vehicle detector channel assignment shall be provided to the Department for approval prior to the delivery of the controller cabinet to the Contractor.

The vehicle detector card rack's mounting flanges shall be turned out on each rack and the power supply modules shall be located on the left side when viewed from the front.

All output channels available from the card rack, including unused channels, shall be brought out to the terminal strips for future use. This shall include providing terminals for future detector loops. Where unused system detector inputs to the controller are available, these shall be tied to unused detector channels or brought out to the terminal facilities.

If approved by the Engineer, 2-channel units may be used in combination with 4-channel units in order to reduce the number of unused channels. This may be allowed provided that the possibility of cross talk will not be increased.

**704.04 Method of Measurement.** Items will be measured as follows:

- (a) Vehicle Detectors will be measured by the unit.
- (b) Loop Wiring will be measured by the linear foot (meter).
- (c) Feeder Wire will be measured by the linear foot (meter).

(d) Preformed Detector Loops will be measured by the unit for the size, type, and number of turns specified. Size shall be designated by length and width dimensions. Type shall be Q for quadrupole configuration (2-4-2) and blank for standard configuration.



(e) Vehicle Detector - Rack Mount will be measured by the unit for the number of standard vehicle detector channels provided.

(f) Vehicle Detector - Rack Mount, with Count will be measured by the unit for the number of standard vehicle detector channels provided (including one separate count output channel). No separate payment will be made for count output channels.

(g) Vehicle Detector - with Count will be measured by the unit for the number of standard vehicle detector channels provided (including one separate count output channel). No separate payment will be made for count output channels.

**704.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) Vehicle Detectors will be paid for at the contract unit price bid per each for Vehicle Detector, or Vehicle Detector-with Count, which price shall be full compensation for furnishing, mounting, and installing the detector; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(b) Loop Wiring will be paid for at the contract unit price bid per linear foot (meter) for Loop Wiring, which price shall be full compensation for laying the loop wiring in place and connecting to the appropriate feeder wire; for sawing and sealing as appropriate; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(c) Feeder Wire will be paid for at the contract unit price bid per linear foot (meter) for Feeder Wire, which price shall be full compensation for laying the feeder wire in place and connecting to the appropriate vehicle detector and loop wiring; for pulling wire through conduit; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(d) Preformed Detector Loops will be paid for at the contract unit price bid per each for Preformed Detector Loop (\_\_\_' x \_\_\_') (\_\_\_ m x \_\_\_m), which price shall be full compensation for sawing and sealing; clearing the slot; removal of surplus material; placing the preformed detector loop in place and connecting to the appropriate feeder wire; and for all materials including the preformed loop, asphalt or sealer material, coupling and connectors; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(e) Rack Mounted Vehicle Detectors will be paid for at the contract unit price bid per each channel for Vehicle Detectors-Rack Mount or Vehicle Detectors-Rack Mount, with Count, which price shall be full compensation for furnishing and installing the detector card rack, power supply, detector cards, and for all equipment, tools, labor, and incidentals required to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Vehicle Detector	Each
Vehicle Detector-with Count	Each
Loop Wiring	Linear Foot (Meter)
Feeder Wire	Linear Foot (Meter)
Preformed Detector Loop (___' x ___') (___ m x ___m)	Each
Vehicle Detector-Rack Mount	Each
Vehicle Detector-Rack Mount, with Count	Each

## **SECTION 705 LOOP WIRING IN DUCT**

**705.01 Description.** This item shall consist of furnishing and installing vehicle detector loop wiring according to these specifications and at the locations shown on the plans or as directed.

**705.02 Materials.** The term "loop wiring" as used in these specifications shall refer to the sensing element (loop), which is the single conductor wire coming from and going to the feeder wire at the curb or pavement edge. Loop wiring shall consist of 14 gage, stranded XHHW or THHN 600V wire completely enclosed in a PVC or polyethylene tubing having a 3/16" (4.75 mm) I.D., 1/4" (6.35 mm) O.D., and a wall thickness of 1/32" (0.8 mm). Loop wiring in duct shall comply with the latest requirements of *International Municipal Signal Association Specification No. 51-5*. The tubing shall be capable of resisting deterioration from oils and solvents. The tubing shall also be highly abrasion resistant and have a smooth bore.

**705.03 Construction Requirements.** The loop wiring shall be installed in a sawed slot 3/8" (10 mm) wide by 2½" (65 mm) deep cut in the roadway surface. The loop wire shall be inserted into the tubing for the full length from the point of splicing at the curb or pavement edge and placed into the slot with the number of turns as shown on the plans or as directed by the Engineer. Twisting of loop wire from the perimeter of the loop to the pull box is not required. The tubing shall be of a continuous length from the point of splicing of the loop wire to the feeder wire. No splices will be made in the tubing or loop wiring. The ends of the tubing shall be sealed to prevent any entrance of moisture into the tubing. The electrical splice between the loop wiring and feeder wire shall consist of providing a watertight protective covering for the spliced wire, the shielding on the feeder wire, and the end of the tubing containing the loop wiring. To eliminate floating when the sealant is poured, the tubing shall be held down by wedges inserted into the slot on 2' (0.6 m) centers. The wedges shall be 1" (25 mm) sections of plastic tubing, folded before insertion. The sealant used shall be listed on the QPL. The installation procedures shall be according to the manufacturer's recommendations.

**705.04 Method of Measurement.** Loop Wiring in Duct will be measured by the linear foot (meter).

**705.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Loop Wiring in Duct, which price shall be full compensation for furnishing and installing the loop wire and protective tubing; for sawing and sealing the slot; for splicing the wires complete in place; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Loop Wiring in Duct	Linear Foot (Meter)

## SECTION 706 TRAFFIC SIGNAL HEAD

**706.01 Description.** This item shall consist of furnishing and installing 12" (300 mm) diameter traffic signal heads of the type specified and according to these specifications and at the locations shown on the plans or as directed.

**706.02 Materials. (a) General.** Each traffic signal head shall consist of an assembly of one or more signal faces and the necessary mounting brackets and hardware.

Each signal face shall consist of an assembly of signal sections in sufficient quantity to provide the required number of indications. The sections shall be joined together in a manner that provides both mechanical integrity and a weatherproof unit.

Each signal section of a signal face shall consist of a housing, door, visor, and optical assembly. The housing, door, and lens, together with necessary gaskets, shall constitute a weatherproof unit. The lens and the remainder of the optical assembly, together with necessary gaskets, shall constitute a dust-tight assembly.

Each signal section and its associated optical system shall be capable of operating satisfactorily with the section's axis either vertical or horizontal.

Each signal section shall be provided with openings in the top or bottom for mounting purposes. Each opening shall be round to accommodate 1½" (40 mm) pipe. Each unused opening shall be closed with a gasketed plug.

Each signal face shall be capable of being rotated 360° about its vertical axis and shall be capable of being locked at 5° intervals. Locking shall be accomplished by the engagement of serrations in the end signal sections with similar serrations in the mounting bracket assembly.

Signal indications shall be assembled according to the latest revisions of the MUTCD.

The Contractor shall submit to the Engineer for approval two copies of the applicable brochures containing design criteria for the components. The specific items proposed for use shall be clearly marked in the brochures. If more than one item is submitted at one

time for Department review, a list shall be attached showing each item for which Department approval of design characteristics is being requested. The Engineer will provide written approval of the design characteristics.

**(b) Optical Unit.** Each optical unit shall consist of an assembly of a lens, reflector, lamp, lamp socket, and other components as required. The optical assembly together with the necessary gaskets shall constitute a dust-tight assembly that shall be designed to give clear visible signal indications within an angle of at least 45° and from 10' to 300' (3 m to 90 m) under all light and atmospheric conditions. The optical assembly shall be designed to minimize the return through the lens of outside light entering the lens at low sun angles to prevent the effect termed Sun Phantom.

Lenses shall be of the color indicated, circular in shape, and made of either glass or ultraviolet stabilized plastic. The composition must be durable on prolonged exposure to weather and all lenses shall be uniformly colored throughout the body of the material, true to size and form, and free from any defects that in any way detract from their efficiency or use. Each lens shall be so designed and manufactured that, when installed in a standard traffic signal, it will satisfy the minimum requirements for candlepower distribution and intensity and chromaticity as specified by the ITE. When mounted, the lens shall have a visible diameter of not less than 11½" (292 mm) as shown on the plans. Lenses shall be marked to indicate the top.

The reflectors shall be of Alzak aluminum and shall comply with the specifications of the ITE Technical Report #1. Aluminum reflectors shall be of high purity aluminum, spun to shape and treated by the Alzak Process. The reflectors shall be of the pressure type, free floating, and must ensure full seal against the lens gasket.

Reflectors shall be mounted in a cast aluminum reflector support attached to the housing, or shall be an integral reflector and support of formed sheet aluminum, or shall be supported in such a fashion that the alignment of all optical components is maintained except when purposely disassembled.

The reflector support assembly, if used, shall be pivoted to the housing and designed so that it can be swung out or easily removed without the use of any tools.

The method of mounting and fastening reflectors shall ensure proper alignment between the lens and reflector when the door is closed.

The construction of the signal head and its components shall be such that the fit between the reflector and the lens will eliminate all possibility of false indications.

Reflectors shall have an opening in the back for the lamp socket.

The lamp socket shall be made of molded Bakelite and the screw shall be so arranged that the lamp will not loosen due to vibration. A lamp socket support shall be provided that can be assembled or removed without the use of tools. Each socket shall be wired with one black lead from the socket and one white lead from the shell. Leads shall be of sufficient length to reach the terminal block with the reflector fully open and shall be of 18 gage AWG wire with thermoplastic insulation, 600 volt dielectric strength at 220° F (105° C) temperature.

Each optical unit shall be supplied with a lamp of appropriate size to comply with the standards set forth in the latest *ITE Standard for Traffic Signal Lamps*. Lamps shall be rated for 8,000 hours for their intended use.

**(c) Housing.** The signal head housing shall consist of an assembly of separate sections substantially secured together in a watertight manner to form a unit of pleasing appearance. Each section shall house an individual optical unit. Each housing shall be equipped with the suitable fittings required for mounting.

The sections shall be interchangeable and so constructed that each section can be removed or added. Each section shall be assembled with 2 plated washers and 3 plated bolts. Each cap shall be drilled for slip fit of a standard 1½" (40 mm) pipe nipple. The area around this opening shall be reinforced and serrated so that serrated fittings may be used to secure the housing. A terminal block of an approved type shall be mounted inside and at the back of the housing.

All mounting brackets and fittings shall be assembled watertight. Brackets shall be 1½" (40 mm) standard pipe or rigid conduit of sufficient strength to withstand the vertical and horizontal loads specified by ITE.

Each housing shall be made using one of the following methods and materials:

- Cast from aluminum alloy. Material for die cast housings shall comply with ASTM B 85 aluminum alloy S-12A, S-12B, SC-84A, SC-84B, or SG-100B. Material for permanent mold castings shall comply with ASTM B 108 aluminum alloy B443.0.
- Molded from structural plastic. Material for molded housings (injection, rotational, or blow molded) shall be made from an engineering structural plastic. Plastic shall be ultraviolet and heat stabilized and flame resistant. Plastic housings may be either molded in one piece or may be fabricated from 2 or 3 pieces joined into a single piece using thermal, chemical, or ultrasonic bonding.

Unless otherwise specified on the plans, plastic shall be used.

Each door shall be composed of one of the above materials and shall be compatible with the material of the housing.

The lens opening in the doors shall provide a visible diameter of not less than 11½" (292 mm) nor more than 12" (300 mm) for a nominal 12" (300 mm) round lens.

All exterior metal parts, except as noted and including hinge pins, shall be made from stainless steel.

Visors and backplates for metal signal sections shall be made from 0.064" (1.6 mm) minimum thickness aluminum alloy sheet.

Visors and backplates for plastic signal faces shall be either formed from sheet plastic or assembled from one or more injection, rotational, or blow molded plastic sections.

Each visor shall be of the open bottom tunnel type, a minimum of 9½" (240 mm) in length for nominal 12" (300 mm) round lens, and not less than 0.05" (1.25 mm) in thickness, with a minimum downward tilt of 3½ degrees.

Gaskets shall be made from neoprene or silicone rubber; resistant to heat, permanent deformation, and weather; and compatible with the materials of the door, housing, and lens.

The door of each signal section shall be a one piece door hinged to the housing so as to permit access to the section for replacement of bulbs. The optical systems shall be so mounted on the door that the various parts may be swung open for ready accessibility and removal. The door shall be secured with simple devices and a non-corrosive door locking device to provide for opening and closing the door without the use of special tools.

All exterior parts of the signal head, except the lens and mounting brackets, shall be finished with 2 coats of synthetic resin enamel of the color specified herein. Nonmetallic materials shall have the color impregnated in the resin material. Unless otherwise specified on the plans, colors shall be as listed below:

- Housing - Black
- Door Assembly - Black
- Visor - Flat Black

The color of the mounting bracket shall match the color of the traffic signal head or the color of the traffic signal pole.

(d) The Contractor shall furnish and install the proper signs [either Left Turn Signal or Left Turn Yield on Green (symbolic green ball, MUTCD R10-12)] adjacent to signal heads controlling an exclusive left turn lane. The sign size and layout shall be as shown on the plans and shall comply with Section 723. Unless otherwise specified, the sheeting shall be Type III or IV.

**706.03 Construction Requirements.** Signal heads shall be installed to maintain a 18'-0" (5.5 m) maximum and 17'-0" (5.2 m) minimum vertical clearance directly under the signal head.

**706.04 Method of Measurement.** Traffic Signal Heads will be measured by the unit. One unit shall include the number of faces and sections specified, together with all mounting brackets and hardware; signs, where required; and other incidentals to provide a signal head complete in place.

**706.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Traffic Signal Head of the type and size specified, which price shall be full compensation for furnishing and installing all materials and signs; and for all labor, equipment, tools, and incidentals necessary to complete the work.



Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Traffic Signal Head (_____)	Each

## **SECTION 707 PEDESTRIAN SIGNAL HEAD**

**707.01 Description.** This item shall consist of furnishing and installing pedestrian signal heads and accessories according to these specifications and at the locations shown on the plans or as directed.

**707.02 Materials.** The pedestrian signals shall be the incandescent type with WALKING PERSON (symbolizing WALK) and UPRAISED HAND (symbolizing DON'T WALK) signal indicators. The symbol designs set forth in the FHWA publication "Standard Highway Signs" shall be used. The WALKING PERSON signal shall be as specified by the ITE and produced with a white glass lens with all but the symbol obscured by an opaque material. The symbol shall be a minimum of 6" (150 mm) in height.

The UPRAISED HAND signal shall be as specified by the ITE and shall be produced with an orange glass with all except the symbol obscured by an opaque material. The symbol shall be a minimum of 6" (150 mm) in height.

The signal shall be 12" x 12" (300 mm x 300 mm) nominal size and provided with lens visors. The reflectors and housings shall comply with Subsection 706.02. When the traffic signal controller is the actuated type, the pedestrian signals shall also be the actuated type.

Pedestrian-actuated signals shall have a push-button detector 3½' to 4' (1 m to 1.2 m) above the surface of the sidewalk at each end of the crosswalks. The push-button detector shall be located on a traffic signal pole or a pedestrian signal pedestal pole. The standard pedestrian-actuated signal sign (MUTCD R10-3e) shall be mounted just above the push-button. The sign shall comply with the requirements of Section 723. Unless otherwise specified, the sheeting shall be Type III or IV.

The Contractor shall submit to the Engineer for approval two copies of the applicable brochures containing design criteria for the components. The specific items proposed for use shall be clearly marked in the brochures. If more than one item is submitted at one time for Department review, a list shall be attached showing each item for which Department approval of design characteristics is being requested. The Engineer will provide written approval of the design characteristics.

**707.03 Construction Requirements.** Pedestrian signals shall be mounted with the bottom of the signal not less than 8' (2.4 m) nor more than 10' (3.0 m) above the sidewalk level and so that there is a signal in the line of vision of pedestrians crossing in any direction. The pedestrian signal head shall be so positioned and adjusted as to provide maximum visibility at the start of the controlled crosswalk. The signal shall be wired to operate upon actuation from the pedestrian push-button when the controller is the traffic actuated type.

**707.04 Method of Measurement.** Pedestrian Signal Heads will be measured by the unit. One unit shall include one complete signal assembly consisting of both WALK and DON'T WALK sections; pedestrian actuated push button detectors and signs, when required; and all wiring except signal cable necessary to provide a complete functioning unit.

**707.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Pedestrian Signal Head, which price shall be full compensation for furnishing and installing all materials and signs; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Pedestrian Signal Head	Each

## SECTION 708 TRAFFIC SIGNAL CABLE

**708.01 Description.** This item shall consist of furnishing and installing traffic signal cable according to these specifications and at the locations shown on the plans or as directed.

**708.02 Materials.** The cable shall be #14 AWG copper with the number of conductors as shown on the plans and shall comply with the *International Municipal Signal Association Specification 20-1 or 20-3* for 600 volt polyethylene insulated and jacketed signal cable.

The Contractor shall furnish and install acceptable bands, ties, and other supports for the cable in poles and control boxes according to the best modern practice.

Cables shall be marked for phase identification according to the manufacturer's standards.

**708.03 Construction Requirements.** Connections to signal heads shall be made with a polyethylene jacketed stranded or solid wire cable. The Contractor will be allowed to make connections to the signal heads by the "line tapping" method.

Splices shall be moistureproof and have a dielectric strength at least equal to that of the original insulation. The sweating or soldering shall be accomplished by pouring, using solder hot enough to run properly. Splices shall be made according to the best modern practice and may be accomplished by methods approved by the Engineer. Splices will be allowed only at pull boxes, pole bases, and traffic signal heads.

**708.04 Method of Measurement.** Traffic Signal Cable will be measured by the linear foot (meter) in place.

**708.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Traffic Signal Cable of the type and size specified, which price shall be full compensation for furnishing and installing all materials; making all splices and connections; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Traffic Signal Cable (____)	Linear Foot (Meter)

## **SECTION 709 GALVANIZED STEEL CONDUIT**

**709.01 Description.** This item shall consist of furnishing and installing hot dipped galvanized steel conduit of the size and at the locations shown on the plans and according to these specifications, or as directed. This item covers galvanized steel conduit installed above and below ground. This item shall also include any flexible runs to light supports; straps and bolts for attachment to poles, bridges, or other structures; fittings for connection to junction boxes, controller cabinets, and other elements of the complete installation, as required; and expansion devices.

**709.02 Materials.** All conduit, expansion joints, and fittings shall be hot dipped galvanized, inside and outside, according to AASHTO M 111. Conduit shall be free of all imperfections that might injure the cable. Conduit fittings and accessories shall be suitable for underground, encased, and exposed applications according to Underwriters Laboratories and the latest National Electric Code. All conduit shall comply with UL Specification UL-6. Conduit straps shall be galvanized stock, sized according to size conduit shown on plans. Nuts on conduit strap anchor studs shall be galvanized and shall be of a locking type.

Where a flexible conduit connection is required, all metal flexible galvanized steel tubing with a liquid tight neoprene jacket extruded over the flexible metal core shall be used. The fittings required for connection between the flexible conduit and rigid conduit or connection boxes shall be liquid tight and as recommended by the manufacturer of the flexible conduit. Factory fabricated flexible conduit assemblies having liquid tight characteristics are acceptable. Non-watertight conduit is not acceptable. A flexible conduit connection is required at the location of all bridge expansion joints.

**709.03 Construction Requirements.** Underground conduit shall be installed in trenches or predrilled tunnels not less than 12" (300 mm) below final grade except where otherwise indicated on the

plans or directed. Trench excavation, backfill, compaction, and disposal of surplus material shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the trench. Disturbed surfaces shall be returned to their original condition.

Conduit with fittings and appurtenances may be attached to bottoms of slabs on bridges; faces of wingwalls, columns, or bent caps; or flanges and webs of steel beams. Such attachment shall be achieved by use of conduit straps spaced at intervals of 5' (1.5 m) and held in place by self-drilling anchors, expansion shield anchors, or clamps on steel flanges.

All conduit shall be reamed after threading to remove all burrs. Conduit shall be brushed thoroughly with a bristle brush before installation to remove all dirt from the inside surface. At the time of installation, each threaded end of conduit shall be coated with an acceptable sealant to form watertight joints. All coupling connections shall be made so that the reamed ends of conduit butt squarely against each other inside the coupling. Conduit ends at boxes shall be fitted with threadless bushings.

Standard bends shall be used wherever possible, but when a conduit bend is formed, the largest possible bending radius shall be used and shall not be less than 6 times the nominal diameter of the conduit.

Upon completion of each conduit run, a device having a diameter of at least 85% of the nominal diameter of the conduit shall be pulled through the conduit run. If the device does not pull through, the cause of the obstruction shall be determined and corrected. A ¼" (6 mm) nylon pull rope shall be pulled through each conduit and left in place for later use if the conduit is to be left empty.

**709.04 Method of Measurement.** Galvanized Steel Conduit will be measured by the linear foot (meter) measured along the axis of the conduit in its final position. It will not be considered complete until backfill and compaction have been satisfactorily performed. All necessary conduit fittings will be included as part of the conduit run and will not be measured separately.

**709.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Galvanized Steel Conduit of the

size specified, which price shall be full compensation for furnishing and installing conduit, fittings, and drag rope; for jacking, drilling, excavation, backfill, compaction, removal of surplus material, and replacement of existing surfaces; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Galvanized Steel Conduit (___") (___mm)	Linear Foot (Meter)

## **SECTION 710 NON-METALLIC CONDUIT**

**710.01 Description.** This item shall consist of furnishing and installing PVC (polyvinyl chloride) or PE (polyethylene) conduit according to these specifications and at the locations shown on the plans or as directed. The Contractor may elect to use either type of conduit where non-metallic conduit is shown on the plans; however, each run of conduit (from pull box or pole base to the next pull box or controller) shall consist of conduit, fittings, and accessories of one type of material.

**710.02 Materials. (a) PVC Conduit.** Conduit, fittings, and accessories shall be PVC suitable for underground, encased, and exposed applications as approved by Underwriters Laboratories according to the National Electric Code. Conduit shall be Schedule 40 rigid PVC.

**(b) PE Conduit.** Conduit, fittings, and accessories shall be polyethylene, suitable for underground, encased, and exposed applications as approved by Underwriters Laboratories according to the National Electric Code. Conduit shall be Schedule 40, meeting the requirements of ASTM D 2447-99, utilizing test procedure ASTM D 1248.

**710.03 Construction Requirements.** Conduit shall be installed in trenches or predrilled tunnels not less than 18" (450 mm) below final grade except where otherwise indicated on the plans or as directed.

Standard bends should be used wherever possible, but when the bend is formed, the longest possible bending radius shall be used

and shall not be less than 6 times the nominal diameter of the conduit.

Upon completion of each conduit run, a device having a diameter of at least 85% of the nominal diameter of the conduit shall be pulled through the conduit run. If the device does not pull through, the cause of the obstruction shall be determined and corrected. A 1/4" (6 mm) nylon pull rope shall be pulled through each conduit and left in place for later use if the conduit is to be left empty.

Trench excavation, backfill, compaction, and removal of surplus material shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the trench. Disturbed surfaces shall be returned to the original condition.

**710.04 Method of Measurement.** Non-Metallic Conduit will be measured by the linear foot (meter) measured along the axis of the conduit in its final position. It will not be considered complete until backfill and compaction have been satisfactorily performed. All necessary conduit fittings will be included as part of the conduit run and will not be measured separately.

**710.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Non-Metallic Conduit, of the size specified, which price shall be full compensation for furnishing and installing the conduit, fittings, and drag rope; for excavation, backfill, compaction, removal of surplus material, and replacement of existing surfaces; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Non-Metallic Conduit (___")(___mm)	Linear Foot (Meter)

**SECTION 711  
CONCRETE PULL BOX**

**711.01 Description.** This item shall consist of furnishing and installing at locations shown on the plans or as directed, a Concrete Pull Box of the type specified according to these specifications.

**711.02 Materials.**

The pull box cover and cover ring shall be constructed with Portland cement concrete reinforced with welded wire or shall be polymer concrete reinforced with heavyweave fiberglass or shall be high density polymer concrete reinforced with Sheet Molded Compound (SMC).

The pull box body shall be constructed with Portland cement concrete reinforced with welded wire or shall be polymer concrete reinforced with heavyweave fiberglass or shall be manufactured using the compression molded process, utilizing high density polymer concrete and SMC to produce a one-piece monolithic structure.

No fiberglass shall be exposed. All exposed portions of the pull box shall be non-electrically conductive.

The minimum inside dimensions measured horizontally across the center of the box just below the lid support lip shall be as follows:

Concrete Pull Box -- Type 1 and 1 HD:

8 ¾" (220 mm) wide x 14 ¼" (360 mm) long

Concrete Pull Box -- Type 2 and 2 HD:

11" (280 mm) wide x 21" (530 mm) long

Concrete Pull Box -- Type 3 and 3 HD:

15 ¼" (385 mm) wide x 28" (710 mm) long

The depth measured from the top of the lid shall be a minimum of 11 ½" (290 mm). A non-metal electrically insulated cover shall be provided for each pull box. The covers shall have a skid resistant surface on top and a lifting eye.

The pull box and cover shall be constructed in such a manner that the assembly will support light vehicular traffic. The cover with pull box shall meet or exceed the following test loading:



Type	Load		Load Area	
	pounds	kg	Sq. inch	sq mm
1	3800	1720	10 (3.16"x3.16")	6400 (80 mm <sup>2</sup> )
1 HD	7500	3400	10	6400
2	3800	1720	20 (4" x 5")	13,000 (100 mm x 130 mm)
2 HD	7500	3400	20	13,000
3	3800	1720	20	13,000
3 HD	7500	3400	20	13,000

Pull box with cover in place shall comply with the National Electric Code for exposed boxes rated at voltages up to 480 VAC.

All Type HD concrete pull boxes are to be installed as shown on the plans with a surrounding apron of concrete 12" (305 mm) wide and 6" (152 mm) in depth. The concrete shall comply with Section 802 for Class S Concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for the Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall meet the requirements of Subsection 804.02(a) for the size and grade shown in the plans and shall be placed as shown in the plans and in conformance with Subsections 804.06 and 804.07.

The pull box shall be permanently labeled with "AHTD", "ELECTRIC", the manufacturer's name and model identifier. The permanent label "AHTD" and "ELECTRIC" shall be placed on the outside of the pull box lid.

**711.03 Construction Requirements.** Excavation for the pull box shall be to a depth that will result in the top of the cover being flush with the surrounding surface. The pull box shall be set on a gravel or crushed stone bedding that will serve as a sump. The bedding shall extend 18" to 24" (450 mm-600 mm) below the bottom of the box, and shall be constructed according to the details shown on the plans.

Concrete Pull Boxes shall be included in the Performance Test under Section 717, and any box or lid that fails for any reason during the 6-month warranty period shall be replaced by the Contractor at no cost to the Department.

**711.04 Method of Measurement.** Concrete Pull Boxes, in place with lids, will be measured by the unit.

**711.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Concrete Pull Box of the type specified, which price shall be full compensation for furnishing and installing the pull box; for excavation, backfill, compaction, removal of surplus materials and replacement of the existing surface; for furnishing and placing the bedding material; for furnishing and placing reinforcing steel and concrete for the HD pull box aprons; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete Pull Box (Type__)	Each

**SECTION 712**  
**SPAN WIRE SUPPORT POLE WITH**  
**FOUNDATION**

**712.01 Description.** This item shall consist of furnishing and erecting steel span wire support poles with foundations according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**712.02 Materials.** The following material requirements shall apply to poles and foundations.

(a) Pole shafts shall comply with ASTM A 1011, SS, Grade 50 (345), AASHTO M 270, Grade 50 (345), ASTM A 595 Grade A, or ASTM A 572, Grade 50 or Grade 65. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(b) Anchor bolts shall comply with AASHTO M 314, Grade 55 (379) including supplemental requirement S1. All exposed portions of bolts shall be galvanized according to AASHTO M 232 or ASTM B 695, Class 40 or 50.

(c) Anchor base plates shall comply with AASHTO M 270, Grade 36 (250). Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(d) Cast anchor base plates shall comply with AASHTO M 103 Grade 65-35. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100, or ASTM B 695 Class 40 or 50.

(e) Hex nuts shall comply with AASHTO M 292 Grade 2H or AASHTO M 291 Grade DH or DH3 (Grade 10S or 10S3). The thread series shall correspond with that of the bolt furnished. Washers shall comply with AASHTO M 293. Galvanizing shall comply with AASHTO M 232 or ASTM B 695 Class 40 or 50. Nuts shall be galvanized by the same process as that of the bolts.

(f) Concrete shall comply with Section 802 for Class S concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall comply with Section 804 for Grade 40 steel.

(g) Ground rods shall be 5/8" (16 mm) diameter Copperweld with ground wire and connections.

(h) When painting is specified on the plans, the pole and base plate shall be painted according to the provisions of Section 638.

**712.03 Fabrication.** The pole shall be constructed to the dimensions shown on the plans. The pole shaft shall have a continuous taper with only 1 vertical seam electrically welded and rolled smooth. A handhole of sufficient size to allow for internal wiring shall be provided near the pole base. A reinforcing frame for the handhole tapped for a grounding bolt shall be welded into the shaft a short distance from the base. A J-hook wire support shall be welded inside the shaft near the top of the pole.

A cast steel or plate anchor base of the size and shape shown on the plans shall be electrically welded to the bottom of the pole. The anchor base and welding thereto shall develop the full strength of the adjacent shaft.

Four anchor bolts with hex leveling nuts shall be provided with each pole. The anchor bolts shall be of the length shown on the plans and have an L-bend on the bottom and shall be threaded at the top.

Before installation, the Contractor shall furnish to the Engineer design details regarding this item. These details shall specify materials and shall include a certification prepared and/or approved by a Professional Engineer who is registered in any of the United States:

- That the design complies with the plans and specifications and meets or exceeds the standards found in *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 4<sup>th</sup> Edition (2001)* with 2003 and 2006 interims.
- That the materials specified in the design meet or exceed the requirements of Subsection 712.02.

The Contractor shall also furnish a certification from the manufacturer or supplier that the span wire support pole was fabricated in compliance with the certified design and that the materials furnished comply with the specifications.

**712.04 Construction Requirements.** The Contractor shall contact the local utility companies to determine the location of underground utilities in the area where the foundations are to be located and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

Excavation, backfill, compaction, and disposal of surplus materials shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to their original condition.

Foundations for span wire support poles shall be constructed in firm earth to the minimum size and depth shown on the plans. The location of the foundations shall be as shown on the plans or as

directed by the Engineer. Foundations shall be placed monolithically and have a 1" (25 mm) chamfer at the top.

Conduit, anchor bolts, and ground rods shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Concrete shall be constructed according to Section 802. The exposed portion of the foundation shall be given a Class 2 finish. The area between the top of the foundation and the pole base shall be neatly grouted after the pole has been raked and secured in place. The pole shall not be erected upon the foundation for a minimum of 72 hours after placement of the concrete.

Span wire support poles shall be securely bolted to the foundation in a raked position employing galvanized leveling nuts.

Span wire support poles shall be effectively grounded by means of a ground rod. The grounding wire shall be attached to the pole by means of a solderless steel bolt.

Subsequent to erection, any damaged galvanized coating or paint shall be repaired according to Subsection 807.88 or Section 638, as appropriate.

All holes in span wire support pole required for eye bolts, signal cable, controller mounting, etc., shall be machine drilled.

**712.05 Method of Measurement.** Span Wire Support Poles with Foundations will be measured by the unit.

**712.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Span Wire Support Pole With Foundation, which price shall be full compensation for furnishing and installing the pole; for excavation, backfill, compaction, and removal of surplus material; for furnishing and placing reinforcing steel and concrete; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Span Wire Support Pole With Foundation	Each

## SECTION 713 SPAN WIRE ASSEMBLY

**713.01 Description.** This item shall consist of furnishing and installing span wire assemblies according to these specifications and at the locations shown on the plans or as directed.

**713.02 Materials.** The supporting strand shall be a continuous length of suspension strand without splices, except for the Y connection and insulator joint, and shall be attached to steel poles at each end as shown on the plans.

The span wire shall comply with ASTM A 475 and shall be a nominal 5/16" (8 mm) extra high strength 7 wire strand and shall have a Class A galvanized coating.

Suitable cable ties shall be provided to suspend the traffic control cable at intervals not to exceed 18" (450 mm). Necessary eyebolts, washers, nuts, and fittings shall be of galvanized steel complying with AASHTO M 232 or M 298, Class 40 or 50.

**713.03 Construction Requirements.** Before erecting the span wire, the Contractor shall determine the length of suspension strand required to span the distance between poles, allowing 5% for sag plus connections.

After the span wire has been assembled and the signal heads suspended, the Contractor shall adjust the assembly to obtain a maximum of 18'-0" (5.5 m) and a minimum of 17'-0" (5.2 m) clearance from the bottom of the signal head to the pavement.

**713.04 Method of Measurement.** Span Wire Assemblies will be measured by the unit.

**713.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Span Wire Assembly, which price shall be full compensation for furnishing and erecting the assembly; for all fittings, clamps, and insulators; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Span Wire Assembly	Each

**SECTION 714**  
**TRAFFIC SIGNAL MAST ARM AND POLE WITH**  
**FOUNDATION**

**714.01 Description.** This item shall consist of furnishing and erecting steel traffic signal mast arms and poles with foundations according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**714.02 Materials.** The following material requirements shall apply to mast arms, poles, and foundations.

(a) Poles and mast arms shall be ASTM A 1011, SS, Grade 50 (345), AASHTO M 270, Grade 50(345), ASTM A 595 Grade A or ASTM A 572, Grade 50 or Grade 65. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(b) Anchor bolts shall comply with AASHTO M 314, Grade 55 (379), including Supplementary Requirement S1. All exposed portions of bolts shall be galvanized according to AASHTO M 232 or ASTM B 695, Class 40 or 50.

(c) Anchor Base Plates shall be AASHTO M 270 Grade 36 (250). Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(d) Cast Anchor Base Plates shall be AASHTO M 103/M 103M Grade 65-35. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100, or ASTM B 695, Class 40 or 50.

(e) Hex nuts shall comply with AASHTO M 292 Grade 2H or AASHTO M 291 Grade DH or DH3 (Grade 10S or 10S3). The thread series shall correspond with that of the bolt furnished. Washers shall comply with AASHTO M 293. Galvanizing shall comply with AASHTO M 232 or ASTM B 695, Class 40 or 50. Nuts shall be galvanized by the same process as that of the bolts.

(f) Clamp Plates shall be AASHTO M 270 Grade 36 (250). Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(g) Flange and Gusset Plates shall be AASHTO M 270 Grade 36 (250). Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(h) Clamp and Flange Bolts shall be AASHTO 164M. Galvanizing shall comply with AASHTO M 232 or ASTM B 695, Class 40 or 50.

(i) Concrete shall comply with Section 802 for Class S concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall comply with Section 804 for Grade 40 steel.

(j) Ground rods shall be 5/8" (16 mm) diameter or larger Copperweld with ground wire and connections.

(k) When painting is specified on the plans, the pole, arm, and base plate shall be painted according to the provisions of Section 638.

**714.03 Fabrication.** The pole shall be constructed to the dimensions shown on the plans. The pole shaft shall have a continuous taper with only one vertical seam electrically welded and rolled smooth. A handhole of sufficient size to allow for internal wiring shall be provided near the pole base. A reinforcing frame for the handhole tapped for a grounding bolt shall be welded into the shaft a short distance from the base. A J-hook wire support shall be welded inside the shaft near the top of the pole.

A cast steel or plate anchor base of the size and shape shown on the plans shall be electrically welded to the bottom of the pole. The anchor base and welding thereto shall develop the full strength of the adjacent shaft.

The arm may be connected to the pole using clamp and gusset plates or flange and gusset plates. When using clamp plates, one rounded plate conforming to the curvature of the pole shall be welded to the mast arm and reinforced with gusset plates as required to develop sufficient strength. The back clamp plate shall be connected to the mast arm clamp plate with 4 bolts of sufficient size to develop adequate strength in the connection.

When using flange and gusset plates to connect the arm to the pole, adequate size plates shall be welded to the pole in the proper position. Another flange plate of suitable design and strength shall be welded to the end of the arm. The arm will then be connected to



the pole by 4 bolts of sufficient size to develop adequate strength in the connection.

Four anchor bolts with hex leveling nuts shall be provided with each pole. The anchor bolts shall be of the length shown on the plans and have an L-bend on the bottom and shall be threaded at the top.

Before installation, the Contractor shall furnish to the Engineer design details regarding this item. These details shall specify materials and shall include a certification prepared and/or approved by a Professional Engineer who is registered in any of the United States:

- That the design complies with the plans and specifications and meets or exceeds the standards found in *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 4<sup>th</sup> Edition (2001)* with 2003 and 2006 interims.
- That the materials specified in the design meet or exceed the requirements of Subsection 714.02.

The Contractor shall also furnish a certification from the manufacturer or supplier that the traffic signal mast arm and pole were fabricated in compliance with the certified design and that the materials furnished comply with the specifications.

**714.04 Construction Requirements.** The Contractor shall contact the local utility companies to determine the location of underground utilities in the area where the foundations are to be located and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

Excavation, backfill, compaction, and disposal of surplus materials shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to the original condition.

Foundations for the traffic signal mast arm and pole shall be constructed in firm earth to the minimum size and depth shown on the plans. The location of foundations shall be as shown on the plans or as directed by the Engineer. Foundations shall be placed monolithically and have a 1" (25 mm) chamfer at the top.

Conduit, anchor bolts, and ground rods shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Concrete shall be constructed according to Section 802. The exposed portion of the foundation shall be given a Class 2 finish. The area between the top of the foundation and the pole base shall be neatly grouted after the pole has been raked and secured in place. The pole shall not be erected upon the foundation for a minimum of 72 hours after placement of concrete.

Mast arm support poles shall be securely bolted to the foundation in a raked position employing galvanized leveling nuts.

Mast arm support poles shall be effectively grounded by means of a ground rod. The grounding wire shall be attached to the pole using a solderless steel bolt.

Subsequent to erection, any damaged galvanized coating or paint shall be repaired according to Subsection 807.88 or Section 638, as appropriate.

All holes in traffic signal mast arms and poles required for traffic signal cable, controller mountings, etc., shall be machine drilled.

**714.05 Method of Measurement.** Traffic Signal Mast Arm and Pole with Foundation will be measured by the unit.

**714.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Traffic Signal Mast Arm and Pole With Foundation of the arm length specified, which price shall be full compensation for furnishing and installing the pole and arm; for excavation, backfill, compaction, and removal of surplus material; for furnishing and placing reinforcing steel and concrete; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Traffic Signal Mast Arm and Pole With Foundation (___') (___m)	Each

**SECTION 715**  
**TRAFFIC SIGNAL PEDESTAL POLE WITH**  
**FOUNDATION**

**715.01 Description.** This item shall consist of furnishing and erecting steel traffic signal pedestal poles with foundations according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**715.02 Materials.** The following material requirements shall apply to poles and foundations.

(a) The poles shall be constructed of 4" (100 mm) standard steel pipe shaft complying with ASTM A 501 or A 53 Grade B. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(b) Anchor bolts shall comply with AASHTO M 314, Grade 55 (379), including Supplementary Requirement S1. All exposed portions of bolts shall be galvanized according to AASHTO M 232 or ASTM B 695, Class 40 or 50.

(c) Anchor Base Plates shall be AASHTO M 270 Grade 36 (250). Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

(d) Cast Anchor Base Plates shall be AASHTO M 103 Grade 65-35. Galvanizing shall comply with AASHTO M 232.

(e) Hex nuts shall comply with AASHTO M 292 Grade 2H or AASHTO M 291 Grade DH or DH3 (Grade 10S or 10S3). The thread series shall correspond with that of the bolt furnished. Washers shall comply with AASHTO M 293. Galvanizing shall comply with AASHTO M 232 or ASTM B 695, Class 40 or 50. Nuts shall be galvanized by the same process as that of the bolts.

(f) Concrete shall comply with Section 802 for Class S concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall comply with Section 804 for Grade 40 steel.

(g) Ground rods shall be 5/8" (16 mm) diameter or greater Copperweld with ground wire and connections.

(h) When painting is specified on the plans, the pole and base plate shall be painted according to the provisions of Section 638.

**715.03 Fabrication.** The pole shall be constructed to the dimensions shown on the plans. A handhole of sufficient size to allow for internal wiring shall be provided near the pole base. A reinforcing frame for the handhole tapped for a grounding bolt shall be welded into the shaft a short distance from the base.

A cast steel or plate anchor base of the size and shape shown on the plans shall be electrically welded to the bottom of the pole. The anchor base and welding thereto shall develop the full strength of the adjacent shaft.

Four anchor bolts with hex nuts shall be provided with each pole. The anchor bolts shall be of the length shown on the plans and have an L-bend on the bottom and shall be threaded at the top.

Before installation, the Contractor shall furnish to the Engineer design details regarding this item. These details shall specify materials and shall include a certification prepared and/or approved by a Professional Engineer who is registered in any of the United States:

- That the design complies with the plans and specifications and meets or exceeds the standards found in *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 4th Edition (2001)* with 2003 and 2006 interims.
- That the materials specified in the design meet or exceed the requirements of Subsection 715.02.

The Contractor shall also furnish a certification from the manufacturer or supplier that the traffic signal pedestal pole was fabricated in compliance with the certified design and that the materials furnished comply with the specifications.

**715.04 Construction Requirements.** The Contractor shall contact the local utility companies to determine the location of underground utilities in the area where the foundations are to be located and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

Excavation, backfill, compaction, and disposal of surplus materials shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to the original condition.

Foundations for the traffic signal pedestal pole shall be constructed in firm earth to the minimum size and depth shown on the plans. The location of foundations shall be as shown on the plans or as directed by the Engineer. Foundations shall be placed monolithically and have a 1" (25 mm) chamfer at the top.

Conduit, anchor bolts, and ground rods shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Concrete shall be constructed according to Section 802. The exposed portion of the foundation shall be given a Class 2 finish. The area between the top of the foundation and the pole base shall be neatly grouted after installation. The pole shall not be erected upon the foundation for a minimum of 24 hours after placement of concrete.

The pedestal pole shall be securely bolted to the foundation in a perpendicular position, employing galvanized shims if necessary.

Poles shall be effectively grounded by means of a ground rod. Grounding wire shall be attached to the pole using a solderless steel bolt.

Subsequent to erection, any damaged galvanized coating or paint shall be repaired according to Subsection 807.88 or Section 638, as appropriate.

All holes in traffic signal pedestal poles required for traffic signal cable, controller mountings, etc., shall be machine drilled.

**715.05 Method of Measurement.** Traffic Signal Pedestal Poles with Foundation will be measured by the unit.

**715.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Traffic Signal Pedestal Pole With Foundation, which price shall be full compensation for furnishing and installing the pole; for excavation, backfill, compaction, and removal of surplus material; for furnishing and placing reinforcing steel and concrete; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Traffic Signal Pedestal Pole With Foundation	Each

## SECTION 716 TREATED WOOD POLE

**716.01 Description.** This item shall consist of furnishing and installing treated wood poles and accessories of the class and size called for at the locations shown on the plans, or as directed by the Engineer.

**716.02 Materials.** The poles shall be selected for straightness. All poles shall comply with AWPA Standard U1, Commodity Specification D, to the requirements of Use Category UC4B for pentachlorophenol or copper chromated arsenate treated poles. The Contractor shall furnish a certification that the poles furnished comply with AWPA Standard U1, Commodity Specification D, to the requirements of Use Category UC4BC1.

**716.03 Construction Requirements.** The Contractor shall contact the local utility companies to determine the location of underground utilities in the area where the poles are to be installed and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

Guy wires shall be installed when shown on the plans.

Excavation, backfill, compaction, and disposal of surplus materials shall be accomplished to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be restored to the original condition.

**716.04 Method of Measurement.** Treated Wood Poles will be measured by the unit.

**716.05 Basis of Payment.** Treated Wood Poles placed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Treated Wood Pole of the class and size specified, which price shall be full compensation for excavation, backfill, and compaction; for furnishing all materials, guy wires, fittings, and clamps; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Treated Wood Pole (Class __, __ft. [__m])	Each

**SECTION 717**  
**TRAFFIC SIGNAL EQUIPMENT PERFORMANCE**  
**TEST**

**717.01 Description.** This item shall consist of providing a 6 month guarantee and proving the soundness of all traffic signal equipment and related electrical components installed at each location according to these specifications and at locations shown on the plans or as directed.

The Contractor shall conduct a performance test, which shall consist of a continuous 30 day period of operation without a major malfunction. A major malfunction is considered to be any occurrence, other than a power failure beyond the Contractor's control, that renders the installation inoperative either momentarily or for a longer period. Lamp burnouts are not considered a major malfunction unless 2 or more bulbs in the same socket burn out within the 30 day period.

The Contractor shall obtain and assign to the Department transferable manufacturers' warranties or guarantees on all electrical and mechanical equipment, consistent with those provided as customary practice. The Contractor shall guarantee satisfactory in-service operation of the mechanical and electrical equipment and related components for a period of 6 months following completion of the 30 day performance test, at no cost to the Department.

Defective equipment or accessories shall be repaired or replaced according to applicable specifications and to the satisfaction of the Engineer, within a reasonable period of time during the 30 day performance test and the 6 month guarantee period.

**717.02 Method of Measurement and Basis of Payment.** Work completed and accepted under this item will not be measured and paid for directly but will be considered a part of the traffic signal equipment involved at each installation. Partial payments will be made as the various items of work are satisfactorily completed and accepted by the Engineer. Final acceptance and processing of the final estimate will be made after the 6 month guarantee period.

## SECTION 718 REFLECTORIZED PAINT PAVEMENT MARKING

**718.01 Description.** This item shall consist of furnishing and placing reflectORIZED paint pavement markings, including words, arrows, and emblems, of the color and type specified, and the removal of pavement markings, all in accordance with these specifications and to the dimensions and at the locations shown on the plans or as directed.

The markings are to be placed under existing traffic conditions. The work shall meet the requirements of the MUTCD except as modified by these specifications.

In lieu of painted markings, the Contractor may substitute Permanent Pavement Marking Tape meeting the requirements of Section 720 for Type 2, 3, or 5, or Thermoplastic Pavement Marking meeting the requirements of Section 719. Payment will be made at the contract unit prices bid for painted markings.

**718.02 Materials.** The paint shall be a ready mixed white and yellow paint suitable for application on concrete and bituminous pavements. All paints used for this application shall be listed on the QPL. The manufacturer shall furnish a certification for each lot certifying that the materials supplied conform to all the requirements specified and stating that the material is formulated the same as the material tested for QPL listing. Random samples may be taken and tested by the Department. The paint shall be a waterborne acrylic emulsion polymer paint or a cold weather waterborne acrylic emulsion polymer paint.

The paint shall have the property of angular reflectivity and shall be suitable as a binding medium for glass beads placed on the surface of the wet paint in the amount of not less than 8 pounds per gallon (0.93 kg/L). It shall be homogeneous and well ground, shall not settle badly, and shall be readily broken up with a paddle to a smooth, uniform consistency. It shall be free from foreign matter and shall dry within the specified time to a tough serviceable film. The paint shall be properly strained during the final filling of containers and not more than 1% of coarse particles and skins shall be retained on a #325 (0.045 mm) sieve when tested according to ASTM D185.



All materials used in the manufacture of these paints shall meet the requirements herein specified. Minor ingredients not specifically covered will be left to the discretion of the manufacturer except that the finished product shall not be adversely affected. The suitability of raw materials from different sources for use in these paints will be the responsibility of the manufacturer. Reactive or unstable products causing excessive viscosity or container instability will be cause for rejection of the paint. Cold weather waterborne acrylic emulsion polymer paint does not have to meet the Raw Materials requirements of paragraph (b), Raw Materials for Vehicles (Waterborne), subparagraphs (1) and (2) of paragraph (c) Physical Requirements of the Finished Pavement (Waterborne) except for Grind, Laboratory Dry Time, and Dry Through, or the Waterborne Acrylic Emulsion Paint Formulation table requirements.

The paint shall conform, on a weight basis, to the composition requirements of the formulation as closely as accepted good paint practice will permit. No intentional variation will be permitted except for replacement of volatiles lost in processing. Recognized test procedures will be used by the Department to determine the composition of the finished paint.

Paint components shall conform to the following requirements:

**(a) Raw Materials for Pigments (Waterborne)**

(1) Rutile Titanium Dioxide shall comply with the latest revision of ASTM-D-476, Type II.

(2) Calcium Carbonate shall comply with the latest revision of the specification for Calcium Carbonate Pigments, ASTM D 1199, Type GC, Grade 1, with minimum of 95% Calcium Carbonate and Type PC, minimum 98% Calcium Carbonate.

(3) Yellow Iron Oxide shall comply with the latest revision of ASTM D768 and will only be allowed from Harcors (YLO-2288D) or OSO Iron Oxide (OSO440).

(4) Pigment Yellow 65 will only be allowed from Hoechst Celanese, Engelhard, or Sun Chemical.

(5) The pigments used for the pavement marking material compound shall not contain any compounds that will exceed the values listed in the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1.

**(b) Raw Materials for Vehicles (Waterborne)**

**(1) Acrylic Emulsion Polymer:** The non-volatile portion of the vehicle shall be composed of a 100% acrylic polymer or 100% styrene acrylic polymer and shall not be less than 44.0% by weight. Acrylic emulsion polymer shall be Rohm and Haas E 3427, Dow DT 250NA, or equal as determined by the Division Engineer, Materials.

**(2) Glycol:** Propylene Glycol - ASTM D5164, or Ethylene Glycol - ASTM D2693.

**(3) Water:** Potable

**(4) Miscellaneous Materials:**

(a) Dispersant - Tamol 850, Colloids 226-35.

(b) Surfactant - Triton X405, Igepal CA407.

(c) Defoamer - Foamaster 111, Drew 493, Colloids 654.

(d) Hydroxy Ethyl Cellulose – Natrosol 250 HBR, Bermocoil E431FQ.

(e) Coalescent - Texanol.

(f) Preservative - Troy 192, Dowicil 75, Nuosept 101.

**(c) Physical Requirements of the Finished Paint (Waterborne)**

**(1) Pigment Composition.** Analysis of the extracted pigment shall conform to the following requirements:

	Percent by Weight	
	White	Yellow
Organic Yellow 65	---	Min. 7.5*
Titanium Dioxide	Min. 13.4	Min. 5.5
Calcium Carbonate	Max. 86	Max. 87
Yellow Iron Oxide	---	Min. 0.3

\*To be determined by x-ray fluorescence, color spectrophotometry, or any other method the Department may choose. This may be sent to an outside agency or organic pigment manufacturer. It also may include audit of the manufacturer's invoices, batch tickets, inventory or any other means determined by the Department.

**(2) Physical Properties.**

% Total Solids by weight, minimum	73
% Volume Solids, minimum	58

% Pigment by weight	49-54
% Vehicle by weight	46-51
% Non-volatile in Vehicle by weight, minimum	44
Weight per gallon, lbs. (per liter, kg)	±0.30 Theo.or ±0.10 by split weight (±0.04) Theo. or ±0.01 by split weight
Viscosity, 77°F (25°C), Krebs Units	83-98
Grind (Hegman Gage), minimum	3
Laboratory Dry Time, ASTM D 711, minutes, max.	10
pH, minimum	9.6
Dry Through	130 minutes, maximum*

\*No more than 15 minutes longer than the specifiers reference paint film

**(3) Color.** The color after drying shall (for white) be a flat white, free from tint, furnishing good opacity and visibility under both daylight and artificial light. For yellow, the color shall closely match Color Chip 33538 of Federal Standard 595 and be  $\pm 6\%$  from the PR 1 chart central color when read over the black portion of a 2A Leneta Chart or equal.

**(4) Flexibility and Adhesion.** The paint shall adhere firmly and shall not show any evidence of cracking or flaking when a 15 mil (380  $\mu\text{m}$ ) wet thickness is tested according to AHTD Test Method 701.

**(5) Water Resistance.** The paint shall show no adhesion loss or blistering when a 15 mil (380  $\mu\text{m}$ ) wet film thickness is tested according to AHTD Test Method 701.

**(6) Heat Stability.** The paint shall show no coagulation, discoloration or change in consistency greater than 10 Krebs Units, when tested according to Federal Specification TT-P-1952B.

**(7) Dilution Test.** The paint shall be capable of dilution with water at all levels without curdling or precipitation such that the wet paint can be readily cleaned up with water only.

**(8) Storage Stability.** After 30 days storage in three-quarters filled, closed container, the paint shall show no caking that cannot be readily remixed to a smooth, homogeneous state, no skinning, livering, curdling, or hard settling. The viscosity shall not change more than 5 Kneb Units from the viscosity of the original sample.

**(9) Contrast Ratio.** The minimum contrast ratio shall be 0.96 when drawn down at a wet film thickness of 15 mils (380 $\mu$ m) on a 2A Leneta Chart or equal, air dried for 24 hours, and tested according to AHTD Test Method 701. Contrast Ratio = Black/White.

**(10) Luminance Factor.** The daylight luminance factor (Y%) of the white paint shall not be less than 84% and not less than 50% for yellow paint of a 15 mil (380  $\mu$ m) wet film applied to a 2A Leneta Chart or equal. After drying 24 hours, measure the reflectance of the paint over the black portion of the chart using ASTM E 1347 with CIE illuminant D65 and the 1931 CIE 2° standard observer.

**(11) Bleeding Ratio.** The paint shall have a minimum bleeding ratio of 0.97 when tested according to Federal Specification TT-P1952B, except the asphalt saturated felt shall be Standard 15# roofing felt with evaluation in accordance with ASTM E 1347. The paint shall not check or crack on asphalt saturated 15# felt indicating unsuitability for use on fresh asphalt overlays. Any checking or cracking on the felt or on fresh asphalt cores will be cause for rejection.

**(12) Dry Through Time.** The paint shall be applied to a non-absorbent substrate at a wet film thickness of 15 mils  $\pm$  1 mils (380  $\pm$  25  $\mu$ m) and placed in a humidity chamber controlled at 90  $\pm$  5% R.H. and 72.5°F  $\pm$  2.5°F (22.5°  $\pm$  1.4°C). The dry through time shall be determined according to ASTM D 1640, except that the pressure exerted shall be the minimum needed to maintain contact with the thumb and film.

**WATERBORNE ACRYLIC EMULSION  
PAINT FORMULATION**

	WHITE		YELLOW	
	lbs. Per 100 gal.	kg per 100 Liters	lbs. Per 100 gal.	kg per 100 Liters
C.I. Pigment Yellow 65	--	--	50	6.0
Titanium Dioxide, Rutile, Type II	100	12.0	40	4.8
Yellow Iron Oxide	--	--	2	0.2
Calcium Carbonate, Type PC	150	18.0	125	15.0
Calcium Carbonate, Type GC	430	51.5	450	53.9
Hydroxy Ethyl Cellulose	0.5*	0.06*	0.3*	0.04*
Acrylic Emulsion, 50% Solids (E-3427 or DT 250NA)	541	64.8	540	64.7
Texanol	23	2.8	23	2.8
Defoamer	5	0.6	6	0.7
Dispersant	8	1.0	10	1.2
Surfactant	2	0.2	2	0.2
Preservative	1.5	0.18	1.5	0.18
Water	20	2.4	20	2.4
Ethylene Glycol or Propylene Glycol	25	3.0	25	3.0
<b>TOTAL</b>	1306	156.54	1294.8	155.12

\*Hydroxy Ethyl Cellulose amount may be varied by up to 0.01 kg (0.1 pound) to adjust viscosity to desired range.

**(g) Glass Beads. (1) General:** The glass beads furnished shall be moisture resistant, free flowing, AASHTO M 247, Type 1 beads with a silane adhesion coating conforming to the specific test requirements herein. A written certification of compliance shall be furnished by the manufacturer for each batch furnished.

**(2) Specific Requirements:**

**(a)** Turn on UV light of intensity 7000 UM/CM (Fisher Scientific Model B-100-R) at least 30 minutes prior to test.

**(b)** Prepare a solution by weighing 0.2 grams of dansyl chloride and dissolving in 25 ml of acetone. This solution can be used for several tests during the day, but must be kept refrigerated in a closed dark container between uses. Make a fresh solution daily.

(c) Weigh 10 grams of beads and place on a filter paper in a Buchner funnel.

(d) Saturate the glass bead sample with dansyl chloride solution using an eyedropper.

(e) Place in a 140° F (60° C) oven for 15 minutes and then rinse off the excess reagent by pouring 100 ml of acetone over the beads in the funnel. Suction should be on during this step. All yellow color must be removed from the bead surface.

(f) Allow the beads to dry at room temperature for 5 - 10 minutes.

(g) Place glass beads on glass filter paper and inspect under UV light. Inspection must be in a dark room. A yellow-white fluorescence will be observed with properly adherence-coated beads. If no fluorescence is observed, test should be rerun using fresh solution of dansyl chloride.

**718.03 Construction Requirements.** Reflectorized paint shall be applied to clean, dry, and dirt-free surfaces. The paint shall be applied at a minimum wet film thickness of 15 mils (380 µm) (a minimum of 16.5 gallons per mile [40 L/km] of 4" [100 mm] line). Glass beads shall be placed on the surface of the wet paint in the amount of not less than 8 pounds per gallon (0.93 kg/L). The Contractor will be responsible for any necessary cleaning of surfaces before paint application.

Spotting the pavement for center line location on two-way roadways is required. It will be the responsibility of the Contractor to spot using a string line or chain so that spots are placed at intervals not exceeding 10' (3 m). The Department will establish the no passing zones if required. On one-way roadways spotting is required for the initial edge line or lane line placed. Edge lines and/or lane lines may be installed by referencing to center or lane lines. Edge lines shall not be broken for driveways.

The finished lines shall have well defined edges, shall be uniform in thickness, and shall be straight and true. No stripe shall be less than the specified width. Any corrections of variations in width or alignment of the stripes shall not be made abruptly. Lines that

cannot be corrected to meet these requirements shall be removed in accordance with Section 604 at the Contractor's expense.

Line removal as specified on the plans shall be performed in such a manner that no conflicting pavement marking will be left in place. Removal of the pavement marking by a means that will gouge the surface will not be permitted.

The Contractor shall use only workers experienced in installing paint markings.

**718.04 Method of Measurement.** (a) Reflectorized paint pavement markings will be measured by the linear foot (meter) of marking actually placed.

(b) Reflectorized paint pavement marking words and arrows will be measured by the unit.

(c) Reflectorized paint railroad emblems will be measured by the unit. Each unit shall consist of the R's, the X, the transverse lines and the stop line at the track.

(d) Removal of pavement markings of all types will be measured and paid for under Section 604.

**718.05 Basis of Payment.** (a) **Reflectorized Paint Pavement Marking.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Reflectorized Paint Pavement Marking of the width specified, which price shall be full compensation for furnishing and installing markings; for surface preparation; and for all labor, equipment tools, and incidentals necessary to complete the work.

(b) **Reflectorized Paint Pavement Marking (Words), (Arrows), and (Railroad Emblems).** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Reflectorized Paint Pavement Marking (Words), (Arrows), and (Railroad Emblem), which price shall be full compensation for furnishing and installing Words, Arrows, and Railroad Emblems; for surface preparation; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Reflectorized Paint Pavement Marking White (___") (___mm)	Linear Foot (Meter)
Reflectorized Paint Pavement Marking Yellow (___") (___mm)	Linear Foot (Meter)
Reflectorized Paint Pavement Marking (Words)	Each
Reflectorized Paint Pavement Marking (Arrows)	Each
Reflectorized Paint Pavement Marking (Railroad Emblem)	Each

## **SECTION 719 THERMOPLASTIC PAVEMENT MARKING**

**719.01 Description.** This item shall consist of furnishing and placing thermoplastic or heat-fused, preformed thermoplastic pavement markings, including words, arrows, and emblems, of the color and type specified, and the removal of pavement markings, all according to these specifications and in conformity with the dimensions and at the locations shown on the plans or as directed.

The markings are to be placed under existing traffic conditions. The work shall comply with the MUTCD except as modified by these specifications.

**719.02 Materials.** The material used shall be a product especially compounded for traffic markings and be listed on the Department's Qualified Products List. Each container shall be clearly and adequately marked to indicate the color, weight, batch or lot number, and type of material.

The material shall meet the requirements of AASHTO M 249 with the following exceptions on yellow materials:



Color Specifications							
Color Specification Limits – Daytime Initial							
Chromaticity Coordinates							
1		2		3		4	
x	y	x	y	x	y	x	y
0.499	0.466	0.545	0.455	0.518	0.432	0.485	0.454
Luminance Factor, Y(%)							
Minimum				Maximum			
40.0				60.0			

Initial daytime color determination will be made in accordance with AASHTO T 250. Values shall be evaluated on material without the drop-on beads.

Color Specifications Limits – Daytime Retained							
Chromaticity Coordinates							
1		2		3		4	
x	y	x	y	x	y	x	y
0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400

Retained daytime color limits shall conform to the specifications for a minimum of ninety days for construction pavement markings and one year for all other markings. Retained readings will be determined on a beaded surface in accordance with the requirements of ASTM E 2366.

Color Specifications Limits – Nighttime Initial with drop-on beads							
Chromaticity Coordinates							
1		2		3		4	
x	y	x	y	x	y	x	y
0.575	0.425	0.508	0.415	0.473	0.453	0.510	0.490

Initial nighttime color limits will be determined in accordance with the requirements of ASTM E 2367 on a beaded surface.

The pigments used for the pavement marking material compound shall not contain any compounds that will exceed the values listed in the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1.

Heat-fused, pre-formed thermoplastic pavement marking material shall meet the requirements of AASHTO M 249 with the exception of the relevant differences due to the material being pre-formed.

The material shall not break down or deteriorate if held at the plastic temperature for a period of 4 hours nor by reason of 4 re-heatings to the plastic temperature. The temperature-viscosity characteristics of the thermoplastic material shall remain consistent and there shall be no obvious change in the color of the material.

The material shall not deteriorate by contact with sodium chloride, calcium chloride, or other chemical formations on the roadway or streets, or because of the oil contact on pavement material, or from oil droppings from traffic.

After application and proper drying time, material shall show no appreciable deformation nor discoloration under local traffic conditions and in air or road temperatures ranging from 0° F (-18° C) to 160° F (71° C). The material shall not smear or spread under normal traffic conditions at temperatures below 160° F (71° C).

Under this specification, the term "drying time" shall be defined as the minimum elapsed time after application when the pavement marking shall have and retain the characteristics required in the preceding paragraphs. In addition, the drying time shall be established by the minimum elapsed time after application when traffic will leave no impression or imprint on the applied marking. The drying time shall not exceed a characteristic straight-line curve, the limits of which are 2 minutes at 50° F (10° C) and 15 minutes at 90° F (32° C), measured at a maximum relative humidity of 70%.

The pavement markings shall maintain its original dimension and placement. The exposed surface shall be free of tack. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping or cracking. The material shall not be slippery when wet and it shall not lift from the pavement in freezing weather.

The marking shall have a uniform cross section. The density and character of the material shall be uniform throughout its thickness and shall be completely reflectorized both internally and externally.

The glass beads used for the drop-on application shall meet AASHTO M 247 with a Type I gradation and shall be suitably treated to resist moisture and retain free flow properties. Beads shall not be specially treated to enhance flotation.

**719.03 Construction Requirements.** The thermoplastic compound shall be screed or ribbon extruded to the pavement surface. Heat-fused, pre-formed pavement markings shall be fusible to asphalt or Portland cement concrete surfaces by means of the normal heat of a propane weed-burner type of torch or other heating device as recommended by the manufacturer.

The equipment used to apply the thermoplastic compound onto the pavement shall be suitably equipped for heating and controlling the flow of the material. The equipment shall be constructed to provide continuous mixing and agitation of the material. The conveying parts of the equipment, between the main material reservoir and applicator, shall be so constructed as to prevent accumulation and clogging. The equipment shall be constructed so that all mixing and conveying parts, up to and including the applicator, maintain the material at the plastic temperature. The thermoplastic material shall be dispensed at a temperature recommended by the manufacturer. The applicator shall include a cutoff device remotely controlled to provide clean, square stripe ends and to provide a method for applying skip lines.

The thermoplastic reservoir shall be insulated and equipped with an automatic thermostatic control to maintain the proper temperature of the material.

The thermoplastic machine shall comply with the requirements of the National Board of Fire Underwriters.

Beads applied to the surface of the completed stripe shall be applied by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are immediately dispensed upon the completed line. The bead dispenser shall be equipped with an automatic cutoff control, synchronized with the cutoff of the pavement marking equipment. The beads shall be automatically applied at a minimum uniform rate of 8 pounds (39 kg) of glass beads to every 100 square feet (100 sq m) of surface.

Heat-fused, pre-formed pavement markings shall be instantly highly reflective without the application of additional glass beads.

Thermoplastic markings shall not be applied to the pavement surface when the pavement surface temperature is less than 50° F (10° C) or when the pavement surface shows evidence of moisture.

On new concrete pavements where no pavement markings exist or on existing concrete or asphalt pavements where the existing pavement markings are paint or thermoplastic and do not conflict with the proposed pavement markings, blasting with water or sand or a combination thereof will be required to remove any curing compound, oxidized paint or thermoplastic, or dirt to ensure a good bond. This blasting is considered surface preparation. On newly constructed asphalt pavements any sand, grit, or other surface contaminants must be removed using compressed air and/or sweeping. Water blasting may be necessary to remove surface contaminants which cannot be removed by the use of compressed air and/or sweeping. This work is considered surface preparation.

Conflicting pavement markings that exist shall be removed by blasting with water and/or sand or by grinding. This blasting or grinding is considered pavement marking removal.

The thickness of thermoplastic markings above the roadway surface shall be 90 mils (2.3 mm) (a minimum of 1584 pounds per mile [446 kg/km] of 4" [100 mm] line). The thickness will be measured by a device supplied by the Contractor during the course of the project capable of measuring the thickness of the marking as installed on the pavement. The minimum thickness, as required above, will be measured in the center of the line when gauged by the equipment described above. The minimum thickness 1/2" (12 mm) from the edges shall not be less than 75% of the thickness required in the center. Maximum thickness of markings is 3/16" (5 mm).

Heat-fused, pre-formed pavement markings shall be supplied with a minimum average thickness of 90 mils (2.3 mm) before application on the roadway surface.

On concrete pavements, paint pavement markings according to Section 718 shall be applied as a primer for the thermoplastic markings, except where thermoplastic markings are to be applied over existing thermoplastic markings. Paint applied to concrete pavement solely as a primer will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items of

Thermoplastic Pavement Markings. A primer other than paint may be used when recommended by the thermoplastic manufacturer.

A primer is not required for asphalt pavements, but paint pavement markings complying with Section 718 may be used by the Contractor as a primer at no cost to the Department.

When temperature limitations prohibit placement of thermoplastic markings within the 3 or 14 day limit specified in Section 604, the Contractor shall place painted markings according to Section 718. Painted markings required due to temperature limitations will be measured and paid for under Section 604. In this case, the Contractor shall maintain the painted markings at no additional cost to the Department until the thermoplastic markings, including primer if required, are installed.

Spotting the pavement for center line location on two-way roadways is required. It will be the responsibility of the Contractor to spot using a string line or chain so that spots are placed at intervals not exceeding 10' (3 m). The Department will establish the no passing zones if required. On one-way roadways spotting is required for the initial edge line or lane line placed. Edge lines and/or lane lines may be installed by referencing to center or lane lines. Edge lines shall not be broken for driveways. The trace of the thermoplastic line shall be uniform.

The finished lines shall have well defined edges, shall be uniform in thickness, and shall be straight and true. No stripe shall be less than the specified width. Any corrections of variations in width or alignment of the stripes shall not be made abruptly. Lines that cannot be corrected to meet these requirements shall be removed in accordance with Section 604 at the Contractor's expense.

Line removal as specified on the plans shall be performed in such a manner that no conflicting pavement marking will be left in place. Removal of the pavement marking by a means that will gouge the surface will not be permitted.

The Contractor shall use only workers experienced in installing thermoplastic markings.

**719.04 Method of Measurement.** (a) Thermoplastic Pavement Markings will be measured by the linear foot (meter) of line of the width specified actually placed.

(b) Thermoplastic words and arrows will be measured by the unit.

(c) Thermoplastic railroad emblems will be measured by unit. One unit shall consist of both R's; the X; the transverse lines; and the stop line near the track.

(d) Sand or water blasting in surface preparation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Thermoplastic Pavement Marking.

(e) Removal of pavement markings will be measured and paid for under Section 604.

(f) Thermoplastic bike emblems will be measured by the unit. One unit shall consist of the words "BIKE" and "ONLY", and the diamond emblem as shown in the plans.

**719.05 Basis of Payment. (a) Thermoplastic Pavement Markings.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Thermoplastic Pavement Markings of the width specified, which price shall be full compensation for furnishing and installing markings; for surface preparation; and for all labor, equipment, tools, furnishing thickness gauge, and incidentals necessary to complete the work.

**(b) Thermoplastic Pavement Marking (Words), (Arrows), (Railroad Emblems), and (Bike Emblems).** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Thermoplastic Pavement Marking (Words), (Arrows), (Railroad Emblems), and (Bike Emblems) which price shall be full compensation for furnishing and installing Words, Arrows, Railroad Emblems; and Bike Emblems for surface preparation; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Thermoplastic Pavement Marking White (___") (___mm)	Linear Foot (Meter)
Thermoplastic Pavement Marking Yellow (___") (___mm)	Linear Foot (Meter)

Thermoplastic Pavement Marking (Words)	Each
Thermoplastic Pavement Marking (Arrows)	Each
Thermoplastic Pavement Marking (Railroad Emblems)	Each
Thermoplastic Pavement Marking (Bike Emblems)	Each

## SECTION 720

### PERMANENT PAVEMENT MARKING TAPE

**720.01 Description.** This item shall consist of furnishing and installing retroreflective preformed pavement markings (RPPM) according to these specifications and in conformity with the types, dimensions, and lines shown on the plans or as directed by the Engineer.

The markings are to be placed under local traffic conditions and nothing in this specification shall be construed as waiving this basic requirement. The work shall comply with the MUTCD.

The retroreflective preformed pavement markings (RPPM) shall be listed on the Department's Qualified Products List.

**720.02 Materials.** The RPPM shall be one of five types, of various compositions for various applications as specified.

Type 1 - Retroreflective preformed pavement marking film for preformed markings subjected to moderate traffic volumes.

Type 2 - Retroreflective pliant polymer preformed pavement marking film for preformed markings subjected to high traffic volumes and severe wear conditions.

Type 3 - Retroreflective pliant polymer preformed pavement marking tape for preformed markings subjected to extremely high traffic volumes and severe wear conditions.

Type 4 - Retroreflective pliant polymer preformed pavement marking tape (removable) for preformed markings shall meet the requirements of ASTM D 4592, Type I.

Type 5 - Retroreflective preformed pavement marking film for marking subjected to high traffic volumes and repeated shear action

from crossover or encroachment or from stop, start or turn movements.

**(a) General.** The preformed markings shall consist of white or yellow tape or film with pigments selected and blended to conform to standard highway colors through the expected life of the markings. Glass beads shall be incorporated to provide immediate and continuing retroreflection.

The size, quality and refractive index of the glass beads shall be such that the performance requirements for the markings shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched with a thumbnail.

The preformed markings shall be capable of adhering to asphalt concrete or portland cement by a pre-coated pressure sensitive adhesive. A primer may be used to precondition the pavement surface according to the manufacturer's recommendations. The preformed markings shall mold to pavement contours by the action of traffic. The pavement markings also shall be capable of being inlaid on new, dense graded asphalt concrete wearing courses during the paving operation according to the manufacturer's instructions. After application, the markings shall be immediately ready for traffic.

**(b) Composition.** Type 1 retroreflective preformed pavement marking film shall consist of glass beads embedded in a white or yellow film with a thin, flexible conformable backing that is pre-coated with a pressure sensitive adhesive. The film without adhesive shall have a minimum thickness of 0.012" (0.30 mm).

Type 2 retroreflective pliant polymer preformed pavement marking film shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a reflective layer of beads bonded to the top surface. The film without adhesive shall have a minimum thickness of 0.060" (1.5 mm).

Type 3 retroreflective pliant polymer preformed marking tape shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a reflective layer of ceramic beads embedded into the waffle-patterned surface. The tape without adhesive shall have a minimum thickness of 0.065" (1.65 mm) at the thickest



portion of the cross-section and a minimum of 0.020" (0.5 mm) at the thinnest portion of the cross-section.

Type 4 retroreflective pliant polymer preformed marking tape (removable) shall consist of a mixture of high quality polymeric materials and pigments. The tape shall be reinforced with a medium to facilitate removal and pre-coated with pressure sensitive adhesive.

Type 5 retroreflective preformed pavement marking film shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a reflective layer of beads bonded to the top urethane wear surface. The film shall have a pre-coated pressure sensitive adhesive.

**(c) Reflectance.** The white and yellow films shall comply with ASTM D 4505 reflectivity with Type 1 meeting Reflectivity Level II, and Type 2, 3, and 5 complying with Reflectivity Level I. Type 3 tapes shall exhibit a minimum retained reflectance value at 1.05° observation and 88.76° entrance angle of 100 mcd/ft<sup>2</sup>/fc (mcd/m<sup>2</sup>/lux) for a period of 36 months from the date of installation regardless of daily traffic volumes, when used in longitudinal lines. Type 4 tape shall comply with the requirements of ASTM D 4592.

**(d) Skid Resistance.** The surface of the markings shall provide an initial minimum skid resistance value of 45 BPN when tested according to AASHTO T 278.

**720.03 Construction Requirements.** The placement of the RPPM shall comply with the manufacturer's recommendations.

For Type 1 marking the minimum air and pavement temperature shall be 45° F (7° C) and rising before installation is allowed.

For Types 2, 3, and 5 markings, the air temperature shall be a minimum of 60° F (16° C) and rising or a minimum road temperature of 70° F (21° C). For Type 4 removable markings, the air, tape, and pavement temperature shall be 50° F (10° C) and rising.

When temperature limitations prohibit placement of Type 1, 2, 3, or 5 markings within the 3 or 14 day limit specified in Section 604, the Contractor shall place painted markings according to Section 718. Painted markings required due to temperature limitations will be measured and paid for under Section 604. In this

case, the Contractor shall maintain the painted markings at no additional cost to the Department until the RPPM is installed.

The roadway surface shall be cleaned by the Contractor with high pressure air or by sweeping. The roadway shall then be marked where the pavement marking polymer is to be applied.

The polymer can then be applied by hand or with a manual or mechanical highway tape applicator designed for that purpose. Only butt splices will be allowed with no overlapping.

After application, firmly tamp the tape with a minimum 200 lbs. (90 kg) load or by slowly (2-3 mph [3-5 km/h]) driving over the tape with a vehicle tire. Do not twist the tamping device on the tape. The Contractor shall ensure that all edges are firmly adhered.

Spotting of the center line and lane line locations, if required, shall be the responsibility of the Contractor. Establishment of no passing zones, if required, will be done by the Department and will be completed at such time as the Contractor begins work. Edge lines shall not be broken for driveways. The trace of the line shall be uniform.

All conflicting existing markings shall be removed according to Section 604.

**720.04 Method of Measurement.** (a) Permanent Pavement Marking Tape will be measured by the linear foot (meter) of the color, width, and type specified.

(b) Permanent Pavement Marking Tape (Words) and (Arrows) will be measured by the unit.

(c) Permanent Pavement Marking Tape (Railroad Emblems) will be measured by the unit. One unit shall consist of both R's; the X; the transverse lines; and the stop line near the track.

Removal of permanent pavement markings will be measured and paid for under Section 604. Removal of Type 4 (Removable) Tape will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Permanent Pavement Marking Tape (Type 4).

**720.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Permanent Pavement Marking

Tape of the color, width, and type specified, or per each for Permanent Pavement Marking Tape (Words), (Arrows), or (Railroad Emblems), of the type specified, which price shall be full compensation for furnishing and installing the markings, for removal of Type 4 (Removable) tape, and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Permanent Pavement Marking Tape (Color, Width, Type___)	Linear Foot (Meter)
Permanent Pavement Marking Tape (Words)(Type___)	Each
Permanent Pavement Marking Tape (Arrows)(Type___)	Each
Permanent Pavement Marking Tape (Railroad Emblems)(Type___)	Each

**SECTION 721  
RAISED PAVEMENT MARKER**

**721.01 Description.** This item shall consist of furnishing and installing raised pavement markers according to these specifications and at the locations shown on the plans or as directed.

**721.02 Materials.** The markers shall conform to the shape and dimensions shown on the plans.

Pavement markers shall be of the type and color shown on the plans or as specified herein.

**(a) Type of Markers.** Pavement markers shall be one of the following types:

- Type I - One-Way (Color) Reflective Markers
- Type II - Two-Way (Color/Color) Reflective Markers

**(b) Packaging and Storage.** Pavement markers shall comply with the following packaging and storage requirements.

**(1) Packaging.** Each package shall be clearly marked as to the name of the manufacturer, type, color, quantity enclosed, lot number, and date of manufacture.

**(2) Storage.** Markers shall be stored indoors and shall be protected from any source of moisture both during shipment to the project site and at the project site. The markers shall be maintained at a temperature high enough to preclude moisture condensation, and, at the time of placement, both the markers and their containers shall be dry.

**(c) Reflective Pavement Markers.** Reflective pavement markers shall be one of the following types:

- Prismatic reflector type, consisting of methyl methacrylate (MM) or suitable compounded acrylonitrile butadiene styrene (ABS) shell filled with a mixture of an inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and contain one or two methyl methacrylate prismatic reflector faces with thin, untempered glass bonded to the faces to provide an extremely hard and durable abrasion-resistant surface. The glass is not required on the red faces of two-way (Clear/Red) reflective markers. The infrared curves of the compounded MM or ABS shells shall match approved curves on file in the Materials Division.
- High performance micropismatic lens type, consisting of a polycarbonate lens with independent lens cells and a ceramer lens coating. The marker shall consist of hermetically sealed components in a fiber reinforced polycarbonate body with finger grip indentations for ease of handling.

The base of the marker shall be flat (the deviation from a flat surface shall not exceed 0.05" [1.3 mm]), rough textured, and free from gloss or substances that may reduce its bond to the adhesive.

Raised pavement markers shall meet the requirements of ASTM D 4280.

**(d) Adhesives.**

**(1) Epoxy Adhesives.** The epoxy adhesives shall comply with all the requirements of either Type I, Rapid Setting, High

Viscosity Epoxy Adhesive or Type II, Standard Setting, High Viscosity Epoxy Adhesive as specified in AASHTO M 237.

**(2) Bituminous Adhesive for Pavement Markers.**

Bituminous adhesive shall be an asphalt material with a homogeneously mixed filler formulated primarily for use in bonding pavement markers to Portland cement concrete and asphalt concrete. The adhesive must be heated to a liquid state for application.

The epoxy adhesive and/or the bituminous adhesive shall be listed on the QPL.

**721.03 Construction Requirements.** Existing raised pavement markers shall be removed prior to the placement of any overlay or seal course. On pavements that are not to be overlaid or sealed, existing raised pavement markers which are damaged or which conflict with the new markers shall be removed as directed by the Engineer. Removal of existing pavement markings will not be paid for separately but will be considered subsidiary to other items of the work.

The surface to which the marker is to be bonded shall be free of dirt, curing compound, grease, oil, moisture, paint, and any other material that would adversely affect the bond of the adhesive. The adhesive shall be placed uniformly on the surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been pressed into place. Markers utilizing epoxy shall be placed in position and pressure applied until firm contact is made with the pavement. Markers with bituminous adhesive shall have a minimum adhesive pad thickness of 3/32" (2.4 mm) after installation. Viscosity of the bituminous material shall be such that flow about the periphery of the marker does not exceed 1½" (38 mm). Excess epoxy adhesive around the edge of the marker, excess adhesive on the pavement, and adhesive on the exposed surfaces of the markers, shall be immediately removed using a solvent and procedure recommended by the manufacturer of the markers. No other solvent shall be used. The marker shall be protected against impact until the adhesive has sufficiently set to resist movement.

Epoxy adhesive requires that the mixing operation and placing of the markers be performed rapidly. Just before use, components A and B shall be mixed in a 1:1 ratio by volume. When automatic proportioning and mixing machines are used, the temperature of the components shall be maintained by indirect heating or cooling, if required, for the adhesive to meter, mix, and extrude properly. The maximum temperature shall be such that after proper mixing, there shall be no excess flow of adhesive from under the marker other than that previously specified.

When hand mixing the Standard Set Type adhesive, not more than 1 quart (1 liter) shall be mixed at one time, and the markers shall be aligned and pressed into place within 5 minutes after mixing operations are started. Any mixed batch that becomes so viscous that the adhesive cannot be readily extruded from under the marker on application of slight pressure shall not be used.

Rapid Set Type adhesive shall not be mixed by hand. This adhesive shall be mixed by a 2 component type automatic mixing and extrusion apparatus.

When machine mixing the Standard Set Type adhesive or the Rapid Set Type adhesive, the markers shall be placed within 60 seconds after the adhesive has been mixed and extruded and no further movement of the marker will be allowed. In addition, no more than 90 seconds shall be permitted between the time the adhesive is pumped into the mixing head and the time this adhesive is in place on the roadway and not subject to further movement. The mixed adhesive shall not remain in the mixing head for more than 45 seconds. Adhesive remaining in the mixing head longer than this period shall be wasted before resuming the operation.

Automatic mixing equipment for the epoxy adhesive shall use positive displacement pumps and shall properly meter the 2 components in the specified ratio,  $\pm 5\%$  by volume of either component. At the beginning of each day, and at any other time ordered by the Engineer, the ratio shall be checked by the Contractor in the presence of the Engineer. This check shall be made by disconnecting the mixing heads, or using suitable bypass valves, and filling 2 suitable containers with the unmixed components. The mixing head shall properly mix the 2 components so that there is no trace of black or white streaks in the mixed material.

The Standard Set Type adhesive shall not be used when either the pavement or the air temperature is less than 50° F (10° C). The Rapid Set Type adhesive shall not be used when either the pavement or air temperature is less than 30° F (-1° C). No markers shall be installed if the relative humidity of the air is greater than 80% or if the pavement surface is not dry.

Voids in a cured, undisturbed sample of the mixed adhesive obtained from the extrusion nozzle shall not exceed 4%.

The Bituminous Type adhesive shall require the use of a melting apparatus. The melting apparatus shall incorporate a means of mixing the material before and during installation to assure homogeneity. Diffuse heat distortion (diffuse plate) shall be used to prevent overheating the material. A dispensing nozzle shall be utilized that has an independent way of heating the material to provide regulated control over output. The working temperature shall be from 400° F to 450° F (204° C to 232° C). The Bituminous adhesive shall not be used when either the pavement or air temperature is less than 32° F (0° C). The pavement markers can only be installed on a dry pavement surface.

Reflective markers shall be placed in such manner that the reflective face of the marker is perpendicular to a line parallel to the roadway centerline.

No pavement markers shall be placed over longitudinal or transverse joints of the pavement surface or over pavement cracks.

**721.04 Method of Measurement.** Raised Pavement Markers will be measured by the unit complete in place.

**721.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Raised Pavement Markers of the type specified, which price shall be full compensation for furnishing and installing Raised Pavement Markers; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Raised Pavement Markers (Type___)	Each

**SECTION 722 VACANT****SECTION 723  
GENERAL REQUIREMENTS FOR SIGNS**

**723.01 Description.** These requirements consist of furnishing and installing highway signs, complete with posts, supports, and concrete bases, where required, according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**723.02 Materials and Fabrication. (a) General.** Signs shall comply with the requirements of the MUTCD, FHWA *Standard Highway Signs*, and *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects*.

All colors for signs shall match the colors specified in the MUTCD. The color and size of letters, symbols, borders, and background on signs shall be as specified on the plans.

Signs shall be made of aluminum and shall be reflectorized.

**(b) Sign Panels.** Standard signs shall consist of a single sheet of aluminum alloy (ASTM B 209, Alloy 5052 H38) without stiffeners on the back. Minimum sign blank thickness shall be 0.100" (2.5 mm) for a sign size of 5 square feet (0.5 sq m) or less; 0.125" (3.2 mm) for a sign size greater than 5 square feet (0.5 sq m); or 0.080" (2.0 mm) if so noted on the plans. Sign blanks shall be flat and straight and within commercial tolerances established by the aluminum industry.

Guide signs shall be fabricated using either one piece extruded panels, extrusheet welded panels, or extrusheet taped panels. The Contractor may use either type of panel fabrication but shall use the same type for all guide signs on the project.

The one piece extruded panels shall be fabricated of aluminum alloy (ASTM B 221, Alloy 6063 T6). The extrusheet welded panels shall be fabricated of sections of extruded aluminum alloy stiffeners (ASTM B 221, Alloy 6063 T6) welded to flat sheet aluminum alloy (ASTM B 209, Alloy 3003 H18) approximately 9" (230 mm) apart with spot welds at 4" (100 mm) centers as shown on the plans.



The extrusheet taped panels shall be fabricated of sections of extruded aluminum alloy stiffeners (ASTM B 221, Alloy 6063T6) adhered to flat sheet aluminum alloy (ASTM B 209, Alloy 3003H18) with double coated, acrylic foam tape.

Extruded panel and extrusheet signs shall consist of sign panels; stringers or horizontal supporting members; necessary fasteners for assembling the units; reflective materials; letters; numerals; symbols; and border. All extrusions and fasteners shall be applied without causing objectionable projections on the sign face.

The one piece extruded aluminum panels shall be a minimum of 12" (300 mm) in width except one 6" (150 mm) panel may be used per sign face when necessary to construct the sign as shown on the plans.

The extrusheet sign panel sections shall be either 24" or 36" (610 mm or 910 mm) in width with the following exceptions:

- If the total height of the sign face is not a multiple of 24" (610 mm) and the remaining increment is greater than 6" (150 mm), the bottom panel shall be the width of that increment with the remainder of the sign face in 24" and/or 36" (610 mm and/or 910 mm) panels.
- If the total height of the sign face is not a multiple of 24" (610 mm) and the remaining increment is 6" (150 mm), the bottom panel shall be 24" (610 mm) in width with the remainder of the sign face in 24" and/or 36" (610 mm and/or 910 mm) panels.
- Signs 2'-6" (750 mm) in height shall be constructed of one 2'-6" (750 mm) panel or one 18" (450 mm) and one 12" (300 mm) panel.

All extruded and extrusheet panels shall be bolted together at every other hole (every 24" [610 mm]) with the faces and ends in alignment.

Single sheet, extruded, and extrusheet panels to which reflective sheeting is to be applied shall be degreased, etched, and alodized.

Degreasing shall be done by the vapor method or alkaline method. Vapor degreasing shall be accomplished by total immersion of the sign panels in a saturated vapor of trichloroethylene or perchloroethylene. Alkaline degreasing shall be

accomplished by immersion of the sign panels in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specification. Immersion time shall depend upon the amount of soil present and the gage of the metal. Trade mark printing shall be removed with lacquer thinner or by a controlled alkaline cleaning system.

Etching shall be done by the acid method or the alkaline method. Acid etch shall be done by immersion in a 6% to 8% phosphoric acid solution at 100° F (38° C) for a minimum of 3 minutes, then thoroughly rinsing with cold water, followed by a hot water tank rinse of 1 minute in water heated to 180° F (82° C). Alkaline etch shall be done by etching the precleaned surface in an alkaline etching material that is controlled by titration, using the time, temperature, and concentration specified by the solution manufacturer, then thoroughly rinsing. Remove smut with an acidic, chromium compound type solution as specified by the solution manufacturer, then rinse thoroughly.

The sign panels shall be treated by the alodizing process to uniformly provide a chemically formed light and tight amorphous coating that becomes an integral part of the aluminum alloy. This process shall be accomplished according to the recommendation of the manufacturer of the coating.

All fabrication, including cutting and punching of holes, excluding holes for demountable letters, numerals, symbols, and borders, shall be completed before metal degreasing, etching, alodizing, and the application of retroreflective sheeting.

Sign panels shall be free of buckles, warp, dents, cockles, burrs, and defects resulting from fabrication. The surface of all sign panels shall be flat.

The Contractor shall submit a Certified Test Report to the Engineer covering the sign panels.

**(c) Retroreflective Sheeting.** The retroreflective sheeting for signs shall comply with ASTM D 4956 for Type III, IV, VIII, or IX Retroreflective Sheeting, except that Type VIII or IX Retroreflective Sheeting shall be used on all delineators. All retroreflective sheeting shall have either Class 1 or Class 2 backing.

Retroreflective sheeting shall be applied to properly treated sign panels with mechanical equipment in a manner specified by the sheeting manufacturer. Sign faces comprising two or more pieces or panels of retroreflective sheeting must be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance both day and night. Alternate successive width sections of either sheeting or panels must be reversed and consecutive to ensure that corresponding edges of retroreflective sheeting lie adjacent on the sign. Non-conformance may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting that will not be acceptable.

At splices, sheeting shall be overlapped no less than 3/16" (5 mm). Sheeting applied to a welded panel shall be trimmed flush with the edge of the panel.

**(d) Legend.** All legend, which includes letters, numerals, symbols, arrows, and border, shall have a regular outline, be clean cut and sharp, and shall have a continuous stroke and border without ragged or torn edges.

All legend on guide signs shall be of the size shown on the plans. Legend on standard signs shall comply with the latest revision of *FHWA Standard Highway Signs*.

Legend on guide signs on main lanes shall be demountable. Legend on guide signs on cross streets and ramps shall be direct applied. Legend on standard signs shall be silk screened except as noted on plans.

All demountable legend shall be of the same manufacturer. The sign area outside the corner radius shall not be trimmed to match the border radius.

**(1) Direct Applied Legend.** Unless otherwise shown, the legend and other features of the sign message shall be cut from the same Type sheeting as the sign face and shall have a Class 1 backing.

**(2) Demountable Legend.** Unless otherwise shown, the legend and other features of the sign message shall be cut from the same Type retroreflective sheeting as the sign face and applied to flat aluminum frames by a mechanical applicator process.

Frames for border strips, corners, shields, and legend shall be fabricated from 0.063" (1.6 mm) sheet aluminum complying with the requirements of ASTM B209, Alloy 5052-H38. Mounting holes shall be provided with the frames to permit the use of screws, bolts, rivets, or other fasteners of stainless steel, galvanized steel, or aluminum to fasten the frames to the sign face, subject to the condition that dissimilar metals shall be insulated to prevent corrosion.

The aluminum frames shall comply with Subsection 723.02(b).

All border material shall be secured from the same company that furnishes the cutout letters, numerals, etc., and shall be mounted in the same manner as the cutout letters.

**(3) Silk Screen Process.** The letters, numerals, arrows, symbols, border, and other features shall be produced on retroreflective sheeting of the sign field by a silk screen process approved by the Engineer. Sign messages and borders of a color darker than the sign field shall be applied to the sheeting by direct process. Sign messages and borders of a color lighter than the sign field shall be produced by the reverse process in which message and border are outlined by applying darker transparent color to the sheeting of the sign field.

Transparent colors, inks, and paints used in the silk screen process shall be of the type and quality recommended by the manufacturer of the reflective sheeting and shall conform to red, blue, yellow, and green colors approved by the FHWA and as shown in the MUTCD and FHWA *Standard Highway Signs*.

**723.03 Shop Drawings.** The Contractor shall submit, for the approval of the Engineer, prints of shop drawings in duplicate showing arrangements and spacing of all letters, symbols, and borders for each type of sign (with the exception of standard signs); the support to be used with each different type of sign panel (other than standard signs); the proposed method of attaching signs to the supports on signs not detailed on the plans; and the arrangement and width of panels on guide signs. The Contractor shall be responsible for the correctness of the drawings, even though the drawings may have been approved by the Engineer.

**723.04 Construction Requirements.** Signs shall be erected at the specified location, plumb, and to the specified vertical and horizontal clearances.

Roadside directional signs shall be erected at a minimum height of 7' (2 m) above the pavement edge, measured to the bottom of the sign. If a secondary sign is mounted below the primary sign, the primary sign shall be erected a minimum of 8' (2.4 m) above the pavement edge and the secondary sign a minimum of 5' (1.5 m) above the pavement edge. Route markers, warning signs, and regulatory signs shall be erected a minimum height of 6' (1.8 m) above the pavement edge. All heights measured to the bottom of the sign.

The minimum horizontal clearance to any ground mounted sign shall be 2' (0.6 m) beyond the edge of the roadway shoulder or unmountable curb face. Where there is a mountable curb, the horizontal clearance shall be established by the Engineer.

Signs shall normally be erected so that the sign face is vertical and at 93° away from the center of the lane that the sign serves and away from the direction of travel. Where lanes divide, or on curves, sign faces shall be oriented so as to be most effective both day and night, and to avoid the possibility of specular reflection.

Field drilling of holes in any part of the sign support structure shall be done only when specified on the plans or as directed by the Engineer.

After sign installation is complete, the signs will be inspected at night by the Engineer. If specular reflection is apparent on any sign, its position shall be adjusted by the Contractor to eliminate this condition.

**723.05 Method of Measurement and Basis of Payment.** Work completed and accepted under this item will not be measured and paid for directly but will be considered a part of the various applicable sign items in the Contract.

## SECTION 724

### OVERHEAD, BRIDGE MOUNTED, AND CANTILEVER SIGN STRUCTURES

**724.01 Description.** This item shall consist of furnishing, fabricating, and installing overhead sign structures with sign, luminaire supports when specified, and concrete foundations, according to these specifications, and to the dimensions and details and at the locations shown on the plans or as directed.

**724.02 Materials.** Materials for sign supports shall consist of aluminum alloy except as otherwise specified.

Aluminum sign support members shall comply with the following specifications for aluminum alloy:

Extrusions-Rods, Bars, and Shapes:	ASTM B 221, 6061-T6
Rolled Shapes:	ASTM B 308, 6061-T6
Sheet and Plate:	ASTM B 209, 6061-T6
Pipe:	ASTM B 241, 6061-T6
Extruded Tubing:	ASTM B 221, 6061-T6
Chord and Post Caps:	Sand Castings: ASTM B 26, 356-T6, or Plate: ASTM B 209, 6061-T6
Bolts:	ASTM B 211, 2024-T4
Nuts:	ASTM B 211, 6061-T6, or 6262-T9
Locknuts-Approved type:	ASTM B 211, 2017-T4
Washers:	ASTM B 209, Alclad 2024-T4
Panel Clips, Fittings:	Permanent Mold Castings ASTM B 108, A356-T61
Splice Flanges Welded:	ASTM B 209, 6061-T6
Welding Rods, Electrodes:	ER4043 or ER5556, AWS A5.10 Consumable Electrode Type

For aluminum sign supports, stainless steel bolts complying with ASTM A 193, Grade B8, Class 2, and strain hardened to a maximum 33 Hardness Rockwell C, may be used in lieu of aluminum alloy. Anchor Bolts, U-bolts and flange splice bolts shall comply with ASTM A 193, Grade B8, Grade B8N, or Grade B8C, Class 2, and strain hardened to a maximum 33 Hardness Rockwell C. Nuts for stainless steel bolts shall comply with ASTM A 194, Heavy Hex, Grade 8A, 8CA, 8MA, 8TA, 8FA, 8PA, 8NA, 8MNA, 8RA, 8SA, 8LNA, 8MLNA, or 8MLCuNA.

A chromate sealed anodized coating at least 0.0002" (0.005 mm) thick shall be applied to all finished aluminum bolts and nuts.

Aluminum alloy surfaces contacting concrete shall be thoroughly coated with an aluminum impregnated asphalt paint approved by the Engineer and allowed to dry before installation.

Concrete for footings shall comply with Section 802 for Class S concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall comply with Section 804 for Grade 60.

**724.03 Commercial Alternates.** Subject to the approval of the Engineer and in conformance with the requirements specified herein, the Contractor may supply sign support structures as manufactured by a commercial sign structures manufacturer in place of the supports detailed on the plans.

If the Contractor elects to use a commercial product, a complete set of design calculations by a Registered Professional Engineer, a certification by the Professional Engineer that the design conforms to the requirements specified herein and as shown on the plans, and general details or pictures of the proposed type of structure shall be submitted to the Bridge Engineer for approval before submitting shop details.

In general, the commercial product shall be a truss type structure that will have an appearance similar to the design shown on the plans. The members may be round pipes or other structural shapes.

Sign supporting structures shall be designed for sufficient strength and stiffness to withstand a basic wind pressure of 25 pounds per square foot (1.2 kPa) on flat surfaces, according to the

current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Materials, construction methods, and inspection shall comply with this specification. If the fabricator elects to use materials of a different strength than that shown in this specification, this information shall be included in the request for approval of the commercial product.

**724.04 Shop Drawings.** Shop drawings, in duplicate, shall be submitted to the Bridge Engineer for approval before fabrication begins. The Contractor shall be responsible for the accuracy of the drawings, even though the drawings may have been approved by the Engineer.

**724.05 Fabrication Requirements.** Overhead, Bridge Mounted, and Cantilever Sign Structure bracing members shall be cut and trimmed for proper fit and shall be welded in correct position to chord or post members to form the specified structural section. Each assembly shall be checked for alignment, correct shape, and sound welds at the fabricating plant before shipment. The fabricator shall certify that each complete structure is free of misfits or structural deficiencies before shipment.

Visual inspection of all welds shall be made and any weld found to be defective shall be repaired only by rewelding. Inspection of all welds shall include, in addition to the visual inspection, an examination of certificates of prequalification of the welders who are performing the work and an inspection of welding equipment and procedure. In addition to visual inspection, the Department may require inspection by the red dye penetrant method for all the connecting welds between sign columns and base plates, including the connecting plate welds, when the column wall thickness is greater than 3/8" (10 mm). A report covering such inspection by the inspection agency, including a list of any defective welds that will require repairing, and certificates of prequalification of welding operators, shall be submitted to the Engineer of Materials. Any weld inspections and reports will be at the Department's expense, except that the Contractor shall make welded members accessible for inspection at no cost to the Department.



The method of qualifications and welding for aluminum alloy shall comply with the method described in the AWS Structural Welding Code - Aluminum D1.2.

The Contractor shall certify in writing that the welding and fabrication of the structures comply with the governing specifications.

**724.06 Construction Requirements.** Excavation, backfill, compaction, and disposal of surplus materials shall be performed according to Section 801. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to their original condition.

The applicable provisions of Sections 802 and 804 shall govern the construction and installation of concrete and reinforcing steel.

Bridge mounted sign structures shall be attached in such a manner as to prevent damage to the bridge. Any resulting damage to the existing bridge shall be repaired as directed by the Engineer at no cost to the Department.

Field welding will not be permitted except upon approval in writing by the Engineer.

All sign supports shall provide a minimum vertical and horizontal clearance as shown on the plans. To insure proper clearances, dimensions of the structure that affect clearances shall be verified by the Contractor by field measurements before fabrication begins.

Sign supports shall be erected so that the sign face is plumb and at right angles to the road unless otherwise directed by the Engineer.

**724.07 Method of Measurement.** Overhead, Bridge Mounted, and Cantilever Sign Structures will be measured by the unit, including foundations, complete in place. One unit consists of the structure and all Z-bars, brackets, bolts, washers, nuts, and other hardware necessary to complete the installation and mount the sign(s). The fabrication and installation of the signs will be measured and paid for under Section 725 or 726.

**724.08 Basis of Payment.** Overhead, Bridge Mounted, and Cantilever Sign Structures completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Overhead Sign Structure, Bridge Mounted Sign Structure, or Cantilever Sign Structure of the structure designation specified,

which price shall be full compensation for furnishing, fabricating, and installing the structure including sign framing, supporting structures, and concrete foundations; for excavation, backfill, compaction, removal and disposal of surplus materials, and replacement of existing surfaces; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Overhead Sign Structure (___)	Each
Bridge Mounted Sign Structure (___)	Each
Cantilever Sign Structure (___)	Each

## **SECTION 725 GUIDE SIGN**

**725.01 Description.** This item shall consist of furnishing and installing a Guide Sign on the sign support assembly according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**725.02 Materials.** The sign shall be fabricated of aluminum and reflective sheeting as described in Section 723.

**725.03 Construction Requirements.** The sign shall be securely installed at the correct location and set at the specified vertical and horizontal clearances.

Signs shall not be erected until the proposed sign layout, approximate location, and method of mounting have been approved by the Engineer.

**725.04 Method of Measurement.** Guide signs will be measured by the square foot (square meter) of sign area. Measurements will consist only of the face of the sign to the nearest 0.10 square foot (0.01 sq m) of area. No deduction will be made for corner radii or mounting holes.

Separate measurement will be made for the specified sign support.

All fabrication, installation, surface treatment, testing, and other items required under Section 723 shall be considered as part of this specification.

**725.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square foot (square meter) bid for Guide Sign - Roadside Mounted or Guide Sign - Overhead Mounted of the type specified, which price shall be full compensation for furnishing, fabricating, and erecting the signs; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Guide Sign - Roadside Mounted (___)	Square Foot (Square Meter)
Guide Sign - Overhead Mounted (___)	Square Foot (Square Meter)

## **SECTION 726 STANDARD SIGN**

**726.01 Description.** This item shall consist of furnishing and installing Route Markers and Components, Regulatory Signs, and Warning Signs on the support assembly according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**726.02 Materials.** The sign shall be fabricated of aluminum and reflective sheeting as described in Section 723.

**726.03 Construction Requirements.** The sign shall be securely installed at the correct location and set at the specified vertical and horizontal clearance.

Signs shall not be erected until the proposed sign layout, approximate location, and method of mounting have been approved by the Engineer.

**726.04 Method of Measurement.** Route markers and components, regulatory signs, and warning signs will be measured by the square foot (square meter) of sign area. Measurements will

consist only of the face of the sign to the nearest 0.10 square foot (0.01 sq m) of area. No deduction in area will be made for corner radii or mounting holes.

The area of octagonal signs, pentagonal signs, U.S. Shields, and Interstate Shields will be computed as the area of the circumscribing square. The area of triangular signs will be computed as the area of the triangle. The area of circular signs will be computed as the area of the circle.

Separate measurement will be made for the specified sign supports.

All fabrication, installation, surface treatment, testing, and other items required under Section 723 shall be considered as part of this specification.

**726.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square foot (square meter) for Standard Sign, which price shall be full compensation for furnishing, fabricating, and erecting the sign; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Standard Sign	Square Foot (Square Meter)

**SECTION 727**  
**EXIT NUMBER PANEL**

**727.01 Description.** This item shall consist of furnishing and installing an exit number panel with all necessary special framing required to be attached to a guide sign according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**727.02 Materials.** The sign shall be fabricated of aluminum and reflective sheeting as described in Section 723. Angles and Z bars used for installation shall be aluminum alloy 6061-T6,

ASTM B 221. Panel Clips and Fittings shall be Permanent Mold Castings ASTM A 356, or B 108.

**727.03 Construction Requirements.** The sign shall be securely installed at the correct location and set at the specified vertical and horizontal clearances.

**727.04 Method of Measurement.** Exit Number Panels will be measured by the square foot (square meter) of sign area, which measurement will consist of the face of the sign to the nearest 0.10 square foot (0.01 sq m) of area. No deduction in area will be made for corner radii or mounting holes.

All fabrication, installation, surface treatment, testing, and other items required under Section 723 shall be considered as part of this specification.

**727.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square foot (square meter) for Exit Number Panel of the type specified, which price shall be full compensation for furnishing, fabricating, and erecting the sign including Z-bars, angles, and hardware necessary for proper mounting; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work. Z-bars, angles, and hardware necessary for mounting will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Exit Number Panel (Type\_\_\_).

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Exit Number Panel (Type___)	Square Foot (Square Meter)

**SECTION 728  
DELINEATORS**

**728.01 Description.** This item shall consist of furnishing and installing galvanized steel posts with delineators according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**728.02 Materials.** Delineators shall consist of white, yellow, or red reflectors made of adhesive coated Type VIII or Type IX reflective sheeting permanently adhered to a sheet of aluminum 0.080" (2.0 mm) thick and complying with Section 723.

Steel posts for roadside installation shall be made of a U-section channel, manufactured from re-rolled rail steel or equivalent, weighing not less than 2 pounds per foot (3 kg/m). The steel shall comply with the mechanical requirements of ASTM A 499, Grade 60, and the chemical requirements of ASTM A 1 for rails having a nominal weight of 90 pounds per yard (45 kg/m) or more. These chemical requirements shall include the following modified limitations:

Carbon	0.67 - 0.89%
Manganese	0.70 - 1.00%
Silicon	0.10 - 0.25%

The Contractor shall submit to the Engineer of Materials mill test reports showing chemical analysis and physical tests.

The post shall be punched or drilled with 3/8" (10 mm) holes on 1" (25 mm) centers for the full length of the post.

Steel posts for bridge rail installation shall be a 1" x 1" x 3/16" (25 mm x 25 mm x 4.76 mm) angle weighing 1.61 pounds per foot (2.4 kg/m), and manufactured from AASHTO M 270, Grade 36. Length of post and spacing of holes shall be as shown on the plans.

All delineator posts shall be hot dip galvanized and all fabrication, including punching or drilling holes, shall be completed before the posts are galvanized.

All delineators shall be fastened to the posts by means of tamper-proof fasteners as shown on the plans.

Bridge rail delineator posts shall be fastened to the bridge rail by means of galvanized U-bolts with hex nuts and lock washers.

**728.03 Construction Requirements.** Roadside delineator posts shall be installed along either side of the roadway 2' (0.6 m) beyond the shoulder edge or 2' (0.6 m) from the face of curbed sections. Delineators shall be located 4' (1.2 m) above the grade of the pavement edge. The post shall be driven before installing the delineator using an approved metal driving cap that fits snugly in or around the post.

Bridge rail delineators shall be mounted to the top bridge rail as shown on the plans.

White delineators shall be installed along the right side of the main lanes and ramps and shall be spaced as shown on the plans. Yellow delineators shall be installed along the left side of the main lanes and ramps and shall be spaced as shown on the plans. Red delineators shall be installed as shown on the plans.

**728.04 Method of Measurement.** Delineators will be measured by the unit. One unit consists of the delineator, post, brackets, and all other hardware necessary to complete the installation.

**728.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Delineator of the type specified, which price shall be full compensation for furnishing, fabricating, and erecting the delineators; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Delineator (Type___)	Each

## SECTION 729 CHANNEL POST SIGN SUPPORT

**729.01 Description.** This item shall consist of furnishing and installing channel post sign supports for roadside mounted signs according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**729.02 Materials.** The posts shall be made of a U-section channel as shown on the plans and shall be manufactured from re-rolled rail steel or equivalent. The steel shall comply with the mechanical requirements of ASTM A 499, Grade 60. The steel shall comply with the chemical requirements of ASTM A 1 for rails having a nominal weight of 90 pounds per yard (45 kg/m) or more, except as modified herein:

Carbon	0.67-0.89%
Manganese	0.70-1.00%
Silicon	0.10-0.25%

The Contractor shall submit to the Engineer certified mill test reports showing chemical analysis and physical tests.

The posts shall be a flanged channel section weighing not less than 3.00 pounds per foot (4.46 kg/m) for Type A and Type B supports and 2.00 pounds per foot (3.0 kg/m) for Type C and Type U supports. The finished posts shall be straight, have a smooth, uniform finish, and shall be free from injurious defects affecting their strength, durability, and appearance. The posts shall be fabricated such that the area of contact between the post and the sign is symmetrical about the vertical axes of both post and sign. The posts shall be punched or drilled with 3/8" (10 mm) holes on 1" (25 mm) centers for the full length of the posts. The holes shall be carefully spaced vertically and horizontally so they will align for splicing. All holes and sheared ends shall be free from burrs.

The posts for Type A, Type B, and Type C supports shall have a green enamel finish. The posts for Type U supports shall be hot dip galvanized. All fabrication, including punching or drilling holes, shall be completed before the posts are painted or galvanized.

The posts shall be a minimum of 12' (3.7 m) in length. If the height of the support requires a splice, the splice shall be made as shown on the plans.

**729.03 Construction Requirements.** The channel post sign support shall be constructed and installed at the locations shown on the plans or as directed. The supports shall be installed so that the signs will be plumb and to the specified vertical and horizontal clearances. The posts shall be driven before installing the signs using an approved metal driving cap that fits snugly in or around the post.

**729.04 Method of Measurement.** Channel Post Sign Supports will be measured by the unit. One unit consists of the post(s) and all bolts, nuts, washers, brackets, and other hardware necessary to complete the installation and mount the sign(s). The fabrication and installation of the sign will be paid for under Section 725 or 726.



**729.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Channel Post Sign Support of the type specified, which price shall be full compensation for furnishing, fabricating, and installing the support; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Channel Post Sign Support (Type__)	Each

## **SECTION 730 BREAKAWAY SIGN SUPPORT**

**730.01 Description.** This item shall consist of furnishing and installing breakaway sign supports for roadside mounted guide signs and standard signs according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

**730.02 Materials.** The posts shall be fabricated of a galvanized steel section as shown on the plans. The length of each post for each sign shall be verified by the Contractor before ordering to meet the existing field conditions and to conform to the specified sign mounting heights. No field cutting of the post will be permitted unless approved by the Engineer.

All structural steel, except pipe posts but including base plates on pipe posts, and steel fuse plates, shall comply with AASHTO M 223 Grade 50. Pipe posts shall be structural steel complying with AASHTO M 183 or ASTM A 53 Grade B pipe. Steel bolted or welded to the primary support posts and not affecting the breakaway function, may be AASHTO M 183.

All high strength bolts, nuts, and washers shall comply with AASHTO M 164M.

Shims shall be fabricated from brass shim stock or strip complying with ASTM B 36.

Concrete for footings shall comply with Section 802 for Class S concrete. The Department will perform all acceptance sampling and

testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall comply with Section 804 for Grade 40.

Footings for standard sign supports shall not be reinforced.

Hardware required for attachment of the sign(s) to the support shall comply with Section 724.

**730.03 Fabrication.** Sign supports shall be fabricated according to the applicable provisions of Section 807. All holes in steel fuse plates and flange holes for fuse bolts shall be drilled or subpunched and reamed. All plate cuts shall preferably be saw cuts; however, flame cutting will be permitted provided all edges are ground after cutting. Metal projecting beyond the plane of the plate face will not be acceptable.

Visual inspection of all welds shall be made and any weld found defective shall be repaired only by rewelding.

All structural steel shall be galvanized after fabrication according to AASHTO M 111. All bolts, nuts, and washers shall be galvanized according to AASHTO M 232 or M 298, Class 40 or 50.

**730.04 Shop Drawings.** Shop drawings, in duplicate, shall be submitted to the Engineer for approval before fabrication begins. The Contractor shall be responsible for the accuracy of the drawings, even though the drawings may have been approved by the Engineer.

**730.05 Construction Requirements.** Excavation, backfill, compaction, and disposal of surplus materials shall be performed according to Section 801. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to the original condition.

The applicable provisions of Sections 802 and 804 shall govern the construction and installation of concrete and reinforcing steel.

Field welding will not be permitted except upon approval in writing by the Engineer.

All sign supports shall provide a minimum vertical and horizontal clearance as shown on the plans. To ensure proper clearances, dimensions of the structure that affect clearances shall be verified by the Contractor by field measurements before fabrication begins.

Sign supports shall be erected so that the sign face is plumb and at right angles to the road unless otherwise directed by the Engineer.

Subsequent to erection, any damaged galvanized coating shall be repaired according to Subsection 807.88.

The procedure for assembly of base connection, as shown on the plans, shall be followed explicitly. The high strength bolts in the base connection shall be tightened only to the torque shown on the plans. They shall not be overtightened.

**730.06 Method of Measurement.** Breakaway Sign Supports will be measured by the total weight of the steel post installed and accepted, rounded to the nearest pound (kilogram). The weight will be determined by multiplying the length of each post, including both sign post and stub post, by the nominal weight per foot (meter) of the section. The weight of base plates, fuse plates, bolts, and other accessories will not be included in this measurement.

**730.07 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per pound (kilogram) for Breakaway Sign Support of the type specified, which price shall be full compensation for excavation, construction of foundation, backfill, compaction, removal and disposal of surplus materials, and replacement of existing surfaces; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Breakaway Sign Support (Type___)	Pound (Kilogram)

## SECTION 731 IMPACT ATTENUATION BARRIER

**731.01 Description.** This item shall consist of furnishing, installing, relocating, maintaining, repairing, and removing temporary and permanent impact attenuation barrier systems, including pads, nose covers, and transitions. The impact attenuation barrier system shall be of the type shown on the plans. The impact attenuation barrier system shall satisfy the National Cooperative

Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH) requirements for a Test Level 3 (TL-3) crash cushion. A copy of the Federal Highway Administration's (FHWA) acceptance letter with all attachments for each impact attenuation barrier system shall be submitted to the Engineer. Impact attenuation barrier systems shall be fabricated and installed in accordance with the plans and with the crash testing documentation provided in the FHWA acceptance letter, which is available at FHWA's website at:

[http://safety.fhwa.dot.gov/roadway\\_dept/policy\\_guide/road\\_hardware/](http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/), if current testing criteria have been fulfilled.

**731.02 Materials.** The Contractor shall furnish a certification from the manufacturer or supplier that the impact attenuation barrier supplied is non-gating, redirective and meets the requirements of NCHRP Report 350 or MASH for a TL-3 crash cushion.

An impact attenuation barrier system specifically designed for protecting motorists from impacting temporary concrete barrier walls or other fixed objects adjacent to the roadway shall be utilized. The impact attenuation barrier system shall be non-gating, redirective and compatible with the site geometry shown on the plans. Sand Barrels will not be allowed for Temporary Impact Attenuation Barriers.

Sand barrier installations shall consist of a foundation pad and modules consisting of three basic components: cylinder, lid, and spacer. The Contractor shall have the option of constructing either a rigid or flexible foundation pad.

The material requirements for the barrier installation are as follows:

**(a) Rigid Pad.** A rigid pad shall be constructed of a course of concrete of the thickness shown on the plans. Concrete shall comply with Section 802 for Class M concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

**(b) Flexible Pad.** A flexible pad shall be constructed of Aggregate Base Course, Class 1, and ACHM Surface Course, to the dimensions shown on the plans. At the option of the Contractor, full depth ACHM Surface Course may be used to construct the flexible

pad. Materials shall comply with the requirements for the appropriate items of Sections 303 and 407.

**(c) Cylinder.** The cylinders shall be 36" (900 mm) in diameter and may be either 30" or 36" (750 mm or 900 mm) in height. The cylinders shall be molded from a tough, high density, polyethylene material that is durable and weatherproof, having a thickness of approximately 1/4" (6 mm). The cylinder shall be of such design, material, and construction as to shatter upon impact. Unless otherwise specified, the color of the cylinder shall be yellow.

**(d) Lid.** The lid shall be formed from high density polyethylene and shall be of such diameter as to ensure a tight fit.

**(e) Spacer.** The spacer shall be in the form of a core with a disc and seal supporting the sand mass or an inner container with a stem. The spacer heights shall be designed to ensure that the center of gravity of each module is at the proper elevation to control the attitude of impacting vehicles.

**(f) Sand.** Sand may be any type of building sand of average grain texture. Wet sand from outside storage or on open trucks, exposed to rain, is acceptable, provided it is not saturated to a liquid or semi-liquid state.

**731.03 Construction Requirements.** The subgrade area for the foundation pad shall be shaped and compacted to the required section. Compaction shall be accomplished by any method satisfactory to the Engineer. The foundation pad shall be constructed as stated above. Each module shall be placed at the location and to the dimensions shown on the plans. The Contractor shall be responsible for outlining with paint the location of the modules for future reference. The Contractor shall mark (with paint) the weight of sand in each module as indicated on the specific site plan. The modules shall be placed in front of the hazardous object according to the dimensions shown on the plans. To facilitate lid installation there shall be a 3/8" - 5/8" (10 mm - 15 mm) clearance between module tops.

After the cylinder is placed in proper location and the proper spacer is assembled and placed in the cylinder, sand shall be placed to the required depth as coded on the module and the lid securely installed.

Impact attenuation barrier system shall be fabricated and installed according to the manufacturer’s most current recommendations and installation methods. Any damage caused by the Contractor to the materials required for the impact attenuation barrier system shall be repaired or replaced immediately at no cost to the Department.

In the event that the impact attenuation barrier system is damaged at no fault of the Contractor, all damaged parts shall be replaced immediately by the Contractor to restore the Impact Attenuation Barrier to a fully functional condition. Replacing damaged parts will be paid for under the item Temporary Impact Attenuation Barrier (Repair). In the event that a crash cushion is damaged beyond repair at no fault of the Contractor, it shall be immediately replaced and paid for under the item Temporary Impact Attenuation Barrier.

**731.04 Method of Measurement.** Impact Attenuation Barrier Systems will be measured by the unit of the type specified. Each unit shall include a foundation pad and a specified number of impact modules, when applicable. Temporary Impact Attenuation Barrier previously furnished and installed, which is authorized to be relocated, will be measured by the unit. Relocations for the convenience of the Contractor will be at no additional cost to the Department.

**731.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Temporary or permanent Impact Attenuation Barrier of the type specified, which price shall be full compensation for excavation and/or embankment; for construction of the pad; for furnishing and installing cylinders, complete with filler and lids; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Impact Attenuation Barrier (Type___)	Each
Temporary Impact Attenuation Barrier	Each
Temporary Impact Attenuation Barrier (Relocation)	Each
Temporary Impact Attenuation Barrier (Repair)	Each
Temporary Impact Attenuation Barrier Left in Place	Each

## **SECTION 732 CRASH CUSHIONS**

**732.01 Description.** This item shall consist of constructing a foundation pad including excavation and/or embankment, transitions from bridge ends, and a backup wall, when specified, and furnishing and installing a crash cushion according to these specifications and to the dimensions and at the locations shown on the plans or as directed. The crash cushion shall satisfy the National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH) requirements for a test level 3 (TL-3) crash cushion.

### **732.02 Materials. (a) Foundation Pad and Backup Wall.**

(1) Concrete shall comply with Section 802 for Class M concrete. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

(2) Reinforcing steel shall comply with Section 804.

(3) Preformed joint filler shall comply with AASHTO M 153, Type I.

**(b) Crash Cushion.** The Contractor shall furnish a certification from the manufacturer or supplier that the crash cushion meets the requirements of NCHRP Report 350 or MASH for a TL-3 crash cushion. The crash cushion shall comply with the most current specifications and details for a guardrail energy absorbing terminal crash cushion as recommended by the manufacturer and as approved by the Engineer.

The Contractor shall provide the Engineer with copies of all necessary manufacturer's details and installation manuals prior to the installation of the crash cushion on the project. These materials shall remain the property of the Department.

**732.03 Construction Requirements.** The subgrade area for the foundation pad shall be shaped and compacted to the required section. Compaction shall be accomplished by any method satisfactory to the Engineer.

The foundation pad, including curb transition from bridge ends, and backup wall shall be constructed to the lines and dimensions shown on the plans. The backup wall shall also be constructed according to Section 631.

The crash cushion shall be installed according to the manufacturer's current recommendations and installation methods.

**732.04 Method of Measurement.** Crash Cushions will be measured by the unit. Each unit shall include one crash cushion and foundation pad with curb transitions, when specified.

Backup Wall will be measured by the linear foot (meter).

**732.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Crash Cushion or per linear foot (meter) for Backup Wall, when specified, which price shall be full compensation for excavation and/or embankment; for construction of the foundation pad, with curb transitions when specified; for furnishing and installing the crash cushion; for construction of the backup wall, when specified; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Crash Cushion	Each
Backup Wall	Linear Foot (Meter)

**SECTION 733**

**VIDEO DETECTOR WITH RADIO INTERFACE**

**733.01 Description.** This item shall consist of furnishing and installing a Video Detector, Video Processor, Cable, Video Monitor, Radio Interface and other hardware and software in accordance with these specifications, and modification of remote video monitoring site(s), at the locations shown on the plans or as directed by the Engineer, for the purpose of providing actuation to a traffic signal controller and for live video monitoring of traffic conditions at the site.



Video detection consists of a Video Detector, Video Processor, Video Cable and other associated equipment and shall measure vehicle information by the means described, process the information and provide vehicle actuation to an actuated controller, system local controller, or other device as outlined in the plans or Contract. In addition, where radio cameras are specified, video signal shall be transmitted back to a central site by means of radio interface. Live video shall be available through standard phone modem connection to a remote location. Video Detection equipment and its associated components shall also meet the environmental and electrical requirements in Section 701.

**733.02 Materials. (a) Video Detector.** All video detectors shall consist of a black and white (BW) video camera with zoom lens, cable, manual pan and tilt bracket, wiring harness and all other accessories. Camera and lens shall have sufficient resolution to discriminate between vehicles in one lane at 300 feet (91 meters) with the detector mounted at a height of 30 feet (9.1 m) above the roadway surface. Output shall be Composite video 75 Ohm Ivt CCIR/EIA. Where called for on the plans, the Detector mounting shall include hardware for mounting on the traffic signal mast arm. The mounting bracket shall position the Detector approximately five feet (5') [1.5 m] above the arm as shown on the plans.

**(b) Video Detector-Radio Interface (RX).** Where radio interface (RX) is specified, the Video Detector shall include an FCC approved radio transmitter unit (RX). RX may be internal to camera, or mounted separately in a cabinet. Where mounted separately, furnishing and installation of the cabinet shall be considered included in the unit price bid for the Video Detector-RX. Receiver/Transmitter system shall have a minimum range of 1500 feet (457 m), line of sight. Furnishing and installation of the antenna, antenna cable, wire, and all wiring shall be considered included in the unit price bid for Video Detector-RX.

**(c) Video Radio Receiver.** Unit shall be shelf mounted. Power supply may be separate or internal, but shall not require power from the traffic signal controller unit (timer). The unit shall receive radio signals from the number channels specified, and relay video signal to the Video Processor unit. The furnishing and installation of the antenna, antenna cable, wire, and all wiring shall be considered included in the unit price bid for Video Radio Receiver.

**(d) Video Processor Unit.** The unit shall be located in a cabinet provided under the item "Actuated Controller". Processor shall provide for a minimum of 24 detector zones, which are user selectable and programmable. Furnishing and installation of the wiring and wiring harness from the Video Processor Unit to the traffic signal controller shall be considered subsidiary to the unit price bid for Video Processor Unit. The Video Processor Unit shall comply with the following:

Video Input:	Composite video 75 Ohm Ivtt CCIR/EIA
Output:	Analog video output with system information, data and detection zones
	8 isolated vehicle detection channels
	Auto diagnostic LED indicators for state of tuning, fault or error condition

One programming module per job shall be provided for alignment and setup of Detector. This shall be considered subsidiary to the Video Processor Unit.

**(e) Video Cable.** Video cable shall be the type and size recommended by the manufacturer of the Video Processor Unit and shall consist of all cable necessary for supplying power to the Detector, transferring programming information to and from a remote data terminal, and for transfer of video data between the Video Detector and the Video Processor Unit. No splices are allowed in Video Cable without specific approval of the engineer.

**(f) Video Monitor.** Where called for in the plans, a video monitor meeting the following shall be provided:

- Display - Black & White (B/W) or Color (Clr) as specified
- Size -9" (225 mm) Diagonal
- Input/Output looping with 75/High Ohm Switchable, BNC Termination
- Power Indicator light and switch
- Input Power - 120 VAC

**(g) Remote Video Monitoring.** Live video monitoring shall be available via. telephone dial up utilizing a modem as specified in the plans.

**733.03 Construction Requirements.** The Video Detector is typically installed on a pole, arm or other structure as described on the plan sheets.

**(a) Installation.** The Contractor shall furnish and properly install each unit with accessory equipment and perform the necessary connections, testing of circuits, adjustments, and such other operations as may be necessary to ensure that each complete installation, with all of its components, be completely integrated and tested as a unit so that the desired control of the system is attained, complete, and in the best of working order, to the satisfaction of the Engineer.

**(b) Setup and Programming.** The Contractor shall provide all necessary equipment for testing, configuring detection zones, on-site monitoring, and other programming of video processor unit and Detector(s) utilized in the system. Any equipment required for programming but not listed in the summary of quantities will remain the property of the contractor but shall be available for further testing and reconfiguring of the zones until the project is accepted as final.

**(c) Software.** Software required for monitoring, setup and programming of the system shall be supplied as subsidiary to the item "Video Processor" of the number of channels specified. Two licensed copies shall be provided for each project. Software shall be Windows based and operate on a system using an IBM compatible laptop with Intel Pentium III processor and Windows 2000 or later operating system. If any other programming device is required for the equipment supplied, the Contractor shall supply one device which shall become the property of the Department or agency responsible for operation of the signal. No additional payment will be made for furnishing the programming device(s).

**(d) Remote Video Site Modification.** The Contractor shall remove all unnecessary equipment; modify the existing cabinet, wiring, and conduit as needed; and provide and install any incidental devices, suppressors, brackets and wiring; and program and test the device.

**(e) Documentation, System Timing and Operation Test.** The Contractor shall provide a minimum of 14 days notice prior to placing the system into operation. A manufacturer's representative

shall be present at the time of turn on and shall provide assistance and operational instructions to Department personnel in setup and programming of the system.

**733.04 Method of Measurement.** Work completed and accepted under this item will be measured as follows:

- (a) Video Detector shall be measured by the unit.
- (b) Video Detector-RX shall be measured by the unit.
- (c) Video Detector Relocation shall be measured by the unit.
- (d) Video Radio Receiver of the number channels specified, shall be measured by the unit.
- (e) Video Processor, of the number channels specified, shall be measured by the unit.
- (f) Video Cable shall be measured by the linear foot (meter).
- (g) Video Monitor of the type specified will be measured by the unit.
- (h) Remote Video Site Modification shall be measured by the unit.

**733.05 Basis of Payment. (a) Video Detector.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Video Detector; which price shall be full compensation for providing and installing the device, wiring and testing, aligning the zones; and shall also be for all labor, equipment, tools and incidentals necessary to complete the work.

**(b) Video Detector-RX.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Video Detector-RX; which price shall be full compensation for providing and installing the device, brackets and extension, wiring; for programming and testing the device; for furnishing and installing cabinet for separate radio transmitter unit installations; for furnishing and installing the antenna, antenna cable, wire, and all necessary wiring; and for all labor, equipment, tools and incidentals necessary to complete the work.

**(c) Video Detector Relocation.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Video Detector Relocation; which price shall be full compensation for removing the device from present site, installing the device at the new location, and for furnishing and installing brackets and extensions, wiring and testing; and for all labor, equipment, tools and incidentals necessary to complete the work.

**(d) Video Radio Receiver.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Video Radio Receiver of the number channels specified; which price shall be full compensation for providing and installing the device, brackets and extensions, wiring and testing the device; and for furnishing and installing the antenna, antenna cable, wire, and all necessary wiring.

**(e) Video Processor.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Video Processor of the number channels specified; which price shall be full compensation for providing and installing the device, wiring, configuring, and testing the device; furnishing and installing wiring and wiring harness from the video processor unit to the traffic signal controller; and for all labor, equipment, tools and incidentals necessary to complete the work.

**(f) Video Cable.** Work completed and accepted under this item and measured as provided above shall be paid for at the contract price bid per linear foot (meter) for Video Cable; which price shall be full compensation for providing and installing all cable, including video, power supply and data cables from the Video Processor to the Video Detector, which cable shall not be measured separately but as one unit per Detector; and shall include all labor, equipment, tools and incidentals necessary to complete the work.

**(g) Video Monitor.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Video Monitor of the type specified; which price shall be full compensation for providing and installing the device, wiring, configuring, and testing the device; and for all labor, equipment, tools and incidentals necessary to complete the work.

**(h) Remote Video Site Modification.** Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price for Remote Video Site Modification; which price shall be full compensation for removing all unnecessary equipment; modifying existing cabinet, wiring and conduit as needed; and for providing and installing any incidental devices, suppressors, brackets and wiring; and for programming and testing the device.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Video Detector	Each
Video Detector –RX	Each
Video Detector Relocation	Each
Video Radio Receiver (__ Channel)	Each
Video Processor (__ Channel)	Each
Video Cable	Linear Foot (Meter)
Video Monitor (CLR)	Each
Video Monitor (B/W)	Each
Remote Video Site Modification	Each

## **SECTION 734 BRIDGE END TERMINAL**

**734.01 Description.** This item shall consist of furnishing and installing an acceptable crashworthy terminal at bridge ends at the locations shown in the plans or as directed by the Engineer. The bridge end terminal shall satisfy the National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH) requirements for a test level 3 (TL-3) terminal.

The bridge end terminal shall be of a configuration that will be compatible with the subgrade width and site geometry shown on the plans. Bridge end terminals that require grading beyond the limits shown on the plans will not be acceptable.

**734.02 Materials. (a) Foundation Pad and Backup Wall.** Concrete shall conform to the requirements of Section 802 for Class A or Class S Concrete or Section 501 for paving concrete. The

Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06. Reinforcing steel shall conform to the requirements of Section 804.

**(b) Bridge End Terminal.** The Contractor shall furnish a certification from the manufacturer or supplier that the bridge end terminal is non-gating, redirective and meets the requirements of NCHRP Report 350 or MASH for a TL-3 terminal. All materials shall be new and shall conform to the most current specifications and details recommended by the manufacturer and as approved by the Engineer. All parts shall be clearly identified for proper assembly and replacement.

The Contractor shall provide the Engineer with copies of all necessary manufacturer's details and installation manuals prior to the installation of the bridge end terminal on the project. These materials shall remain the property of the Department.

**734.03 Construction Requirements.** The subgrade for the foundation pad shall be shaped and compacted to the required section as directed by the Engineer.

The foundation pad, including curb transition from bridge ends, and backup wall, if required, shall be constructed according to the details provided by the manufacturer.

The bridge end terminal shall be fabricated and installed according to the manufacturer's most current recommendations and installation methods. Any damage caused by the Contractor to the materials required for the bridge end terminal shall be repaired or replaced immediately at no cost to the Department.

**734.04 Method of Measurement.** Bridge End Terminal completed and accepted under this item will be measured by the unit. Each unit shall include one bridge end terminal, foundation pad with curb transitions and backup wall, if required.

**734.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Bridge End Terminal, which price shall be full compensation for shaping and compacting the subgrade; for constructing the foundation pad, with curb transitions; for constructing the backup wall, if required; for furnishing and

installing the bridge end terminal; and for all materials, labor, equipment, tools and incidentals necessary to complete the work.

**Pay Item**

**Pay Unit**

Bridge End Terminal

Each



**DIVISION 800  
STRUCTURES**

**SECTION 801  
EXCAVATION AND BACKFILLING**

**801.01 Description.** The work under this item shall include the removal of material, of whatever nature, necessary for the construction of foundations for bridges, box culverts, and retaining walls according to the plans or as directed. It shall include the furnishing of necessary equipment and the construction of cofferdams, shoring, etc., which may be necessary for the execution of the work. It shall also include dewatering and the subsequent removal of cofferdams and shoring and the backfilling with suitable materials as herein specified. It shall also include the disposal of excavated material not required for backfill, in a manner and in locations as herein specified and/or as shown on the plans. Compliance with the applicable provisions of Section 110 is an essential requirement of work performed under this Section. Unless a specific pay item is provided in the Contract, work required to comply with Section 110 will not be paid for separately but will be considered subsidiary to other items of the work.

**801.02 Preservation of Channel.** No excavation shall be made within stream channel limits outside a vertical plane 3' (1 m) from the footing lines and parallel thereto unless approved by the Engineer. Unless otherwise specified, no excavation shall be made outside of cofferdams, caissons, or shorings without the permission of the Engineer. If excavation or dredging is allowed at the site of the structure before cofferdams, caissons, or shorings are sunk or in place, the Contractor shall, at no cost to the Department, and after the foundation is in place, backfill such excavation to the original ground surface or stream bed elevation with gravel or crushed rock material satisfactory to the Engineer. Excavated material not used for backfill shall be disposed of according to Section 210.

**801.03 Depth of Footings.** The elevation of the bottoms of footings, as shown on the plans, shall be considered as approximate only. The Engineer may require such changes in dimensions or elevations as may be necessary to secure a satisfactory foundation.

After each bridge footing in rock excavation has been completed to plan elevation, one hole 1½" (35 mm) or more in diameter shall

be drilled to a minimum depth of 5' (1.5 m) for each 50 square feet (5 sq m) or less of bearing area. If the footing elevation is then lowered, the same pattern of such holes shall be drilled after the new excavation has been completed. No direct payment will be made for this drilling as it is considered a part of the items of excavation for structures.

**801.04 Preparation of Foundations.** Foundations, where practicable, shall be constructed in open excavation and, where necessary, the excavated faces shall be sloped, shored, or protected by cofferdams according to approved methods.

Rock or other hard foundation material shall be reasonably free of loose material. The foundation excavation shall be cleaned and cut to a firm surface, either leveled, stepped, or roughened, as directed by the Engineer. Seams shall be cleaned and filled with concrete, mortar, or grout. Excavation in rock shall be made to neat line of footings. When the use of explosives has been approved by the Engineer, care shall be exercised to avoid shattering rock faces by excessive blasting. The Contractor shall be responsible for any extra work and associated costs caused by excessive blasting.

When concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. As a minimum, the final 1' (0.3 m) of excavation shall be completed by hand methods. The final removal of the foundation material to grade shall not be made until just before the concrete is to be placed. Foundation pits shall be kept dry and free of flowing water.

Details for all excavation and/or shoring for foundation work adjacent to operated railroad tracks and plans of falsework, staging, protective sheeting, or other temporary construction near the operated track, shall be approved by the Railroad Company prior to beginning the work. The Contractor shall construct the work according to the approved plans.

**801.05 Cofferdams. (a) General.** Cofferdams for foundation construction shall be safely designed and constructed, and made as watertight as is necessary for proper performance of the work. The interior dimensions of cofferdams shall provide sufficient clearance for dewatering, the construction of forms, and for inspection.

Cofferdams that are tilted or moved laterally shall be righted, reset, or enlarged as necessary. This shall be at no cost to the Department.

When natural conditions are encountered that render it impracticable to dewater the foundation before placing concrete, the Engineer may require the construction of a concrete foundation seal of such dimensions as may be necessary, according to Subsection 802.11. The water shall then be pumped out and the balance of the concrete placed in the dry. During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal.

**(b) Protection of Concrete.** Cofferdams shall be constructed so as to protect the concrete against damage from a sudden rising of the stream and to prevent damage to the foundation by erosion. No bracing shall be left in cofferdams in such a way as to extend into the substructure concrete without the written permission of the Engineer.

**(c) Details Required.** Details for each unit of cofferdam construction, complete with dimensions and kind and condition of materials, shall be submitted to the Engineer prior to construction, for informational and record purposes. These details shall be prepared and/or approved by a Registered Professional Engineer who shall certify that the adequacy of all components has been verified. File copies of all design calculations shall be maintained by the Contractor until final acceptance of the project. The Contractor shall be responsible for the results obtained by the use of the cofferdam design. Construction of the cofferdam shall be according to the details submitted to the Engineer for informational purposes.

**(d) Removal.** Unless otherwise provided, the cofferdams, sheeting, and bracing shall be removed after the completion of the substructure. Care shall be taken not to damage the finished concrete.

**801.06 Dewatering Foundations.** Pumping from the interior of any foundation enclosure shall be performed in such a manner as to prevent the movement of water through the fresh concrete. No pumping will be permitted during the placing of concrete unless it is performed from a suitable sump separated from the concrete work.

The pumping shall continue until the placement of the concrete is completed.

**801.07 Inspection.** After each excavation is completed, the Contractor shall notify the Engineer. No concrete shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

**801.08 Backfill.** Spaces outside the streambed excavated for and not occupied by abutments, piers, or other permanent work shall be backfilled and compacted to the general level of the surrounding ground. This work shall be performed immediately after completion of each unit of concrete work and after the forms have been removed and the concrete has reached its minimum required strength. Material used for backfill shall be of the same quality as that removed and shall be reasonably free from large or frozen lumps, wood, and other extraneous material.

Piers located within the streambed need not be backfilled unless directed on the plans or as required by the Contractor's cofferdam removal procedure. Material for backfilling in the streambed shall be reasonably clean gravel or crushed rock.

Backfill within the roadway embankment and immediately adjacent to bridge abutments, culverts, retaining walls, or other places inaccessible to rollers, shall be placed in approximately 6" (150 mm) horizontal layers, loose measurement, at near optimum moisture content, and compacted with mechanical equipment to 95% of the maximum density as determined by AASHTO T 99. The specified density will not be required immediately adjacent to wingwalls of box culverts. The backfill in front of such units shall be placed first to prevent the possibility of forward movement. Special precautions shall be taken to prevent any wedging action against the concrete, and the slope bounding the excavation for abutments and wingwalls shall be stepped or roughened to prevent wedge action. Jetting of the fill behind abutments and wingwalls will not be permitted. Backfill for box culverts shall be placed equally on both sides of the culvert in 6" (150 mm) lifts, loose measurement, and compacted as required above.

Fill placed around piers shall be deposited uniformly on all sides to approximately the same elevation.

No backfill shall be placed against abutments, retaining walls, or box culverts until the concrete has cured for at least 14 days or until test cylinders show that the minimum strength has been obtained.

Backfilling of structural plate pipe and arches shall be according to Subsection 608.03(d).

The Department will perform acceptance sampling and testing of compacted backfill material in accordance with Subsection 210.10 at the frequencies established in the Department's *Manual of Field Sampling and Testing Procedures*.

**801.09 Classification of Excavation.** Where excavation is not classified, all excavation will be grouped under the items Unclassified Excavation for Structures-Bridge or Unclassified Excavation for Structures-Roadway. These items shall include the removal of all materials encountered regardless of their nature or the manner in which they are removed.

Where excavation is classified it shall be classed as Common Excavation for Structures-Bridge, Common Excavation for Structures-Roadway, Rock Excavation for Structures-Bridge, or Rock Excavation for Structures-Roadway, according to the following criteria:

\* Common Excavation for Structures-Bridge and Common Excavation for Structures-Roadway shall include the removal of all materials encountered, regardless of their nature, other than rock as defined in the items Rock Excavation for Structures-Bridge or Rock Excavation for Structures-Roadway.

\* Rock Excavation for Structures-Bridge and Rock Excavation for Structures-Roadway shall include the removal of such firm and compact materials as cannot be excavated without first being loosened or broken by blasting, sledging, or drilling.

Water is not considered a material for the purposes of excavation.

**801.10 Method of Measurement.** Work under this item will be measured by the cubic yard (cubic meter). The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

Where cofferdams are required, the quantities of excavation for bridges, as shown on the plans for the cofferdam location, shall be considered as final quantities and no further measurement will be made unless it becomes necessary to carry the footing or seal concrete below the elevation shown on the plans.

Plan quantities and the adjustments thereof are based on vertical planes parallel to and 18" (450 mm) outside the neat lines of the footing or bottom slab and wings when in material other than rock, and vertical planes parallel to and 4" (100 mm) outside the footing or bottom slab and wings in rock for all foundations except seal foundations. Plan quantities and the adjustments thereof for seal foundations are based on vertical planes parallel to the neat line of seal.

The quantities do not include the volume of any material that lies within the typical roadway cut section or within a channel change section.

When it is necessary, as directed by the Engineer, to lower the bridge footing elevation below the elevation shown on the plans, such excavation will be measured and adjusted according to the following schedule:

<b>Depth of Bridge Footing Excavation Below Plan Grade</b>	<b>Adjustment</b>
Material between 0' and 3' (0 and 1 m) below elevation shown:	Actual Volume
Material between 3' and 7' (1 m and 2 m) below elevation shown:	Actual Volume + 50%
Material deeper than 7' (2 m) below elevation shown:	Actual Volume + negotiated adjustment factor.

When undercutting for box culverts or box culvert extensions is directed by the Engineer, the Engineer may direct that the undercut section be backfilled with roadway excavation material, borrow, or Stone Backfill. If the Engineer directs that Stone Backfill be used for backfill, the volume of excavation for undercut will not be measured for payment, and the backfill will be measured and paid for as Stone Backfill in accordance with Section 207.

If the Engineer directs that roadway excavation or borrow be used for backfill of the undercut section, the volume of excavation

for the undercut will be measured by length, width, and average depth, and the computed volume will be paid for as Unclassified Excavation in accordance with Section 210. The backfill material will be included in the measurement and payment for the appropriate earthwork items under Section 210.

Undercutting and backfilling with upgraded material for the Contractor's convenience shall be at no cost to the Department.

When the item Cofferdam is included in the Contract, each cofferdam will be measured by the unit.

**801.11 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Unclassified Excavation for Structures-Bridge, Common Excavation for Structures-Bridge, Rock Excavation for Structures-Bridge, Unclassified Excavation for Structures-Roadway, Common Excavation for Structures-Roadway, or Rock Excavation for Structures-Roadway, as the case may be, which price shall be full compensation for site preparation, excavation, and backfill; for shoring, bracing, cribbing, cofferdams, pumping, or dewatering; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Excavation for bridge length culverts will be included in Excavation for Structures-Roadway.

Unclassified, Common, or Rock Excavation for Structures-Roadway for box culvert extensions will be measured and paid for at the quantity shown on the plans.

When the item Cofferdam is included in the Contract, work completed and accepted as provided above will be paid for at the contract unit price bid per each for Cofferdams, which shall be full compensation for preparation of necessary design details and/or Registered Professional Engineer certifications; for furnishing and installing all materials; for shoring, bracing, pumping, dewatering, maintenance, removal, backfilling, and satisfactory clean-up of the area; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Unclassified Excavation for Structures-Bridge	Cubic Yard (Cubic Meter)
Common Excavation for Structures-Bridge	Cubic Yard (Cubic Meter)
Rock Excavation for Structures-Bridge	Cubic Yard (Cubic Meter)
Unclassified Excavation for Structures-Roadway	Cubic Yard (Cubic Meter)
Common Excavation for Structures-Roadway	Cubic Yard (Cubic Meter)
Rock Excavation for Structures-Roadway	Cubic Yard (Cubic Meter)
Cofferdam	Each

**SECTION 802  
CONCRETE FOR STRUCTURES**

**802.01 Description.** This item shall consist of concrete in bridges, culverts, and miscellaneous structures, including the concrete portion of steel, timber, stone masonry, precast, prestressed, and composite structures, prepared and constructed according to these specifications and conforming to the lines, grades, dimensions, and designs shown on the plans. Concrete shall consist of approved portland cement, fine aggregate, coarse aggregate, water, and any approved chemical admixtures mixed in the proportions specified for the various classes of concrete.

**802.02 Materials.** The materials used in concrete shall conform to the requirements specified below. No materials shall be used that contain foreign matter, frost, or lumps or crusts of hardened substances.

**(a) Cement.** Unless otherwise specified, Portland cement conforming to the requirements of AASHTO M 85, Type I shall be furnished.



One of the following blended cements may be used in lieu of Type I:

- Portland-Pozzolan Cement, AASHTO M 240, Type IP (20% maximum)
- Slag-Modified Portland Cement, AASHTO M 240, Type IS (25% maximum)

Fly ash or slag cement shall not be substituted for blended cements. Cement shall be from sources that are listed on the Department's Qualified Products List and that have executed a certification agreement with the Department.

The total alkalis in the Portland cement ( $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$ ) shall not exceed 0.60%. The total alkalis in the cementitious material (Portland cement, fly ash or ground granulated blast-furnace slag) shall not exceed 5 lbs./cu yd (3 kg/cu m). In lieu of using low alkali cement as specified, the Contractor may choose alternative testing of the proposed aggregates and cementitious materials as follows:

Option 1 – Test the fine and coarse aggregate sources in accordance with AASHTO T 303. If the 14 day expansion  $\leq 0.10\%$ , the requirement for low-alkali cement is waived. If the 14 day expansion is greater than 0.10%, further testing per Option 2 below is required using slag cement or fly ash.

Option 2 – Test using the specific job materials and selected replacement level of supplemental cementitious materials (slag cement or fly ash) proposed for the project according to AASHTO T 303. If the 14 day expansion is  $\leq 0.10\%$ , the requirement for low-alkali cement is waived. If the 14 day expansion is greater than 0.10%, additional testing with a different cement, different supplemental cementitious material, and/or different replacement level is required.

Type II (MH), Moderate Heat of Hydration, cement shall be used for Class B concrete. During the cool season of the year, the Engineer may approve the use of Type I cement in lieu of Type II (MH) cement for Class B concrete. Upon approval of the Engineer, Type III cement may be used in the manufacture of prestressed concrete products.

Cement furnished in sacks shall weigh not less than 94 pounds (42.6 kg) per sack.

The mixing or alternate use of cement from different manufacturing plants will not be permitted. The source of cement shall not be changed without the written approval of the Engineer. Cement placed in storage shall be suitably protected. Loss in quality occurring during the storage period will be cause for rejection. If the cement furnished produces erratic results under the field conditions incident to the placing of the concrete, or in regard to the strength of the finished product, or in the time of the initial or final set, the Contractor shall, without notice from the Engineer, cease the use of that source of cement.

**(b) Fine Aggregate.** The fine aggregate shall consist of clean, hard, durable particles of natural sand or other approved inert material with similar characteristics.

When determined necessary by visual observation, the amount of deleterious substances will be tested by laboratory methods and shall not exceed the following limits:

**Maximum Permissible  
Percent by Weight**

Coal and lignite (AASHTO T 113)	0.25
Clay lumps (AHTD Test Method 302)	0.5
Removed by decantation (AASHTO T 11)	2.0
Soft and flaky particles (AHTD Test Method 302)	2.0

All fine aggregate shall be free from injurious amounts of organic impurities.

Aggregates shall be subjected to testing according to AASHTO T 21. Should AASHTO T 21 produce results that indicate that the sand may possibly contain injurious or damaging organic compounds, mortar strength test specimens shall be tested according to AASHTO T 71, such that the fine aggregate has a compressive strength of 95% of the standard sand samples at 7 days.

Fine aggregate shall comply with the following grading requirements when tested according to AASHTO T 27:

<b><u>Sieve (mm)</u></b>	<b><u>Percent Passing</u></b>
3/8" (9.5)	100
#4 (4.75)	95-100
#8 (2.36)	70-95
#16 (1.18)	45-85
#30 (0.600)	20-65
#50 (0.300)	5-30
#100 (0.150)	0-5

The fineness modulus of the fine aggregate shall not vary more than 20 points from the established value of the fine aggregate used in the mix design. In the event that the fineness modulus exceeds 20 points, a new mix design will be required. When approved by the Engineer, the source of fine aggregate may be changed in all work except bridge superstructures, but the mixing or alternate use of different sources of fine aggregate will not be permitted.

**(c) Coarse Aggregate.** The coarse aggregate shall consist of crushed stone or gravel.

Crushed stone shall consist of clean and durable fragments of rock of uniform quality. The stone shall have a percent of wear of not more than 40 by Los Angeles Test (AASHTO T 96), and, when subjected to 5 cycles of the Soundness Test (Sodium Sulfate, AASHTO T 104) shall have a loss not to exceed 12%. Gravel shall consist of clean, hard, durable, uncoated aggregate, crushed or uncrushed, having a percent of wear of not more than 40 by Los Angeles Test (AASHTO T 96).

When determined necessary by visual observation, the amount of deleterious substances will be tested by laboratory methods and will not exceed the following limits:

	<b><u>Maximum Permissible Percent by Weight</u></b>
Coal and lignite (AASHTO T 113)	0.25
Clay lumps (AHTD Test Method 302)	0.25
Soft Fragments (AHTD Test Method 302)	5.0
Total deleterious substances	5.0
Removed by decantation (AASHTO T 11)	1.0

The maximum percentage by weight removed by decantation (AASHTO T 11) from crushed stone coarse aggregate may be increased to 1.5% provided the percent loss (AASHTO T 11) from the fine aggregate does not exceed 1.0% or to 1.8% provided the percent loss from the fine aggregate does not exceed 0.5%.

Coarse aggregate shall comply with the following grading requirements when tested according to AASHTO T 27:

**Class A, S, S(AE), and Seal Concrete:**

Sieve (mm)	% Passing	
	Standard Gradation AHTD	Alternative Gradation AASHTO M43 #57
1½" (37.5)	-	100
1¼" (31.5)	100	-
1" (25.0)	60-100	95-100
¾" (19.0)	35-75	-
½" (12.5)	-	25-60
⅜" (9.5)	10-30	-
#4 (4.75)	0-5	0-10
#8 (2.36)	-	0-5

**Class B Concrete:**

Sieve (mm)	Percent Passing
3" (75)	100
1¼" (31.5)	35-65
¾" (19.0)	15-40
#4 (4.75)	0-5

The fineness modulus of the coarse aggregate shall not vary more than 20 points from the established value of the coarse aggregate used in the mix design. In the event that the fineness modulus exceeds 20 points, a new mix design will be required. When approved by the Engineer, the source of coarse aggregate may be changed in all work except bridge superstructures, but the mixing or alternate use of different sources of coarse aggregate will not be permitted.

**(d) Water.** Water used in mixing or curing shall be clean and free from injurious amounts of oil, salts, or other deleterious substances, and shall not contain more than 1000 ppm of chlorides.

Water from municipal supplies approved by the State Health Department will not require testing but water from other sources shall be sampled and tested before use in concrete.

Tests will be made according to AASHTO T 26.

Where the source of water is relatively shallow, it shall be maintained at such depth and the intake so enclosed as to exclude silt, mud, grass, or other foreign materials.

**(e) Admixtures. (1) General.** Admixtures shall be used to improve certain characteristics of the concrete when specified on the plans or may be used when requested by the Contractor and approval is given by the Engineer. The Contractor's request shall be supported with the manufacturer's certified formulation of the proposed admixture and with sufficient evidence that the proposed admixture has given satisfactory results on other similar work. Permission to use the admixture may be withdrawn at any time by the Engineer when satisfactory results are not being obtained.

Admixtures shall be approved by the Engineer. Admixtures shall be compatible with each other, as advised by the manufacturer. The admixture dosage rate range as recommended by the manufacturer shall be used. Should the dosage rate for any admixture not yield desirable characteristics in the concrete, the dosage of admixture used shall be based on test results obtained by trial batches.

Admixtures shall be added to the mixing water by means of a mechanical dispenser that will accurately meter the additive throughout the mix water cycle. The dispenser shall be constructed and connected so that the amount of admixture entering the mixing water can be readily determined.

**(2) Air Entraining Agent.** Air entraining agent shall comply with the requirements of AASHTO M 154 and be approved by the Engineer. Permission to use the agent may be withdrawn at any time by the Engineer when satisfactory results are not being obtained.

**(3) Retarding Agent.** In order to permit the retarding of the set and extend the finishing time of concrete, a retarding agent shall be used when specified on the plans or may be used when permission

for its use is requested by the Contractor and such permission is given by the Engineer. The retarding agent shall be a Type B or Type D admixture as defined in AASHTO M 194. Permission to use the agent may be withdrawn at any time by the Engineer when satisfactory results are not being obtained.

The agent shall be free of intentionally added chlorides or chloride containing compounds as a functional ingredient. When air-entrained concrete is specified, the air-entraining agent and the retarding agent shall be so incorporated that the air content of the concrete shall fall within the percentage range stipulated in the specifications. When air-entrained concrete is not specified, the concrete to which the retarding agent has been added shall have air content not greater than 3 percent.

No compensation will be made for furnishing and incorporating the agent in the mix. No additional compensation will be made for furnishing, placing, finishing, and curing the concrete involved.

**(4) Other Admixtures.** The use of other admixtures will be considered by the Engineer on a case by case basis upon written request from the Contractor. When admixture(s) affecting the slump of the plastic concrete are approved by the Department, the Department may, upon request of the Contractor, modify the concrete slump requirements for that concrete utilizing this approved additive. If approved, the admixture used shall be furnished at no additional cost to the Department. Permission to use an admixture may be withdrawn at any time by the Engineer when satisfactory results are not being obtained.

**(f) Fly Ash.** Fly ash used in concrete shall meet the requirements of AASHTO M 295, Class C or F. Mixing of Class C and Class F fly ashes will not be permitted.

**(g) Slag Cement.** Slag cement used in concrete shall meet the requirements of AASHTO M 302, Grade 100 or higher.

**802.03 Handling and Storage of Materials.** The handling and storage of concrete aggregates shall be such as to prevent segregation and contamination with foreign materials.

Coarse and fine aggregates shall be separated by bulkheads or stored in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed. Coarse aggregate stockpiles not confined by bulkheads

or bins shall be built up in layers not to exceed 4' (1.2 m) in height and each layer shall be completely in place before beginning the next. Coning or building up of stockpiles by depositing material in one place will not be permitted. In order to control the gradation of the large aggregate for Class B concrete, it may be necessary that the Contractor stockpile the aggregate in two or more gradation ranges, blending by weight as required to obtain the specified gradation.

There shall be adequate aggregate stockpiled to allow representative sampling sufficiently in advance of any placement to determine its acceptability, with the minimum amount being that required to adequately complete the planned placement.

Cement shall be stored in suitable weather-proof buildings or silos that will protect the cement from dampness. Provision for storage shall be ample and the shipments of cement as received shall be separately stored in such a manner as to provide easy access for the identification and inspection of each shipment. Stored cement shall meet the test requirements at any time after storage when a re-test is ordered by the Engineer.

On small jobs, storage in the open may be permitted by written authorization from the Engineer, in which case a raised platform and ample waterproof covering shall be provided.

**802.04 Classes of Concrete.** The appropriate class of concrete shall be used in the part of the structure as specified or where designated by the Engineer. The classes are as follows:

<u>Non Air-entrained Concrete</u>	<u>Air-entrained Concrete</u>	<u>Miscellaneous Concrete</u>
Class A	Class S(AE)	Class M
Class B		
Class S		
Seal		

The following requirements shall govern unless otherwise shown on the plans:

Class A concrete shall be used in wingwalls and miscellaneous construction.

Class B concrete shall be used in mass concrete.

Class S or S(AE) concrete shall be used in retaining walls, box culverts, footings, piers, bents, columns, abutments, and

superstructures, including girders, beams, floor slabs, and parapet walls.

Seal concrete shall be used for concrete deposited under water.

Class M concrete shall be used in miscellaneous construction as specified in Sections 500, 600, and 700.

Class S(AE) may be substituted for Class S. Class S(AE), Class S or paving concrete under Section 501 may be substituted for Class A. Acceptance criteria for strength, water/cement ratio, and slump shall be that of the Class specified. Different classes of concrete shall not be mixed in the same continuous placement.

When Class M concrete is specified, the Contractor may use any commercially produced concrete mix or an approved Class A, S, S(AE), or paving concrete under Section 501. Unless otherwise specified, bagged commercial concrete mix may not be used for Class M concrete. For acceptance purposes, the minimum strength, maximum water/cement ratio, and maximum slump shall be that specified for Class A concrete. For small placements (approximately 1 cubic yard m [ 1 cu m] or less), the concrete may be mixed on site using a portable mixer. The size of each batch shall not exceed 80% of the manufacturer's rated capacity of the mixer. When mixing on site, and with the prior approval of the Engineer, the materials for each batch may be measured by volume by converting the mix design weights of each material to equivalent volumes.

**802.05 Mix Design. (a)General.** The concrete mixture shall be proportioned to ensure a workable and durable concrete for the various classes, as specified in Table 802-1.

The Engineer will not perform any pre-bid testing of materials. It will be the Contractor's responsibility to locate acceptable material sources unless the sources are so noted in the plans or Special Provisions.

**(b) Mix Design by the Contractor.** The proportions to be used in the mix for each class shall be determined by the Contractor using the absolute volume method. The Contractor may use the procedure provided in the ACI Standard 211.1 or Portland Cement Association "Design and Control of Concrete Mixtures", modified to comply with the minimum cement content and maximum water/cement ratio specified for the class of concrete. Prior to the start of production of the concrete mixture, the Contractor shall submit test results and/or



certifications for all materials and detailed mix design data to the Engineer for review. Aggregate, fly ash, and slag cement material properties used in the mix design shall be representative of the exact materials proposed for use. The testing source (commercial laboratory, qualified technician, AHTD provided data, etc.) and the date of the test shall be provided. The specific plant sources for the cement, fly ash or slag cement, and aggregates shall be shown on the mix design. The documentation submitted with the mix design shall specify which procedure was used and whether oven dry or saturated surface dry weights were used in the calculations. The mix design shall specify the quantity of each component of the mix, including all authorized additives. Acceptance of the mix design by the Engineer will be based on apparent conformity to the requirements shown in Table 802-1. If the mix design fails to produce acceptable results or if there is a change in the aggregates, fly ash, or cement being used, a new mix design will be required. It shall remain the Contractor's responsibility during production to produce concrete conforming to the mix design and the minimum acceptance criteria specified. When requested by the Engineer, the Contractor shall submit samples of all materials for verification testing. Production shall not begin until the mix design is accepted by the Engineer.

A mix design submitted for acceptance need not be prepared specifically for this project, but may be a previously accepted design that uses the same materials and meets the same design criteria.

Mix designs accepted under this section will become the property of the Department and may be accepted for use on other projects, by other contractors, or by the Department.

**(c) Trial Batches.** Mix designs proposed by the Contractor for all Class S(AE) and Class B concretes shall be tested by trial batches using the specific materials, including admixtures that are intended for use on the job. The Contractor shall prepare a plant batch of at least 2 cubic yards (1.5 cu m) or one-third the rated capacity of the mixer, whichever is greater. In lieu of the plant batch, the Contractor may prepare trial batches in a laboratory according to AASHTO T 126. These trial batches shall be accomplished by the Contractor under the observation of the Engineer. Sampling and testing will be conducted by the Engineer. These batches shall be sampled and tested for compliance with the specifications for slump, air content, and compressive strength.

**TABLE 802-1**  
**Class of Concrete**

<b>Characteristic</b>	<b>A</b>	<b>B</b>	<b>S</b>	<b>S(AE)</b>	<b>Seal</b>
Minimum Compressive Strength (psi [MPa] at 28 days)	2100 [15.0]	3000 [21.0]	3500 [24.0]**	4000 [28.0]**	2100 [15.0]
Minimum Cement Factor (bags per cubic yard) [kg/cu m]	5.5 [307]	*	6.5 [362]	6.5 [362]	6.0 [335]
Maximum Water/Cement Ratio (gal. per bag) [kg/kg]	6.5 [0.58]	*	5.5 [0.49]	5.0 [0.44]	6.5 [0.58]
Slump Range (inches) [mm]	1"-4" [25-100]	1"-4" [25-100]	1"-4" [25-100]	1"-4" [25-100]	4"-8" [100-200]
Air Content Range (%)	--	--	--	6 ± 2	--

\* As determined by trial batch. Maximum water-cement ratio is 0.49. In addition, Class B shall obtain 3500 psi (24.0 MPa) compressive strength in the trial batch at 90 days.

\*\* Class S or S(AE) concrete for use in prestressed concrete members shall have a minimum compressive strength of 5000 psi (35.0 MPa) at 28 days unless otherwise shown on the plans. The maximum size of coarse aggregate shall be 1" (25 mm).

In lieu of the above procedure, the Contractor may retain an approved independent laboratory or a Registered Professional Engineer to prepare and test trial batches. In this case, trial batch information and laboratory results shall be furnished to the Engineer along with a statement certifying that the testing was performed according to the specifications.

For Class S(AE) concrete the air-entrainment shall be accomplished by adding to the mixing water the proper amount of air-entraining agent in solution. The Contractor shall determine the amount of admixture required to produce air content within the range specified. The amount of air entraining agent shall be adjusted by the Contractor during production as necessary to keep the air content within the range specified. A mix design may be approved with respect to compressive strength when at least two test cylinders show the minimum required strength value at any age between 7 days and 28 days, inclusive.

For Class B concrete, the mix design shall produce a workable and durable concrete meeting the minimum strength requirements specified in Table 802-1 and shall have a low heat of hydration when placed in large quantities. Fly ash conforming to AASHTO M295 may be substituted for a part of the Type II (MH) Cement not to exceed 120 pounds per cubic yard (70 kg/cu m) of concrete, and shall be included in the calculation of the water/cement ratio. Ninety-day test specimens will be required for Class B trial batches. For construction purposes, the sampling and testing will comply with standard procedures for sampling and testing.

All trial batches required by these specifications or developed at the option of the Contractor shall be accomplished by the Contractor and shall be subject to the review and approval of the Engineer.

Concrete from the trial batch may be used in miscellaneous construction subject to the approval of the Engineer and further provided that the minimum compressive strength specified for the construction in which the concrete is used is attained. If the required compressive strength is not attained, the Contractor shall remove the concrete and replace it with acceptable concrete at no cost to the Department.

**(d) Fly Ash.** Fly ash may be used as a partial replacement for Type I cement, not exceeding 20% by weight, in all classes of concrete except Class B. Substitution shall be made at the rate of

one pound (kilogram) of fly ash for each pound (kilogram) of cement replaced. The water/cement ratio shall be calculated using the total weight of both cement and fly ash. Fly ash in Class B concrete shall meet the requirements specified in Subsection 802.05(c). Mixtures with fly ash shall meet the same requirements as mixtures without fly ash. Fly ash will not be allowed as a substitute for high early strength or blended cements. Class F fly ash shall not be used in bridge deck concrete placed between October 15 and April 1. When fly ash is used, the total weight of both cement and fly ash will be used in design calculations.

When the Contractor elects to use fly ash as a partial replacement for the cement in Class S or Class S(AE) concrete, the proposed mix design shall be tested by the preparation and testing of trial batches according to Subsection 802.05(c). Trial batches will not be required for Class A concrete.

**(e) Slag Cement.** Slag cement may be used as a partial replacement, not exceeding 25% by weight, for Type I cement, in all classes of concrete except high early strength and seal. Substitution shall be made at the rate of one pound (kilogram) of slag cement for each pound (kilogram) of cement replaced. slag cement will not be allowed with high early strength or blended cements.

When the Contractor elects to use slag cement as a partial replacement for the cement in Class S or Class S(AE) concrete, the proposed mix design shall be tested using trial batches according to 802.05(c). Trial batches will not be required for Class A concrete.

**802.06 Quality Control, Acceptance, and Adjustments in Payments.** **(a) Quality Control by the Contractor.** The Contractor shall be responsible for quality control of materials during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of materials used to produce the specified concrete.

The Contractor shall be responsible for determining gradation and moisture content of fine and coarse aggregates used in the concrete mixture and for testing the mixture for air content, slump, and compressive strength. The Contractor shall determine the specific locations for samples and frequency of sampling for quality control, except the minimum frequency which is listed below for aggregate gradation shall be used. In addition, the Contractor shall be required to perform acceptance sampling and testing at specific

times and/or locations specified by the Engineer according to Subsection 802.06(b).

Test procedures shall be:

Coarse and Fine Aggregates	AASHTO T 27 (gradation)* AASHTO T 255 (moisture)
Air Content	AASHTO T 152
Slump	AASHTO T 119
Compressive Strength**	AASHTO T 22 (Test specimens for compressive strength determined by cylinders will be obtained according to AASHTO T 23.

\*1 test per 500 cubic yards (400 cubic meters) of mix (minimum), sampled from the stockpile. A minimum of one set of tests per bridge structure will be required.

\*\*A minimum of two (2) cylinders shall be cast and tested. Results will be based upon the average result from the two cylinders.

An adequate supply of aggregate must be stockpiled to allow representative sampling in advance of any placement, with the minimum amount being that required to complete the day's planned placement. The initial quality control test results for gradation must be completed and the test results submitted to the Engineer prior to the beginning of mix production of each class of concrete. Subsequent tests shall be taken and tested during production, and the test reports submitted to the Engineer by the end of the next business day after the sample is taken. Any failing gradation test result will result in halting production. The aggregate remaining in the stockpile will be resampled and tested by the Contractor and the Engineer. If the test results indicate that the aggregate is outside of the specification limits in Subsection 802.02, the stockpile shall either be corrected or replaced. Passing test reports must be submitted to the Engineer before work resumes.

The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing. The Contractor's facilities shall be separate from any Field Laboratory and/or Field Office furnished to the Department under the Contract. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician.

Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall maintain records of all samples taken and the results of all tests performed. Test reports shall be signed and copies made available to the Engineer if requested.

The Contractor shall certify to the Engineer that the calibration of the concrete cylinder compression testing machine has been verified. This verification shall be performed in accordance with AASHTO T 22 and T 67 under any of the following conditions and documented in accordance with AASHTO T 67:

1. After an elapsed interval of 18 months (maximum) since the previous calibration.
2. After original installation of the machine or following relocation of the machine.
3. Immediately after repairs or adjustments.
4. Whenever there is a reason to doubt the accuracy of the results, without regard to the time interval since the last verification.

If the Contractor desires additional compressive strength tests to be used for scheduling purposes or to determine the time for stripping forms or loading the structure, such tests will be performed by the Contractor at no cost to the Department.

The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures. The Contractor shall split samples with the Department when requested. The Contractor shall be required to make changes to the equipment and/or procedures if this testing or additional testing by the Department does not verify the Contractor's test results.

When individual gradation, slump, or air content measurements fall outside tolerance limits, the Contractor shall immediately make adjustments to bring the mixture within specified limits. If the Contractor fails to make proper adjustments, or if the mix is obviously defective, operations shall cease. Operations shall not resume until proper adjustments have been made.

**(b) Acceptance Testing.** Acceptance sampling and testing by the Contractor will be based upon lots. The lot sizes shall be determined as follows:

**Slump, Air Content, and Compressive Strength:** The standard lot size for acceptance of slump, air content, and compressive strength of concrete will be 400 cubic yards (300 cubic meters) of mix, with each standard lot divided into four sublots of 100 cubic yards (75 cubic meters). In addition, for Class S(AE) concrete the maximum subplot size will be 100 cubic yards (75 cubic meters) or one deck pour, whichever is less. Partial lots, of any size, may be established by the Engineer at any time. A minimum of one set of tests per bridge structure will be required. The minimum frequency for acceptance of slump, air content, and compressive strength by the Contractor shall be one set of tests for each subplot of each class of concrete. The Contractor shall obtain and test one sample taken at random from each subplot. All samples of the mixture to be tested for air content, slump, and compressive strength shall be taken from one location. The Department will determine the location for each sample in the subplot by AHTD Test Method 465.

Test methods for acceptance shall be the same as specified for quality control testing. Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall provide an opportunity for the Engineer to observe all acceptance sampling and testing procedures.

The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

Acceptance sampling and testing shall be accomplished in a timely manner. The Contractor shall maintain records of all samples taken and the results of all tests performed. Signed copies of these

records shall be furnished to the Engineer for inclusion in the project files within one business day of the day that the tests are performed. The item of work being tested shall not be considered complete or accepted until test reports for all materials are submitted to the Engineer.

The Department will obtain and test a minimum of one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. The location of the lot sample will be determined by AHTD Test Method 465. Verification testing for compressive strength will be by casting and testing cylinders and/or drilling and testing cores. Verification testing will be conducted in accordance with Subsection 106.11 and the *Manual of Field Sampling and Testing Procedures*.

The Department will perform all testing required for water, cement, fly ash, soundness and Los Angeles wear of aggregates.

**(c) Acceptance and Adjustments in Payments.** Acceptance and adjustment in payments will be by lot. Acceptance of a standard lot will be based on the average results of the tests performed on the lot. The average result will include the subplot results of tests performed by the Contractor and the results of the test performed by the Department.

In the event that the compressive strengths of the test specimens in a subplot are below the specified value in Table 802-1, the Department will conduct an investigation to determine the structural adequacy of the concrete. If this investigation determines that the concrete in question is acceptable, then price adjustments will be calculated according to Table 802-2. Table 802-2 lists test properties for acceptance, price reduction, and rejection limits.

When test results for a lot fall within the limits shown in Table 802-2 as "Compliance Limits", the concrete shall be accepted with no price reduction. If test results for a lot for any single property falls within the limits shown as "Price Reduction Limits", the failing material may be left in place at a reduced price. If test results for a lot for any single property falls within the limits shown as "Rejection Limits", the failing material shall be removed and replaced at no cost to the Department. The percent the bid price shall be reduced for a lot not meeting the "Compliance Limits" for both Air Content and Compressive Strength will be determined by adding the price reduction percentages contained in Table 802-2.



In the subplot containing the Department's lot test, if the result of either the Contractor's subplot test or the Department's lot test falls outside the "Compliance Limits", the two tests will be averaged and the average will be used to determine acceptance or rejection.

At the Contractor's option, additional testing for confirming price reductions or rejection due to compressive strength results may be performed by the Contractor at locations determined by the Department. In such cases three cores shall be taken in each subplot containing compressive strength results not in "Compliance Limits". The compressive strength shall be determined by the average result of the cores. Cores shall be taken according to AASHTO T 24. The average of the three cores must meet or exceed applicable price reduction limits or rejection limits. Acceptance and pay adjustments will then be determined based on these results.

When two consecutive lots or any three out of five consecutive lots fail to qualify for full payment, work will be stopped until corrective action is taken.

Continuous production of concrete not qualifying for full payment will not be allowed.

**(d) Incentives.** If the Contractor elects, on bridges over 150' (50 m) in length, an incentive payment for exceptional smoothness will be included in the pay schedule for Class S(AE) concrete if:

- the bridge deck smoothness criteria below are met, and
- no corrective grinding is required to achieve the incentive profile index values.

The Contractor shall furnish a California-style profilograph complying with ASTM E 1274 or an automated lightweight profilometer complying with ASTM E 950, Class 1 and calibrated to the California-style profilograph scale and take a profile near the center of all continuous traffic lanes, including auxiliary lanes and ramps. The Engineer will verify the calibration of the profilograph as frequently as necessary to assure proper operation. In order to position the profilograph, the profile record may exclude 12.5' (4 m) of the deck at each end of the bridge if using a California-style profilograph. If using an automated lightweight profilometer, the profile record shall start and stop at the ends of the bridges at the joints. A blanking band of  $\pm 0.1$ " ( $\pm 2.5$  mm) will be used in the determination of the profile index.

Contract unit price adjustments will be made according to the following schedule:

PROFILE INDEX		PRICE ADJUSTMENT (% of payment for calculated volume of Class S(AE))
inches per mile per bridge	mm per km per bridge	
Less than 3"	Less than 50	1.05
> 3" ≤ 6"	> 50 ≤ 100	1.04
> 6" ≤ 9"	> 100 ≤ 150	1.03
> 9" ≤ 12"	> 150 ≤ 200	1.02
> 12" ≤ 15"	> 200 ≤ 250	1.01
> 15"	> 250	No incentive payment

The additional payment will be applied to the concrete in the bridge deck only. The calculation for the volume of concrete in cubic yards (cubic meters) will be based on the bridge length, bridge clear roadway width between parapets, and 7½" (190 mm) of deck thickness. The surface profile for payment will be based on the average profiles for all traffic lanes.

The Contractor shall take all profiles required by this subsection, under the observation of the Engineer. All data obtained from the profiling operations will be furnished to the Engineer at the completion of the project. The incentive payment will be determined at the completion of the project and when all profile traces have been submitted to the Engineer for the project files.

**802.07 Measurement of Materials.** Materials will be measured by weighing, except as otherwise specified or where other methods are specifically authorized by the Engineer. Aggregates shall be measured separately and accurately by weight. Measuring devices shall be operated in a manner that will consistently weigh the cement within ±1% and the individual aggregates within ±2% of the required weight. Measuring devices shall be so designed and plainly marked that the weights can be accurately and conveniently verified for the quantities of each component actually being used.

Cement in standard packages (sack) need not be weighed, but bulk cement shall be weighed.

The mixing water shall be measured by weight or by volume. The water measuring device shall be accurate to within  $\pm 1\%$ .

Scales shall be satisfactory to the Engineer and shall be inspected, adjusted, and certified according to Subsection 109.01(f), except that automatic ticket printers and automatic weighing systems will not be required.

Where volumetric measurements are authorized by the Engineer for projects where the amount of concrete is small, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregate, including the bulking effect in the fine aggregate.

Representative samples shall be taken and the moisture content determined for each kind of aggregate. When the aggregates contain more water than the quantity necessary to produce a saturated surface-dry condition, the batch weights for aggregates and water shall be adjusted accordingly.

**802.08 Mixing Concrete.** Concrete shall be thoroughly mixed in a mixer of an approved size and type that will ensure a uniform distribution of the materials throughout the mass.

The concrete shall be mixed only in the quantity required for immediate use. Concrete that has developed an initial set shall not be used. Re-tempering concrete will not be permitted.

Concrete may be proportioned and mixed in a stationary central plant and hauled to the point of delivery in agitator trucks of approved type or in non-agitating equipment, when approved by the Engineer; proportioned in a stationary central plant and mixed in approved transit mix trucks enroute to the point of delivery; or mixed completely in transit mix trucks at the point of delivery, following the addition of mixing water.

The Engineer shall be furnished the manufacturer's rated capacity of each mixer and agitator, along with the recommended speed of rotation for the various uses of each mixer. Truck mixers and agitators shall be equipped with means by which the number of revolutions of the drum, blades, or paddles may be readily verified.

Mixers and agitators shall not be charged in excess of the manufacturer's rated capacity. Concrete shall be delivered and discharged from the truck mixer or agitator into the forms within  $1\frac{1}{2}$  hours after the introduction of the mixing water to the cement. In

hot weather, or under other conditions contributing to quick setting of the concrete, the maximum allowable time may be reduced by the Engineer. Each batch shall be accompanied by a time slip issued at the batch plant.

Plants and transit mix trucks shall be equipped with adequate water storage and a device for accurately measuring and controlling the amount of water used in each batch. When a stationary mixer is used, a mechanical means shall be provided for automatically preventing the discharge of the mixer until the materials have been mixed for a period of not less than one minute.

Truck mixers shall be capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass, and of discharging the concrete within the specified range of consistency. The concrete shall be mixed not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation specified by the manufacturer as the mixing speed. The pick-up and throw-over blades in the drum of all mixers shall be maintained in satisfactory condition to assure thoroughly mixed concrete.

Agitators shall be capable of maintaining the concrete in a thoroughly mixed and uniform mass and of discharging the concrete within the specified range of consistency.

When approved in writing by the Engineer, concrete may be transported in approved non-agitating equipment. Bodies of this equipment shall be smooth, watertight, metal containers equipped with gates that will permit control of the discharge of the concrete. Covers shall be provided for protection against the weather. The concrete shall be delivered in a thoroughly mixed and uniform mass and discharged within the specified range of consistency. Placement in forms shall be completed within 30 minutes after introduction of the mixing water to the cement.

Concrete shall be mixed according to the mixer manufacturer's specifications in order to obtain an acceptable mass of concrete. During the period of mixing, the mixer shall operate at the manufacturer's recommended mixing speed. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed.

If additional mixing water is required to maintain the specified slump, and is added with the permission of the Engineer, approximately 20 revolutions of the mixer drum at mixing speed shall be required before discharge of any concrete.

**TABLE 802-2  
COMPLIANCE, PRICE REDUCTION, & REJECTION LIMITS FOR  
CONCRETE STRUCTURES**

<b>Property</b>	<b>Compliance Limits</b>	<b>Price Reduction Limits</b>	<b>Price Reduction</b>	<b>Lot Rejection Limits</b>	<b>Sublot Rejection Limits</b>
<b>Air Content</b>	4% - 8%	3.5%-3.9% and 8.1%-8.4%	10%	less than 3.0% and greater than 9.0%	less than 2.0% or greater than 10.0%
		3.0%-3.4% and 8.5%-9.0%	20%		
<b>Compressive Strength</b>	$\geq f_c$	95% $f_c$ or greater	10%	Less than 85% $f_c$	Less than 75% $f_c$
		90% $f_c$ or greater but less than 95% $f_c$	20%		
		85% $f_c$ or greater but less than 90% $f_c$	30%		

$f_c$  is the minimum specified compressive strength in Table 802-1 for the particular class of concrete.

When a quality control sample for air content, taken within the allowable time limits for discharge of the concrete and prior to discharge for placement, shows an air content below the specified level by more than the allowable tolerance shown in Table 802-2, the Contractor may use additional air-entraining admixture to achieve the desired air content. The air-entraining agent and water shall be mixed in a separate container, and the mixed solution added to the truck mixer and mixed for a minimum of 30 revolutions at the mixing speed. A second air content test shall then be taken to determine if the air content is now within the allowable limits.

The entire contents of the mixer, including wash water, shall be removed from the drum before the addition of materials for a succeeding batch.

There shall be sufficient capacity and transporting equipment to ensure continuous concrete delivery at the rate required.

If the concrete furnished produces erratic results relative to consistency, strength, or time of initial or final set, the Contractor shall cease the use of that concrete until corrections are made to ensure work of the specified quality.

**802.09 Handling and Placing Concrete. (a) General.** The Contractor shall provide sufficient supervision, manpower, equipment, tools, and materials and shall assure proper production, delivery, placement, and finishing of the concrete for each placement according to the specifications. Unless otherwise specified, concrete shall be placed continuously between authorized construction and/or expansion joints, subject to the time limits and placement rates specified below.

The time interval between batches of concrete shall not exceed 20 minutes. Unless otherwise specified, the minimum placement rate shall be 20 cubic yards per hour (15 cu m/h).

Any placement that does not produce results that conform to the specifications shall be repaired or replaced, as required, at no cost to the Department. Further placements of a similar nature and size will not be permitted until corrective measures have been taken to assure compliance with the specifications.

The minimum placement rate shall not apply to concrete other than bridges, box culverts, and retaining walls, but the interval between batches shall not exceed 20 minutes.

In preparation for the placing of concrete, construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays, and braces, serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete, shall be removed when the concrete placement has reached an elevation rendering their service unnecessary.

**(1) Conveying.** Concrete shall be placed to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying the concrete to the forms will be permitted only when authorized by the Engineer. In case an inferior quality of concrete is produced by the use of such conveyors, the Contractor shall, without notice from the Engineer, cease the use of that conveyor until such corrections in procedure are made to ensure work of the quality specified.

Open troughs and chutes shall be of metal or metal lined. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. Aluminum chutes, troughs, and pipes shall not be used for depositing concrete.

Chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

When placing operations involve dropping the concrete more than 5' (1.5 m), it shall be deposited through approved pipes. Walls of 10" (250 mm) thickness or less may be placed without the use of pipes, provided the concrete can be placed without segregation.

**(2) Placing.** Concrete shall be placed in horizontal layers not more than 18" (0.5 m) thick except as hereinafter provided. When less than a complete layer is placed, it shall be terminated in a vertical bulkhead. Each layer shall be placed and consolidated before the preceding batch has taken initial set to prevent injury to the concrete and avoid surfaces of separation between the batches. Each layer shall be consolidated so as to avoid the formation of a construction joint with a preceding layer that has not taken initial set.

Concrete in footings shall be placed in the dry unless natural conditions prohibit. In that case, concrete shall be placed according to Subsections 801.05 and/or 801.06, as appropriate. In order to

separate water from the concrete, it will be permissible to utilize polyethylene sheeting or tarpaulins to maintain a physical barrier between the water and the concrete.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel. Where a "feather edge" might be produced at a construction joint, an inset form shall be used to produce an edge thickness of not less than 6" (150 mm).

Immediately following the discontinuance of placing concrete, accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms should be removed. Dried mortar chips and dust shall not be puddled into the concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to damage or break the concrete-steel bond at or near the surface of the concrete while cleaning reinforcing steel.

After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcing bars.

**(3) Consolidating.** All concrete, except seal concrete, during and immediately after depositing shall be thoroughly consolidated. This shall be accomplished by mechanical vibration subject to the following provisions:

- a. The vibration shall be internal unless special authorization of other methods is given by the Engineer.
- b. Vibrators shall be of a type and design approved by the Engineer. They shall be capable of transmitting vibration to the concrete at rated frequencies of not less than 4500 impulses per minute.
- c. The intensity of vibration shall be such as to visibly affect a mass of concrete over a radius of at least 18" (0.5 m).
- d. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms and shall have in reserve at all times sufficient vibratory



equipment to guard against shut down of the work because of the failure of the equipment in operation.

- e. Vibrators shall be manipulated to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

- f. Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete that have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms. When epoxy coated reinforcing steel is used, the provisions of Subsection 804.05 relative to vibrators shall apply.
- g. Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.
- h. These provisions shall apply to precast products except that, if approved by the Engineer, the manufacturer's methods of vibration may be used.

**(b) Box Culverts.** Concrete in walls and top slabs shall not be placed less than 24 hours after the concrete in previous placements has set.

Provision shall be made for bonding the walls to the bottom slab or footing and the top slab to the walls by means of roughened

longitudinal keys. Before concrete is placed in the walls or top slabs, the bottom slab, footing, or walls shall be thoroughly cleaned of extraneous material and the surface bond prepared according to Subsection 802.12. No horizontal construction joints will be allowed in any wall of a box culvert unless provided on the plans or approved by the Engineer. In the construction of box culverts 6' (1.8 m) or less in height, the walls and top slab may be constructed as a monolith.

**(c) Bridge Substructures.** Concrete in columns shall not be placed less than 24 hours after the concrete in footings has been placed, and shall be placed in one continuous operation, unless otherwise directed. The concrete in the columns shall be allowed to set at least 24 hours before the caps are placed. When friction collars or column dowels are used to support cap forms, the concrete for the columns shall have a minimum compressive strength of 3500 psi (24.0 MPa) before the concrete is placed for the cap.

Unless otherwise permitted by the Engineer, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the character of the concrete in the columns.

With proper handling to avoid damage to the concrete, and at the option of the Contractor, structural steel may be erected 48 hours after completion of the caps. Depositing of concrete in the deck or placing of precast concrete girders or deck units that will place dead load on the cap will not be permitted until the cap has been in place at least 7 days and has attained the minimum specified compressive strength.

**(d) Bridge Superstructures.** For concrete in bridge deck slabs, when a longitudinal concrete strike-off is used, the rate of placement and consolidation shall be adequate to assure that no concrete will take its initial set before the entire placement is complete. Sufficient concrete shall be placed ahead of the strike-off to fully load the beam or girder prior to strike-off. When a transverse concrete strike-off is used, the rate of placement and consolidation shall be adequate to assure that no concrete will take its initial set closer than 100' (30 m) behind the strike-off. Compliance with these requirements may require the use of a retarding agent.

Concrete shall be deposited in a manner that will ensure uniform loading of the span. For continuous spans, the concrete placing

sequence shall be shown on the plans. Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers. Concrete in girder haunches less than 3' (1 m) in height shall be placed at the same time as that in the girder stem, and the columns or abutment tops shall be cut back to form seats for the haunches. Whenever any haunch or fillet has a vertical height of 3' (1 m) or more, the abutment or columns, the haunch, and the girder shall be placed in three successive stages; first, up to the lower side of the haunch; second, to the lower side of the girder; and third, to completion.

For haunched continuous girders, the girder stem (including haunch) shall be placed to the top of stem. Where the size of the member is such that it cannot be made in one placement, vertical construction joints shall preferably be located within the area of contraflexure.

Concrete in deck girder spans shall be placed in one continuous operation.

Concrete in parapet or barrier walls, curbs, and sidewalks that are not placed monolithically with the deck slab shall not be placed less than 72 hours after the concrete for the deck slab of the entire simple span or the entire continuous unit has been placed, except when stage construction is specified. When stage construction is specified, the concrete in parapet or barrier walls, curbs, and sidewalks that are not placed monolithically with the deck shall not be placed less than 72 hours after the concrete for the portion of the deck slab required under that stage has been placed for the entire simple span or the entire continuous unit.

**(e) Concrete Placement Intervals.** Use of the minimum time intervals and compressive strengths provided above relative to expediting subsequent concrete placements shall in no way relieve the Contractor of the responsibility for attaining the minimum compressive strengths for the class of concrete specified.

**802.10 Pumping.** Concrete may be placed by pumping. The equipment for pumping shall be arranged and operated so that no vibrations result that might damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipe, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

Samples of concrete for slump and air content tests will be obtained at the discharge end of the pipe.

The use of aluminum pipe as a conveyance for the concrete will not be permitted.

**802.11 Depositing Concrete Under Water.** Concrete shall not be deposited in water except when shown on the plans or with the approval of the Engineer. Concrete deposited in water shall be Seal Concrete.

The supply of concrete shall be maintained at the rate necessary to raise the elevation over the entire seal by a minimum of 1' (0.3 m) per hour or an approved retarder shall be used as necessary for lesser placement rates.

For parts of structures under water, seal concrete shall be placed continuously from start to finish. The surface of the concrete shall be kept as nearly horizontal as practicable. The Contractor shall provide equipment and personnel to sound the top of the seal in the presence of the Inspector in order to verify the location of the seal at all times. Previously placed seal concrete shall not have taken its initial set prior to the placement of adjacent concrete.

Concrete shall be carefully placed by means of a tremie or other approved method. Still water shall be maintained at the point of deposit. Concrete shall be deposited in such a manner that the planned horizontal concrete flow shall be no more than 15' (4.5 m). This shall be accomplished by locating the points of deposit in such a manner as to provide for a maximum flow distance of 15' (4.5 m).

A tremie shall consist of a tube having a diameter of not less than 10" (250 mm), constructed in sections having flanged couplings fitted with gaskets and an approved foot valve. The tremie shall be supported so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work so as to prevent water entering the tube and shall be

entirely sealed. The tremie tube shall be kept sufficiently full to prevent the loss of the concrete seal. When a batch is dumped into the tube, the flow of concrete shall be induced by slightly raising the discharged end, always keeping it in the deposited concrete. If at any time the seal is lost, the tremie shall be raised, the discharge end closed for a new start, and then lowered into position with the discharge end in the previously deposited concrete. Aluminum tremies will not be permitted.

Dewatering may proceed when the seal concrete has been allowed to cure for a minimum of 72 hours at a water temperature above 45° F (7° C). All laitance or other unsatisfactory materials shall be removed from the exposed surfaces that are to support other structural loads.

Prior to the placement, the Contractor shall advise the Engineer of his methods for complying with these requirements.

**802.12 Construction Joints. (a) General.** Construction joints shall be made only where located on plans or shown in the placement schedule, unless otherwise approved by the Engineer.

Before depositing new concrete on or against concrete that has hardened, the forms shall be re-tightened.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints that are exposed to view shall be carefully finished true to line and elevation.

If not detailed on the plans, or in the case of emergency, construction joints shall be placed as directed by the Engineer. Shear keys or inclined reinforcement shall be used where necessary to transmit shear or bond the two sections together. When shear keys or inclined reinforcement is not provided, the concrete shall be roughened as directed.

**(b) Bonding.** The surface of the hardened concrete shall be roughened in a manner that will not leave loosened particles of aggregates or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance and saturated with water.

**802.13 Falsework.** Details for each unit of falsework construction for bridge span and overhang support systems, complete with dimensions and kind and condition of materials, shall be submitted to the Engineer prior to construction for informational

and record purposes. These details shall be approved by a Registered Professional Engineer, who shall certify that the adequacy of all components has been verified. File copies of all design calculations shall be maintained by the Contractor until final acceptance of the project. Construction of the falsework shall be according to the details submitted to the Engineer for informational purposes. The Contractor shall be responsible for the results obtained by the use of the falsework design.

For designing falsework, a weight of 150 pounds per cubic foot (2400 kg/cu m) shall be assumed for fresh concrete. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Falsework shall be set to give the finished structure the camber specified.

Falsework that cannot be founded on a satisfactory footing shall be supported on piling which shall be spaced, driven, and removed as specified in the Contractor's falsework details.

The use of transverse welds greater than 1" (25 mm) in length used for attachment of hanger brackets, nut plates, or other falsework support devices to the structural steel shall be approved by the Bridge Engineer prior to construction. The use of welds for attaching screed rail supports larger than 1" (25 mm) diameter to the top flange of the structural steel shall be approved by the Bridge Engineer prior to construction.

All temporary field welds on structural steel shall be performed by a certified welder using low-hydrogen electrodes in accordance with Subsection 807.26 and the ANSI/AASHTO/AWS D1.5, Bridge Welding Code. Unless otherwise permitted by the Engineer, temporary welds shall be removed by grinding the weld flush.

**802.14 Forms. (a) Standard Forms.** Forms shall be mortar-tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.

Forms for exposed surfaces shall be made of dressed lumber or plywood of uniform thickness, steel, or other approved materials that will provide a smooth surface, and shall be mortar-tight. Forms shall have 3/4" (20 mm) fillet at all sharp corners unless otherwise directed. In the case of projections, such as girders and copings, forms shall be given a bevel or draft to ensure easy removal.

Metal snap-ties within the forms shall be so constructed as to permit their removal to a depth of at least 1" (25 mm) from the face of the concrete. Fittings for metal snap-ties shall be of such design that, upon removal, the cavities that are left will be of the smallest possible size.

Metal inserts or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 1" (25 mm) from the face of the concrete or be covered by being embedded a minimum of 1" (25 mm) in the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least 1/4" (6 mm) from the face of the concrete.

All cavities shall be filled with cement mortar and the surface left sound, smooth, even, and uniform in color.

Forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Before depositing new concrete on or against concrete that has hardened, the forms shall be re-tightened. Forms shall remain in place for the periods specified in Subsection 802.15. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer shall order the work stopped until the defects have been corrected.

The shape, strength, rigidity, watertightness, and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged lumber must be re-sized before being re-used.

For narrow walls and columns, where the bottom of the module is inaccessible, the lower portions of the forms shall be so constructed as to facilitate cleaning out of extraneous material immediately before placing the concrete.

Forms shall be cleaned before being set to line and grade and shall be oiled prior to placing reinforcing steel in the vicinity of the

forms. Materials or methods used in oiling the forms shall not result in the discoloration of the concrete.

In lieu of the conventional stationary forms, concrete parapet rail may be constructed by using an extrusion machine or other equipment specifically designed for constructing cast-in-place concrete parapet rail, provided the finished barrier is true to line and grade and the concrete is properly consolidated.

**(b) Permanent Steel Deck Forms.** An approved type of galvanized steel form, complying with the requirements shown on the plans and these specifications, may be used as an alternate to conventional removable forms for forming the bridge deck between the exterior beams or girders. These forms shall be designed to provide not less than the minimum concrete cover shown on the plans for all reinforcing bars in the bottom of the slabs. The effective design depth of slab shall be maintained over the entire area of the deck. Provision shall be made to provide encasement of top flanges of beams or girders in compression except where shear connectors are provided.

Detailed plans of proposed permanent steel deck forms shall be submitted to and approved by the Engineer before work of forming the bridge deck is started. The approval of the Contractor's plans shall not be considered as relieving the Contractor of any responsibility for the results obtained by the use of these approved plans. Construction shall be according to the approved plans.

All material and elements of the permanent steel deck form units shall be fabricated from steel conforming to ASTM A653/A653M, Structural Steel (SS), Grades 33,37,40,50 Class 1 or 2, or 80, having a coating class of G165 [Structural Steel(SS), Grades 230, 255, 275, 340 Class 1 or 2, or 550, having a coating class of Z350]. Thickness and grade of form sheets and form supports shall be as designated on the shop drawings. In no case shall thicknesses be less than 22 gage for sheets and 16 gage for form supports. The Contractor shall provide a manufacturer's certification indicating compliance with the above requirements and Section 106.

Permanent steel forms shall be designed on the basis of the dead load of the form, reinforcement, and the plastic concrete, plus 50 psf (245 kg/sq m) for construction loads. Unit working stresses shall be according to the standard specifications for construction loads and the unit stress in the steel sheet shall be not more than 0.725 of the



specified minimum yield strength of the material furnished, but not to exceed 36,000 psi (250 MPa). Maximum deflection shall be calculated using the weight of plastic concrete, reinforcement, and forms, or 120 psf (585 kg/sq m), whichever is greater. Maximum deflection shall not exceed 1/180 of the form span or 1/2" (12 mm), whichever is less. The form span for design and deflection shall be the clear distance between supports plus 2" (50 mm), but not less than the clear distance between the flanges of the supporting beams less 4" (100 mm) measured parallel to the form flutes.

Physical design properties shall be computed according to requirements of the latest edition of *AISI Specifications for the Design of Cold-Formed Steel Structural Members*.

All reinforcement shall have a minimum concrete cover of 1" (25 mm). Bars in the bottom layer of the main reinforcement shall be approximately centered over the valleys of the forms when necessary to achieve the minimum 1" (25 mm) concrete cover. The distance from the top of the slab to the bottom layer of main slab reinforcement shall be not less than that shown on the plans.

Permanent steel forms used in panels where longitudinal slab construction joints are located between stringers must provide adequate structural capacity without excessive deflections. Adequate external support of forms at the joint must be provided to assure that the forms do not separate from the hardened concrete.

All forms shall be installed according to detailed fabrication plans submitted to the Engineer for approval. The fabrication plans shall clearly indicate locations and methods of attachment where the forms are supported by steel beam flanges subject to tensile stresses and without shear connectors.

Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1" (25 mm) at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by welds, bolts, clips, or other approved means. However, welding of form supports to flanges of steels other than AASHTO M 270, Grades 36 (250), 50 (345), or 50W (345W) of a weldable grade, and to those portions of a flange subject to tensile stresses will not be permitted except as provided for in the plans. Welding shall be accomplished by certified welders and according

to Subsection 807.26 except that 1/8" (3 mm) fillet welds will be permitted.

Provisions shall be made to keep the panels at an acceptable temperature before placement of concrete.

Calcium Chloride or any other admixture containing chloride salts shall not be used in the concrete placed on permanent steel deck forms.

After the deck concrete has been placed for a minimum of 2 days, the following inspection procedure shall be followed:

The forms shall be tested for soundness of the concrete and bonding of the forms to the concrete by striking the form a sharp blow with a geologist hammer. As a minimum, the forms shall be struck at 10' (3 m) intervals parallel to and 6" (150 mm) from the edge of the steel beam, and at 10' (3 m) intervals along the centerline of each bay between the beams in an X pattern with those along the beams, and at random points on a semicircle or circle, as applicable, with approximately 2' (0.5 m) radius from the above points. They shall be struck in other places as directed by the Engineer to define any suspicious or defective area. Areas where efflorescence is evident shall be thoroughly investigated.

The Contractor shall furnish all facilities such as ladders, scaffolding, etc., that will provide for a thorough inspection of the forms.

The striking of the forms shall be accomplished in such a manner and at a time that the sound is clearly audible. Properly bonded sheets attached to sound concrete will emit a clear ring when struck a sharp blow with a hammer. Honeycomb concrete and/or unbonded areas will give a different sound such as a thud or clatter. The forms shall be removed full width between beams wherever the Engineer suspects that honeycomb or unbonded areas exist so that the Engineer may make a visual examination of the concrete surface. Any defective concrete shall be repaired to match the adjacent concrete to the satisfaction of the Engineer.

The amount of sounding and form removal may be reduced, at the Engineer's discretion, after a substantial amount of slab has been constructed and inspected, if the Contractor's methods of construction and the results of the inspections as outlined above indicate that sound concrete is being obtained throughout.

If the Contractor varies his procedures significantly, the initial inspection procedure shall be used to verify that the new conditions are yielding desirable results.

Any forms that must be removed because of unsatisfactory test results shall be removed by a metal saw or air-carbon-arc gouging with minimum damage to the concrete. The cut in forms parallel to the corrugations shall be located in a non-horizontal lap section of the corrugation. The cuts parallel to the beam shall be through the supporting angles taking care not to damage the structural steel beams.

All concrete that is found defective or is damaged in removing a section of the form for inspection shall be repaired to match the adjacent concrete in section and color. All repair work shall be completed to the satisfaction of the Engineer.

Payment for forms will be made and fully covered under the unit price bid for superstructure concrete. No direct or additional payment of any kind will be made because of the use of these forms. Payment will be made for Class S(AE) Concrete in place in the bridge decks on the basis of the thickness specified on the plans, not including any excess thickness used and not including any concrete in portions of haunches that may be omitted because of the use of these forms.

**802.15 Removal of Falsework and Forms.** In the determination of the time for the removal of falsework and forms and the discontinuance of heating, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the materials used in the mix.

Removal of falsework and forms shall be according to the following schedule:

<b>Item</b>	<b>Minimum Time</b>	<b>Strength Requirement</b>
Bottom Forms for Deck Slabs, Beams, and Caps	7 Days	Min. Spec.
Top Slabs of RC Box Culverts	7 Days	80% Spec.
Forms for Columns and Vertical Walls	24 Hours	N/A
Side Forms for Footings, Beams, and Caps	12 Hours	N/A
Side Forms for Parapets, Median Barriers, and Curb Faces	6 Hours	N/A

Both time and strength requirements must be met before removal of forms and/or falsework begins.

Forms on surfaces that will require a Class 2 finish according to Subsection 802.19 shall be removed at the earliest time permitted under these specifications in order to begin finishing operations.

Forms and their supports shall not be removed without the approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight. Methods of form removal likely to cause overstressing of or damage to the concrete shall not be used.

**802.16 Weather and Temperature Limitations and Protection of Concrete.** When the ambient temperature at the placement site is 85° F (29° C) and rising, an approved retarding agent shall be required in all concrete used in bridge superstructures. A retarding agent will not be required in concrete used for bridge deck curb, parapet, railing, posts, sidewalks, or median treatment provided they are not placed monolithically with the deck itself.

When the internal temperature of the plastic concrete in bridge decks reaches 85° F (29° C), the Contractor shall take the necessary precautions to ensure that the temperature of succeeding batches does not exceed 90° F (32° C). Concrete batches with temperatures in excess of 90° F (32° C) will be rejected. The method used to control the concrete temperature shall be approved in writing by the Engineer. The temperature of the plastic concrete shall be determined immediately prior to its being deposited in the forms by inserting a thermometer to a depth consistent with the capabilities of the thermometer being used to obtain a true reading. Prior to beginning placement, the Contractor shall ensure that sufficient materials, labor, and equipment are available during placement to implement the previously approved cooling process.

The maximum mix temperature for all Class B concrete at the time of placement shall be 75° F (24° C). This requirement will be strictly adhered to and any concrete delivered to the job site that does not meet this provision will be rejected. The maximum differential between the internal concrete temperature and the concrete surface temperature shall not exceed 36° F (20° C). The Contractor shall devise a method for monitoring the temperature differential for at least seven days and shall have the method approved by the Engineer before the concrete is placed. The internal

temperature shall be measured as nearly as practicable to the center of mass of the pour. Methods used to meet these requirements shall be submitted to the Engineer for approval. Methods that may be used to meet this provision include using ice in the mixing water, storing cement and aggregates in cool or shaded locations, watering down of coarse aggregates, installation of cooling pipes in the concrete, and use of insulation (tenting, quilts, or sand on polyethylene sheeting). Cooling by watering of fine aggregates will not be allowed.

No concrete shall be placed unless the temperature of the concrete is more than 50° F (10° C) when placed. If heating of the ingredients is necessary to meet this criterion, it shall be accomplished by a method such as dry heat or steam and not by direct flame. Water shall not be heated to more than 180° F (82° C), and shall be combined with the aggregate before the addition of cement. Frozen aggregates may not be used.

After concrete is placed, it shall be protected by insulated forms, blankets, enclosing and heating, and/or any other method approved by the Engineer that will maintain the temperature adjacent to the concrete at a minimum of 50° F (10° C) for at least 7 days. For concrete other than bridges, box culverts, and retaining walls, the requirement for maintaining the temperature at or above 50° F (10° C) shall not apply, but the concrete shall be protected and/or heated, as necessary, to prevent freezing for a period of at least 7 days.

For Class B concrete, forms shall remain in place 4 days after placing any time the temperature is below 40° F (4° C) or forecast to drop below 40° F (4° C). In addition, exposed top surfaces of the concrete shall be protected with an insulated blanket. The surface of the concrete shall not be saturated when it is exposed to freezing air temperatures.

The Contractor shall have available and ready for immediate use sufficient materials and equipment for maintaining the temperature of the concrete as required above.

Concrete that has been frozen or damaged due to weather conditions shall be removed and replaced by the Contractor at no cost to the Department.

**802.17 Curing Concrete for Structures. (a) Materials.**

Materials used in curing concrete shall conform to one of the following types:

(1) Burlap-polyethylene sheeting shall meet the requirements of ASTM C171.

(2) Polyethylene sheeting shall have a minimum thickness of 4 mils (0.10 mm).

(3) Copolymer/synthetic blanket shall meet the performance requirements of ASTM C171. Copolymer/synthetic blankets shall be a composite of a copolymer membrane material coated over a layer of absorbent nonwoven synthetic fabric weighing at least 6 ounces per square yard (200 g/sq m), uniform in appearance, and free from visible defects.

(4) Other approved sheeting materials shall meet the performance requirements of ASTM C171.

(5) Membrane curing compound shall meet the requirements of ASTM C309, Type 1-D or Type 2.

**(b) Application.** The exposed concrete, immediately after finishing, shall be covered with one of the curing materials listed above and shall be kept continuously and thoroughly wet for a period of not less than 7 days after the concrete is placed. Membrane curing does not require the application of additional moisture, except as required for bridge roadway surfaces.

All Class B concrete shall be cured by free moisture. Water curing shall be provided for all exposed surfaces for a period of 14 days.

Membrane curing compound shall not be used on surfaces requiring a Class 2 finish.

Clear membrane curing compound shall be used as an interim cure for concrete bridge roadway surfaces and shall be applied immediately after final finishing. Final curing of bridge decks shall be by mats or blankets and shall be begun immediately after completing the surface test specified in Subsection 802.20(c). The mats or blankets shall be kept continuously and thoroughly wet for a period of 7 days after the concrete is placed.

When an extrusion machine is used for concrete parapet railing, curing shall be performed as specified herein and shall be

accomplished as soon after extrusion as possible. Clear curing compound shall be used as an interim cure until such time as the parapet rail will support the curing methods specified.

When membrane curing is used, the exposed concrete shall be thoroughly sealed by applying the membrane curing solution immediately after the free water has left the surface. The concrete inside the forms shall be sealed immediately after the forms are removed and necessary finishing has been done. For uniform application in the field on vertical concrete surfaces, the specified rate of application may be achieved by two coats applied at an interval of approximately 1 hour.

The Contractor shall provide satisfactory equipment and means to properly control and assure the direct application of the curing solution on the concrete surface so as to result in a uniform coverage at the rate of 1 gallon per 125 square feet (1 L/3 sq m) of area.

If rain falls on the newly coated concrete before the film has dried sufficiently to resist damage, or if the film is damaged in any other manner, a new coat of the solution shall be applied to the affected portions equal in curing value to that specified above.

**802.18 Expansion and Fixed Joints.** Joints shall be constructed according to the details shown on the plans.

**(a) Open Joints.** Open joints shall be placed in the locations shown on the plans and shall be constructed by the insertion and subsequent removal of a wood strip, metal plate, or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint unless specified on the plans.

**(b) Filled Joints.** Filled expansion joints shall be constructed similar to open joints. When premolded types are specified, the filler shall be in the correct position when the concrete on the second side of the joint is placed. A joint sealer is required in addition to the joint filler. The cavity for the sealer shall be formed by the insertion and subsequent removal of a wood strip, metal plate, or other approved material. When required, adequate water stops of metal, rubber, or plastic shall be carefully placed as shown on the plans.

All faces of the joint to be sealed shall be thoroughly cleaned by sand blasting, water blasting, or other approved methods prior to placing the joint seal material.

(1) Poured joint sealer shall meet the requirements of Subsection 501.02(h) for Types 3 through 7.

(2) Preformed expansion joint filler shall meet the requirements of Subsection 501.02(h) for Type 2.

When called for on the plans or in the Special Provisions the joint material shall be that specified in Section 809 or 810.

(c) **Steel Joints.** Plates, angles, or other structural shapes shall be accurately shaped at the shop to conform to the section of the bridge deck. The fabrication and painting shall conform to the requirements of the specifications covering those items. When specified on the plans or in the Special Provisions, the material shall be galvanized in lieu of painting.

Care shall be taken to ensure that the surface in the finished plane is true and free of warping. Positive methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. The opening at expansion joints shall be that designated on the plans at 60° F (16° C), and care shall be taken to avoid impairment of the clearance in any manner.

(d) **Felt Joints.** Joint material and bearing pads shall consist of a roofing felt saturated and coated on both sides with asphalt, and coated on one side with powdered mineral matter such as talc or mica, and shall conform to ASTM D 224. Where Standard Drawings indicate the use of 45 # (2.2 kg/sq m) roofing felt, this material shall meet or exceed the requirements for ASTM D6830 Class S Type IV.

(e) **Water Stops and Flashing.** Water stops and flashing shall be furnished and placed as provided on the plans. They shall be spliced, welded, soldered, or otherwise joined to form continuous watertight joints and shall conform to the following requirements:

(1) Copper water stops and flashing shall conform to ASTM B152, unless otherwise specified on the plans. Sheet copper shall meet the embrittlement test of Section 10 of ASTM B152.

(2) Rubber water stops shall be formed from synthetic rubber made exclusively from neoprene, reinforcing carbon black, zinc



oxide, polymerization agents, and softeners. This compound shall contain not less than 70% by volume of neoprene. The tensile strength shall not be less than 2750 psi (19 MPa) with an elongation at breaking of 600%. The Shore Durometer indication (hardness) shall be between 50 and 60. After 7 days in air at 158° F ± 2° F (70° C ± 1° C) or after 4 days in oxygen at 158° F ± 2° F (70° C ± 1° C) and 300 psi (2 MPa) pressure, the tensile strength shall be not less than 65% of the original.

The water stops shall be formed with an integral cross section in suitable molds so as to produce a uniform section with a permissible variation in dimension of ± 1/32" (±0.8 mm). No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured in a manner such that any cross section shall be dense, homogeneous, and free from all porosity. Junctions in the special connection pieces shall be full molded. During the vulcanizing period, the joints shall be securely held by suitable clamps. The material at the splices shall be dense and homogeneous throughout the cross section.

(3) Polyvinylchloride (PVC) water stops shall be manufactured by the extrusion process from an elastomeric plastic compound, the base resin of which shall be polyvinylchloride (PVC). The compound shall contain any additional resins, plasticizers, stabilizers, or other materials needed to ensure that, when the material is compounded, it will meet the performance requirements given in this specification. No reclaimed PVC or other material shall be used.

The water stops shall be of the size and shape shown on the plans. They shall be dense, homogeneous, and without holes or other defects.

The material shall comply with the following physical requirements when tested under the indicated ASTM test method:

Tensile Strength	ASTM D 412	1800 psi (12.4 MPa) Minimum
Elongation	ASTM D 412	350%
Cold Brittleness	ASTM D 746	-35° F (-37° C)
Stiffness in Flexure	ASTM D 747	350 psi (2.4 MPa) Minimum

The manufacturer shall be responsible for the testing, either in his own or a recognized commercial laboratory, and shall submit a certified copy of test results.

**802.19 Finishing Concrete Surfaces. (a) General.** Surface finishes shall be classified as follows:

- Class 1. Ordinary Surface Finish.
- Class 2. Rubbed Finish.
- Class 3. Textured Coating Finish.
- Class 4. Exposed Aggregate Finish.
- Class 5. Tined Bridge Roadway Surface Finish.
- Class 6. Broomed Finish.
- Class 7. Grooved Bridge Roadway Surface Finish.

All concrete shall be given a Class 1, Ordinary Surface Finish. In addition, if further finishing is required, such other types of finish will be as specified herein.

Payment for Class 1 through Class 6 finishes will be considered a part of the applicable item of concrete used. Measurement and payment for Class 7 finish will be made according to Subsections 802.24 and 802.25.

Sidewalks shall be given a Class 6 finish.

Curbs shall be given a Class 2 or Class 6 finish.

Bridge roadway surfaces shall be given a Class 5 finish unless Class 7 finish is specified on the plans.

The following surfaces shall be given a Class 2 finish except when a Class 3 finish is specified on the plans:

All Structures. Exposed surfaces of retaining walls, surfaces of concrete rails, rail posts, rail end posts, rail bases, and parapets, including the outside face.

Bridges Over Public Roads. Surfaces above finished ground of piers, columns, abutments, and retaining walls; the outside vertical surfaces of parapets, slabs, and girders; and the underneath side of the overhang outside the exterior beam.

At the option of the Contractor, a Class 3 finish may be used on all surfaces requiring a Class 2 finish provided the same class of finish is used on the entire structure.

(b) The various classes of surface finish are defined as follows:

**(1) Class 1, Ordinary Surface Finish.** Immediately following the removal of forms, fins and irregular projections shall be removed from all surfaces except from those that are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, broken corners or edges, and other defects shall be thoroughly cleaned, and after having been thoroughly saturated with water, shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportion of 1:2. Mortar used in pointing shall be not more than 1 hour old. If required, the concrete shall then be rubbed or sprayed and cured as specified under Subsection 802.17. Construction and expansion joints in the completed work shall be left carefully tooled and free of mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

The resulting surfaces shall be true and uniform. Repaired surfaces, the appearance of which is not satisfactory to the Engineer, shall be rubbed as specified under Class 2 finish.

Exposed surfaces not protected by forms shall be struck off with a straightedge and finished with a float to a true and even surface. The use of additional mortar to provide a plastered or grout finish will not be permitted.

The tops of caps in the area of the bridge seat shall be finished with a steel trowel or by grinding to a smooth finish and true slope at the proper elevation.

**(2) Class 2, Rubbed Finish.** After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work the concrete shall be thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished. Rubbing shall be continued until form marks, projections, and irregularities have been removed, voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time.

After concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum

stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks.

**(3) Class 3, Textured Coating Finish.** The material furnished for textured coating finish shall be a commercial paint type texturing product produced specifically for this purpose, and shall consist of a synthetic non-alkyd resin containing mica, perlite, non-biodegradable fibers, and durable tinting pigments. The material shall be listed on the QPL.

Unless otherwise specified in the Contract, the color of the textured coating finish shall be concrete gray, equal or close to Shade 36622 of the Federal Color Standard 595 B.

Surfaces to be coated shall be free from efflorescence, laitance, flaking, coatings, dirt, oil, and other foreign substances. The finish shall not be applied over surfaces cured with membrane curing compound until 30 days has elapsed from application of the membrane; however, the time may be reduced if the curing membrane is removed. Prior to application of the finish, the surfaces shall be free of moisture, as determined by sight and touch, and in a condition consistent with the manufacturer's published recommendations.

The finish shall be applied at the rate recommended by the manufacturer and as approved by the Engineer. The finish shall be applied with heavy duty spray equipment capable of maintaining a constant pressure as necessary for proper application. When recommended by the manufacturer and approved by the Engineer, the finish may be applied with rollers and/or brushes.

The completed finish shall be tightly bonded to the structure and shall present a uniform appearance and texture equal to or better than that required for rubbed finish. If necessary, an additional coat or coats shall be applied to produce the desired surface texture and uniformity. Upon failure to adhere positively to the structure without chipping or cracking, or if the desired surface appearance cannot be attained, the coating shall be removed from the structure and the surface given a rubbed finish, or another approved finish satisfactory to the Engineer.

**(4) Class 4, Exposed Aggregate Finish.** This type of finish shall be produced by scrubbing the surface of green concrete with stiff wire or fiber brushes, using a solution of muriatic acid in the proportion of 1 part acid to 4 parts water, or by sand blasting, until the cement film or surface is completely removed and the aggregate particles are exposed. The amount of aggregate exposure will be specified on the plans or designated by the Engineer. Any surface treated with muriatic acid shall be thoroughly washed with water to which a small amount of ammonia has been added to remove all traces of the acid. The resulting surface shall be an even pebbled texture.

**(5) Class 5, Tined Bridge Roadway Surface Finish.** The concrete bridge roadway surface shall be given a finish with a burlap drag, followed by tining.

The surface shall be finished by dragging a seamless strip of damp burlap over the full width of the roadway surface. The burlap drag shall consist of sufficient layers of burlap and have sufficient length in contact with the concrete to slightly groove the surface, and shall be moved forward with a minimum bow of the lead edge. The drag shall be kept damp, clean, and free of particles of hardened concrete.

The final finish shall be accomplished by using the drag finish as described above with the further application of a metal tine finishing device. The tine shall be approximately 0.032" x 0.125" (0.8 mm x 3.0 mm) of steel flat wire, 2"-5" (50 mm-125 mm) in length, and spaced on 1/2"-3/4" (13 mm-19 mm) centers. The grooves produced in the concrete shall be substantially from 1/8"-3/16" (3 mm-5 mm) in depth. The grooves shall be transverse to the centerline of the surface. The metal tine device shall be operated by approved mechanical or manual means. Other texturing equipment may be approved by the Engineer provided it produces a texture equivalent to that produced by the metal tine.

The tining shall be terminated with a transition in depth 18" (0.5 m) from the gutter line.

As an alternate to the use of a burlap drag and a metal tine finishing device, a finned float may be used according to the following requirements:

After a tight uniform surface meeting the straightedge requirements of Subsection 802.20(b) has been achieved, the surface

shall be given a texture by transverse grooving with a finned float. The finned area of the float shall be at least 4" x 36" (100 mm x 900 mm). The fins shall extend the full length of the float and cover at least half of the width. The grooves produced shall be approximately 3/16" (5 mm) in width at 3/4" (19 mm) centers and substantially 1/8"-3/16" (3 mm-5 mm) in depth. This operation shall be performed at such time and in such manner that the desired texture will be achieved while minimizing displacement of the larger aggregate particles. The transverse grooving shall be terminated approximately 18" (0.5 m) from the gutter line at the base of the curb. The un-grooved area adjacent to the curbs shall be given a longitudinal light broom finish.

**(6) Class 6, Broomed Finish.** After the concrete has been deposited in place, it shall be consolidated and the surface shall be struck off by means of a strike board, floated, and broomed. An edging tool shall be used on edges and expansion joints. The surface shall not vary more than 1/4" (6 mm) under a 10' (3 m) straightedge. The surface shall have a granular or matte texture.

**(7) Class 7, Grooved Bridge Roadway Surface Finish.** Following straightedging according to Subsection 802.20(b) and after all excess moisture has disappeared, the concrete shall be given a finish with a belt or a burlap drag, prior to the grooved finish.

The belted finish shall be accomplished by two applications of a soft, flexible belt of approved composition 8" - 12" (200 mm-300 mm) in width. The belt shall be moved forward with a combined transverse and longitudinal motion, the longitudinal advance being very slight for the first belting, but with a sweeping motion for the final belting. Care shall be exercised that the belting operation does not work the crown out of the deck surface. Just before the concrete attains its initial set, the surface shall be given the final belting with the purpose of producing a uniform surface of roughened texture.

The burlap drag finish shall be accomplished by dragging a seamless strip of damp burlap over the full width of the surface. The burlap drag shall consist of sufficient layers of burlap and have sufficient length in contact with the concrete to slightly groove the surface and shall be moved forward with a minimum bow of the leading edge. The drag shall be kept damp, clean, and free of particles of hardened concrete.

The bridge roadway surface shall be grooved perpendicular to the centerline with grooves extending across the slab to within 18" (0.5 m) of the gutter lines.

The grooves shall be cut into the concrete using a mechanical sawing device that will leave grooves 1/8"-3/16" (3 mm-5 mm) in depth and spaced on 1/2"-3/4" (13 mm-19 mm) centers. Grooving blades shall be 0.075"-0.125" (2 mm-3 mm) wide. Sawing shall not be performed before the end of the normal curing.

Residue from the grooving operations shall be removed and the bridge deck thoroughly cleaned. Residue shall not be permitted to enter drainage facilities or streams.

**802.20 Bridge Roadway Surface Construction. (a) Striking Off.** After the concrete is placed and consolidated according to Subsection 802.09, bridge roadway surfaces or top slabs of structures serving as finished roadway surfaces shall be finished using approved equipment. The Contractor shall show the type, size, and weight of the finishing machine and auxiliary equipment that is to be used in the bridge deck construction on the drawings submitted for the span and overhang support system required by Subsection 802.13.

Mechanical strike-off machines shall be power driven, with oscillating type screeds, traveling on rails or headers adjusted to conform to the profile or cross section of the roadway. The screed shall be adjusted to conform to the profile or the required cross section of the roadway. Consolidation by a vibratory action of the finishing machine will not be permitted. The screeds shall have sufficient strength to retain their shape after adjustment. The finishing machine shall go over each area of the bridge roadway surface as many times as is required to obtain the required profile and cross section. A slight excess of concrete shall be kept in front of the screed at all times. This excess of concrete shall be carried all the way to the edge of the placement or form, and shall not be worked into the slab but shall be wasted. When a finishing machine travels on rails supported by fixtures embedded in the concrete area, these supports shall be removed and the holes filled and finished to the same quality and finish as the surrounding concrete. The holes shall be cleaned of grease and other foreign matter prior to filling.

When non-mechanical strike-off methods are approved, the bridge roadway surfaces or slabs shall be struck off with a screed

that is parallel to the centerline of the roadway, resting on bulk heads or screed strips cut or set to the required cross section of the roadway. This screed shall be so constructed as to have sufficient strength to retain its shape and the cutting edge shall be adjusted to conform to the profile of the roadway. Screed strips or headers shall be accurately set to the specified grades, checked, and adjusted as necessary prior to the final screeding operation. The screed shall be worked back and forth over the surface until the proper profile and cross section is obtained.

Longitudinal screeds shall be of sufficient length to finish the full length of spans 50' (15 m) or less in length. Spans over 50' (15 m) in length and continuous spans shall be placed with lengths of placements as shown on the plans. The use of longitudinal screeds on spans with a horizontal curve is prohibited.

Excess water, laitance, or foreign materials brought to the surface during the course of the finishing operations shall not be reworked into the roadway surface, but shall be removed immediately upon appearance by means of a squeegee or straightedge drawn from the center of the roadway surface toward either curb.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

**(b) Straightedging.** After finishing as described above, the entire surface shall be checked by the Contractor, in both directions, for trueness using a 10' (3 m) metal straightedge. The surface shall show no deviation in excess of 1/8" (3 mm) from the straightedge. Deviations in excess of this requirement shall be corrected before the concrete sets. The checking operation shall progress by overlapping the straightedge at least 1/2 the length of the preceding pass. Major deviations shall be corrected with the strike-off; minor deviations may be corrected using the straightedge or a metal float.

**(c) Initial Surface Test.** As soon as the surface has set sufficiently to withstand damage when walking on it, and not later than the morning following the placing of the concrete, it shall be straightedged in both directions with the 10' (3 m) straightedge and any variations exceeding 1/8" (3 mm) shall be plainly marked. In addition, profiles shall be taken at 10' (3 m) intervals along the centerline of bridge, centerline of each lane, and each gutter line.



When the bridge roadway surface profiles exhibit surface deviations in excess of 1/4" (6 mm) in 20' (6 m), the Contractor shall make appropriate changes to either equipment or methods prior to proceeding with the next bridge deck placement.

After the initial placement, the straightedge and profile requirements shall extend onto the adjacent placements.

**(d) Final Surface Test.** Upon completion of the entire bridge superstructure, the bridge roadway surface shall be checked as specified above.

All marked areas shall be corrected by grinding until such deviations have been reduced to meet the tolerances of 1/8" (3 mm) in 10' (3 m) and 1/4" (6 mm) in 20' (6 m) at no cost to the Department. The grinding equipment shall be power driven and specifically designed to smooth and texture portland cement concrete by means of diamond blades.

All areas that have been ground shall be re-grooved according to Subsection 802.19, Class 7.

**802.21 Precast Concrete Products. (a) General.** This subsection pertains to concrete units that have been cast prior to erection or installation, and shall include precast concrete slab and girder units, bent caps, rail posts, piling, and other items. The casting may be done at the site or at the Contractor's or Manufacturer's central casting plant and transported to the bridge site.

The foregoing requirements of Section 802 and those of Section 804 governing materials and construction of reinforced concrete structures, insofar as they are applicable, shall govern the materials requirements, quality control and quality acceptance, and construction methods relative to precast concrete products, except as modified and supplemented by this subsection. In case of conflict, the specifications of this subsection shall govern.

Concrete in precast products shall be placed in one continuous operation for each unit in a line. The use of split pours for multiple units in a prestress line will not be permitted.

The Engineer shall be notified prior to beginning a placement and only those completed products bearing identification marks of acceptance by the Department will be permitted for use in

construction. The date of casting and a unique identification mark shall be inscribed on each unit.

**(b) Quality Control and Quality Acceptance for Concrete.** Quality control and quality acceptance shall be according to the provisions of Subsection 802.06.

**(c) Defective Materials.** Materials and manufactured products not conforming to the requirements of these specifications will be rejected and shall be removed immediately from the site of the work, unless otherwise permitted by the Engineer. No rejected material or products, the defects of which have been subsequently corrected, shall be used until written approval of the Engineer has been given.

**(d) Forms.** The provisions of Subsection 802.14, insofar as they are applicable, shall govern material and construction of forms. Forms shall be sufficiently true and unyielding such that the 4 sides of slabs and bent caps shall not vary more than 1/8" (3 mm) for the full depth of the unit when tested with a straightedge in both horizontal and vertical directions. The top and bottom of bent caps and the tops of slab and girder units shall not vary more than 1/8" (3 mm) in any 10' (3 m) length when tested with a straightedge in both longitudinal and transverse directions.

**(e) Reinforcing.** Reinforcing steel shall be accurately located in the forms and firmly held in place by means of auxiliary steel wire supports sufficient in number and size to prevent displacement during the course of construction.

**(f) Placing Concrete.** Concrete shall not be deposited in the forms until the Engineer has inspected and approved the placing of the reinforcement. Vibrating shall be done with care and in such a manner as to avoid displacement of reinforcement or wires.

The maximum concrete mix temperature at the time of placement shall be 95° F (35° C). When the internal temperature of the plastic concrete reaches 90° F (32° C), the Contractor shall take necessary precautions to ensure that the temperature of succeeding batches does not exceed 95° F (35° C). No concrete shall be placed when the air temperature is below 36° F (2° C) unless provision is made for heating the ingredients and for enclosing the concrete and heating the enclosure. The minimum placement temperature of the

plastic concrete mix shall be 50° F (10° C). The methods used to control the concrete temperature shall be approved by the Engineer.

**(g) Curing, Removal of Forms, and Handling of Completed Units.** The requirements of Subsections 802.15 and 802.17 shall be modified according to the following specifications:

Exposed surfaces shall be covered with wetted burlap-polyethylene sheeting as soon as the concrete has set sufficiently to prevent marring of surfaces, and the entire unit shall be kept continuously wet for a period of not less than 5 days. Steam curing, according to the requirements of Subsection 802.22(f)(2)f, may be used in lieu of covering with sheeting. Other precautions to ensure development of strength shall be taken if directed. Side forms may be removed when such removal will cause no breakage, distortion, slump, or misalignment of the concrete.

The precast concrete units shall remain on the bottom supporting forms until the concrete has reached a compressive strength of 2500 psi (17.0 MPa), or as specified, for slab and cap units and 3000 psi (21.0 MPa), or as specified, for piling, as evidenced by test cylinders molded, cured, and tested as specified above. Then the units may be removed from the bottom forms to a curing or storage area. The units may be shipped and used when the concrete reaches the minimum specified 28 day compressive strength, as evidenced by test cylinders made at the time of casting, except that the minimum time between casting and shipping shall be not less than 10 days.

After casting, units shall be picked up and supported, as a minimum, at points designated on the plans. Units shall be handled, transported, and erected in such manner as to prevent cracking, spalling, or marring the concrete.

**(h) Finishing Concrete Surfaces.** Surfaces of precast members shall be finished according to the requirements set forth in Subsections 802.19. The exterior faces of the exterior members shall be given a Class 2 Finish. Other surfaces shall be given a Class 1 Finish, except that holes less than 3/8" (10 mm) in depth can be left. The final finish shall be made at the casting yard and any impairment of the surface occurring in transportation and erection shall be corrected before acceptance.

**802.22 Prestressed Concrete Structures. (a) General.** This subsection pertains to all prestressed concrete elements in structures and shall govern the manufacture, transportation, and storage of

beams, slabs, piling, and other structural members of precast concrete prestressed by the pre-tensioning method. This subsection shall govern the installation of all precast prestressed members except piling, which shall be placed according to the provisions of Section 805.

Plants furnishing precast prestressed concrete products shall be certified by the Prestressed Concrete Institute. Shop drawings for prestressed concrete structures or components shall be submitted to the Engineer for review and approval before fabrication begins.

The Engineer shall be notified prior to beginning a placement and only those completed products bearing identification marks of acceptance by the Department will be permitted for use in construction. The date of casting and unique identification mark shall be inscribed on each unit.

**(b) Prestressing Methods.** The method of prestressing to be used shall be optional with the Contractor, subject to requirements hereinafter specified.

Prior to casting members to be prestressed, the Contractor shall submit to the Engineer for approval complete details of the method, materials, and equipment proposed for use in the prestressing operations. Such details shall outline the method and sequence of stressing; complete specifications and details of the prestressing steel and anchoring devices proposed for use; anchoring stresses; type of enclosures; and other data pertaining to the prestressing operations, including the proposed arrangements of the prestressing units in the members.

**(c) Consulting Service.** Unless otherwise directed, the Contractor shall certify to the Engineer that a technician skilled in the approved prestressing method will be available to the Contractor to give such aid and instruction in the use of the prestressing equipment and installation of materials as may be necessary to obtain required results.

**(d) Materials. (1) Concrete.** The materials for concrete shall conform to the requirements of Subsection 802.02. The class of concrete to be used, including strength requirements, shall be as specified or shown on the plans or in the Special Provisions. Class S concrete for use in prestressed concrete girders shall be as specified in Table 802-1.

**(2) Reinforcing Steel.** Reinforcing steel shall conform to requirements of Section 804.

**(3) Prestressing Reinforcement Steel.** Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength 7-wire strand, or high-tensile-strength alloy bars as specified on the plans or in the Special Provisions.

High-tensile-strength steel wire shall conform to the requirements of AASHTO M 204.

High-tensile-strength 7-wire strand shall conform to the requirements of AASHTO M 203.

Low-relaxation strand shall conform to the requirements of AASHTO M 203. The Contractor shall furnish certified test reports that the strand furnished meets all of the applicable requirements.

High-tensile-strength alloy bars shall conform to the requirements of AASHTO M 275.

At the Contractor's option, a design other than that shown on the plans may be submitted. This optional design must be approved by the Engineer. Any additional expense as a result of the Contractor's design shall be at no cost to the Department.

**(4) Testing.** Wire, strand, or bars to be shipped to the site shall be assigned a lot number and tagged for identification purposes.

Samples submitted shall be according to the Department's *Manual of Field Sampling and Testing Procedures* and shall be representative of the lot to be furnished. Materials specified for testing shall be furnished at no cost to the Department and shall be delivered in sufficient time for tests to be made prior to use. If directed by the Engineer, the selection of samples shall be made at the Manufacturer's plant by the Inspector.

**(e) Quality Control and Quality Acceptance for Concrete.** Quality control and quality acceptance shall be according to the provisions of Subsection 802.06.

**(f) Construction Requirements. (1) General.** Prestressed concrete structural members shall be constructed according to the applicable requirements of the foregoing, and reinforcing steel shall be placed according to the requirements of Section 804, subject to the modifications and amendments contained in this subsection.

The manufacture of precast prestressed concrete structural units shall conform to the dimensional tolerances in the latest revision of the *Manual for Quality Control for Plants and Production of Structural Precast Concrete Products MNL-116* published by the Prestressed Concrete Institute.

Girders shall have a permanent identification plate or permanent marking located on the girder in such a place that it may be read after the bridge is complete. Records shall be furnished to the Bridge Engineer and Resident Engineer which will enable them to determine the date of casting, the date of prestressing, and the location of the casting yard. The identification system, type and placement of the identification plate shall be detailed on the manufacturer's shop drawings.

**(2) Manufacture. a. Prestressing Equipment.** Hydraulic jacks shall be equipped with accurate pressure gauges. The Contractor may elect to substitute screw jacks or other types for hydraulic jacks. In such cases, proving rings or other approved devices shall be used in connection with the jacks. All devices, whether hydraulic jack gauges or otherwise, shall be calibrated so as to permit the stress in the prestressing steel to be determined at all times. All devices shall be calibrated at least annually and a certified calibration curve shall accompany each device. If at any time there are indications that the calibration may be in error, the Engineer may require the device to be re-calibrated. Indications that the calibration may be in error include, but are not limited to, such conditions as apparent damage to the device or any of its components; corrosion of the device; etc.

Safety measures shall be taken by the Contractor to prevent accidents due to possible breaking of the prestressing steel or the slipping of the grips during the prestressing process.

**b. Casting Yard.** The precasting of prestressed concrete structural members may be done at any location selected by the Contractor, subject to the approval of the Engineer.

Before any site on Department right-of-way is approved for use as a casting yard, the Contractor shall submit to the Engineer a plan of operation showing anticipated leveling or altering of the selected area. Upon completion of the work, the site shall be cleared of equipment and rubbish and restored as nearly as possible to its original condition.

c. Placing Steel. Steel shall be accurately placed in the position shown on the plans, firmly held during the placing, and maintained during the setting of the concrete.

Distances from the forms and the spacing of steel shall be maintained by stays, ties, hangers, or other approved supports.

d. Pretensioning. The prestressing elements shall be positively and accurately held in position and shall be stressed by jacks. A record shall be kept of the jacking force and the elongations produced thereby. Several units may be cast in one continuous line and stressed at one time. Sufficient space shall be left between ends of units to permit access for cutting after the concrete has attained the required strength. No bond stress shall be transferred to the concrete, nor end anchorages released, until the concrete has attained a compressive strength, as shown by cylinder tests, of at least 4000 psi (28.0 MPa), or as specified. The elements shall be cut or released slowly and in such order that lateral eccentricity of prestress will be a minimum.

e. Placing Concrete. Concrete shall not be deposited in the forms until the Engineer has inspected and approved the placing of the reinforcement, anchorages, and prestressing steel. The concrete shall be vibrated internally or externally or both as directed by the Engineer. The vibrating shall be done with care and in such a manner as to avoid displacement of reinforcement or wires.

The maximum concrete mix temperature at the time of placement shall be 95° F (35° C). When the internal temperature of the plastic concrete reaches 90° F (32° C), the Contractor shall take necessary precautions to ensure that the temperature of succeeding batches does not exceed 95° F (35° C). No concrete shall be placed when the air temperature is below 36° F (2° C) unless provision is made for heating the ingredients and for enclosing the concrete and heating the enclosure. The minimum placement temperature of the plastic concrete mix shall be 50° F (10° C). The methods used to control the concrete temperature shall be approved by the Engineer.

f. Steam Curing. Steam curing will be permitted in lieu of wet curing. If the Contractor elects to cure with steam or by any other special method, the method and its details shall be approved by the Engineer.

Steam curing shall be accomplished under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be 2-4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If retarders are used, the waiting period before application of the steam shall be increased to 4-6 hours. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the ambient air temperature shall increase at a rate not to exceed 40° F (22° C) per hour until a temperature of 120° F to 160° F (49° C to 71° C) is reached. The attained temperature shall be held until the concrete has reached the desired strength. Detensioning shall be accomplished immediately after steam curing has been discontinued. Additional curing is not required after detensioning. In discontinuing the steam, the ambient air temperature shall not decrease at a rate exceeding 40° F (22° C) per hour until a temperature has been reached about 20° F (10° C) above the temperature of the air to which the concrete will be exposed. The concrete shall not be exposed to temperatures below freezing for 5 days after casting.

The Contractor shall furnish recording thermometers showing the time-temperature relationship throughout the entire curing period. One such recording thermometer shall be furnished for each 200' (60 m) of casting bed of each separate enclosure. Heat sensing elements shall be freely suspended within the accelerated cure enclosure. Recording thermometers shall be kept in proper calibration and recalibrated at least annually.

Prestressed concrete units shall remain on the bottom supporting forms until the concrete has reached a compressive strength of 4000 psi (28.0 MPa), or specified strength, as evidenced by test cylinders molded, cured, and tested as herein specified. The units may then be detensioned and removed from the bottom forms to a curing and storage area. Units may be shipped and used when the concrete reaches the greater of the minimum specified 28 day strength or 5000 psi (35.0 MPa), as evidenced by test cylinders made at the time of casting, except that the minimum time between casting and shipping shall be not less than 10 days.

g. Detensioning. Detensioning shall be performed immediately following the curing period while the concrete is still warm (100° F



to 130° F [38° C to 54° C ]) and moist. Forms, ties, inserts, hold downs, blocking between bulkheads, or other devices that would restrict longitudinal movement of the members along the bed shall be removed or loosened prior to transfer of stress.

In single strand detensioning, the strands shall be released by heat-cutting using a low-oxygen flame, played along the strand for a minimum of 5" (125 mm). In order for the release of stress to occur gradually, strands shall not be cut quickly but shall be heated until the metal gradually loses its strength. Detensioning shall be accomplished at both ends of the prestressing bed and at all spaces between ends of members simultaneously, unless otherwise directed. The sequence used for cutting strands shall keep the stresses nearly symmetrical about the axes of the members and the pattern and schedule shall be approved by the Engineer.

In multiple strand detensioning, strands shall be released simultaneously by hydraulic jacking. The total force shall be taken from the header by the jack, then gradually released.

Detensioning of draped strands shall follow the procedures outlined in the *Manual For Quality Control for Plants and Production of Structural Precast Concrete Products, MNL 116* published by the Precast Concrete Institute, except as modified by these specifications.

**(3) Handling.** Extreme care shall be exercised in handling and moving precast prestressed concrete members. Precast girders and slabs shall be transported in an upright position and the points of support and directions of the reactions with respect to the member shall be approximately the same during transportation and storage as when the member is in its final position.

After casting, precast prestressed piling shall be picked up and supported, as a minimum, at points designated on the plans. Care should be taken during storage, hoisting, and handling of the precast units to prevent cracking or damage. Units damaged by improper storing or handling shall be replaced by the Contractor at no cost to the Department.

**(4) Placing.** Precast prestressed structural members shall be placed in the structure in conformity with the plans and any Special Provisions governing the particular type of structure to be built.

**802.23 Opening Structure to Traffic.** Precast and cast in place spans, including top slabs of all box culverts, may be opened to traffic, public or construction, according to the following schedule. Both time and strength requirements must be met before opening the structure to traffic.

<b>Unit</b>	<b>Minimum Time</b>	<b>Strength Requirement</b>
Precast Spans	Immediately*	--
Cast in Place Spans	7 Days	Min. Specs.
R.C. Box Culvert Spans	7 Days	Min. Specs.

\*Grouted keyways for precast spans shall be allowed to cure a minimum of 3 days prior to opening the structure to traffic.

In no event shall any spans be opened to traffic before the longitudinal and transverse joints are properly finished and the surface cleaned of foreign substances.

**802.24 Method of Measurement.** (a) Concrete of the various classes will be measured by the cubic yard (cubic meter) in place, based upon actual volume within the neat lines of the structure as shown on the plans or revised by authority of the Engineer. Concrete parapet walls will be included in the volume of concrete for payment.

No deductions will be made for the volume of concrete displaced by reinforcing steel, piling, structural steel, or expansion joint material. No deduction will be made for fillets, scorings, and chamfers 1 square inch (650 sq mm) or less in concrete cross-sectional area.

The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

(b) Grooving will be measured by the square yard (square meter). The quantity of grooving to be paid for will be determined by multiplying the width of the grooved area by the length grooved.

(c) Precast concrete products, except for precast reinforced concrete box culverts, will be measured by the unit of each type and

size of product. Precast reinforced concrete box culverts may be substituted for cast-in-place box culverts according to Section 607. Precast piling will be measured as specified in Sections 805.

(d) Prestressed Concrete Girders will be measured by the linear foot (meter) of the type shown on the plans. The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and the actual quantities due to changes in alignment or dimensions or to apparent errors.

(e) Concrete used to construct miscellaneous items for which a separate pay item is provided (such as curbs, drop inlets, etc.) will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit price bid for the item in which used.

**802.25 Basis of Payment.** (a) Concrete of the various classes, completed and accepted and measured as provided above, will be paid for at the contract unit price bid per cubic yard (cubic meter) for the Class specified, which price shall be full compensation for furnishing all materials, forms, falsework, and bracing; for mixing, placing, consolidating, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Reinforcing steel, metal drains, and structural steel placed in this concrete will be paid for under other contract items. Unless otherwise provided, conduits, joint fillers and sealers, water stops, flashing, and roofing shown on the plans will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various classes of concrete.

(b) Grooving completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Grooving, which price shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the grooving including removal of residue and cleaning of the bridge deck.

(c) Precast and prestressed precast concrete products, except piling, prestressed girders and precast reinforced concrete box culverts, constructed, transported, erected, accepted, and measured as provided above, will be paid for at the contract unit price bid per each for Precast Concrete Curb Units, Precast Concrete Interior Units, Precast Parapet Rail Units, or other type units as designated on the plans and in the Proposal. Prestressed Concrete Girders will be paid for at the contract unit price bid per linear foot (meter) for the type shown on the plans. The price shall be full compensation for furnishing all materials and forms; for performing mix designs and quality control and acceptance sampling and testing; for casting; for prestressing operations; for transporting and erecting units; and for all labor, equipment, tools, and incidentals necessary to complete the work. Reinforcing steel, prestressing materials, bolts, nuts, washers, wire mesh, reinforcing bar supports, grout for shear keys, joint fillers and sealers, and unreinforced bearing pads will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for precast concrete products. Precast reinforced concrete box culverts may be substituted for cast-in-place box culverts according to Section 607.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Class B Concrete-Bridge	Cubic Yard (Cubic Meter)
Class S Concrete-Bridge	Cubic Yard (Cubic Meter)
Class S(AE) Concrete-Bridge	Cubic Yard (Cubic Meter)
Seal Concrete-Bridge	Cubic Yard (Cubic Meter)
Class A Concrete-Roadway	Cubic Yard (Cubic Meter)
Class S Concrete-Roadway	Cubic Yard (Cubic Meter)
Class S(AE) Concrete-Roadway	Cubic Yard (Cubic Meter)
Seal Concrete-Roadway	Cubic Yard (Cubic Meter)
Grooving	Square Yard (Square Meter)
___' (___m) Precast Concrete Curb Units	Each
___' (___m) Precast Concrete Interior Units	Each
___' (___m) Precast Parapet Rail Units	Each
Prestressed Concrete Girders (Type___)	Linear Foot (Meter)

## SECTION 803

### PROTECTIVE SURFACE TREATMENT FOR CONCRETE

**803.01 Description.** This item shall consist of cleaning, surface preparation, and treating concrete surfaces, including concrete cracks, bridge decks, and other concrete surfaces at the locations shown on the plans. The protective surface treatment used will be specified in the Contract and will be one of the three classes described in these specifications.

**803.02 Materials.** The protective surface treatment shall meet one of the following requirements:

(a) **Class 1 Protective Surface Treatment.** The protective surface treatment shall consist of boiled linseed oil meeting the requirements of ASTM D 260-86 (2001) mixed with an equal amount of thinner consisting of mineral spirits, kerosene, or turpentine. The linseed oil and thinner shall be shipped to the work site in separate containers and mixed in the presence of the Inspector.

(b) **Class 2 Protective Surface Treatment.** The protective surface treatment shall be an organo silicon compound dissolved in a suitable solvent carrier that, when applied, will produce a hydrophobic surface covalently bonded to the concrete. The organo silicon compound shall be either alkyl-alkoxysilane or oligomeric alkyl-alkoxysiloxane. The solvent shall leave a residue of less than 1% by weight after evaporation. The material furnished shall be listed on the QPL.

The sealer shall not permanently stain, discolor, or darken the concrete. Application of the sealer shall not alter the surface texture or form a coating on the concrete surfaces. Treated concrete shall be surface dry within 30 minutes after application.

The sealer shall be tinted with a fugitive dye to enable the sealer to be visible on the treated concrete surface for at least four hours after application. The fugitive dye shall not be conspicuous more than 7 calendar days after application when exposed to direct sunlight.

The material shall meet the following performance criteria based on a single application at the manufacturer's recommended application rate:

<u>Test</u>	<u>Test Method</u>	<u>Duration</u>	<u>Max. Absorption</u>
Water Immersion	ASTM C642	48 hours	1% by weight
Water Immersion	ASTM C642	50 days	2% by weight
Salt water ponding (based on non-abraded specimen)	AASHTO T 259	90 days	0.76 lbs./cu yd (0.44 kg/cu m) Depth: 1/2" to 1" (13 to 25 mm)

The sealer shall be delivered to the project in unopened containers with the manufacturer's label identifying the product and with the seal(s) intact. Each container shall be clearly marked by the manufacturer with the following information:

- Manufacturer's name and address.
- Product name.
- Date of manufacture and expiration date.
- Lot identification.
- Storage requirements.

The sealer shall be used as supplied unless otherwise specified by the manufacturer. If the manufacturer specifies dilution, the requirements for such dilution shall be shown on the label of each container.

**(c) Class 3 Protective Surface Treatment.** The material used shall be a low viscosity, nonfuming, high molecular weight methacrylate resin listed on the Department's qualified products list (QPL) and conforming to the following:

<u>Property</u>	<u>Test Method</u>	<u>Requirement</u>
Viscosity	Brookfield RVT 100 RPM @ 72° F (22° C)	25 cps maximum
Pot Life	Application life before curing begins (@68° F [20 ° C] air temperature)	15 minutes minimum
Curing Time	On site at 50° F (10° C)	6 hours Maximum

**803.03 Construction Requirements. (a) Class 1 Protective Surface Treatment.** The area to be treated shall be clean of dirt, grease, and other foreign matter. The mixture shall be applied by means of spraying in such a manner as to obtain uniform coverage at the specified rate. All areas shall receive two applications of the linseed oil treatment. The first application shall be at a rate of 1 gallon of the mixture per 40 square yards (1 liter per 9 square meters) and the second application at the rate of 1 gallon of the mixture per 67 square yards (1 liter per 15 square meters). The second coat shall be delayed until the first coat has been completely absorbed and the concrete has regained its dry appearance.

The linseed oil shall not be applied when the concrete temperature is below 50° F (32° C) or when very humid or wet conditions prevail.

Boiled linseed oil shall not be used on surfaces where Class 3 concrete finish is specified or used.

**(b) Class 2 Protective Surface Treatment. (1) General.** The treatment of concrete surfaces shall be performed by personnel certified by the manufacturer of the penetrating water repellent solution as qualified applicators. Surface preparation shall be performed under the direct, on-site supervision of the certified applicator. The manufacturer's written certification of the applicator shall be furnished to the Engineer before the surface preparation and actual application is begun. The application, including surface preparation, shall comply with the manufacturer's explicit procedures. Before beginning the work, the Contractor shall submit to the Engineer documentation of the procedures to be used. The procedures shown in the documentation shall include, but are not limited to:

- The identification of the product to be used by brand name and name of the manufacturer.
- A copy of the manufacturer's unabridged application procedures.
- A description of the manufacturer's recommended surface preparation methods and the equipment to be used.
- Weather and surface moisture limitations.
- Time between surface preparation and application.
- Time traffic should be kept off the treated surface.
- Re-treatment procedures.

- A copy of the manufacturer's authorized applicator certificate for the personnel approved to perform the work.

**(2) Surface Preparation.** All concrete surfaces shall be thoroughly cleaned before application of the penetrating water repellent solution. The method of cleaning shall remove all traces of curing compound, laitance, dirt, dust, salt, oil, asphalt or other foreign materials, but shall not cause undue damage to the surface, remove or alter the existing surface finish or texture, or expose the coarse aggregate. Unless otherwise specified, the equipment used for preparation of the surface shall comply with one of the following:

- Compressed air pressure type sand blasting equipment of proper size and capacity to clean concrete surfaces as specified.
- A portable machine designed especially for cleaning horizontal concrete surfaces using recyclable steel shot blasting techniques.
- A hot water pressure system for cleaning concrete surfaces using 160° F (71° C) minimum temperature water at a minimum 3500 psi (24 MPa) nozzle pressure.
- A high pressure cold water washer unit for cleaning concrete surfaces using a minimum of 7500 psi (52 MPa) nozzle pressure.
- Steam jet cleaning equipment for cleaning concrete surfaces using 320° F (160° C) water temperature at 300 psi (2 MPa) operating pressure.

Concrete surfaces prepared for treatment shall be approved by the certified applicator.

**(3) Application.** The Contractor shall notify the Engineer at least one day before beginning application. The concrete shall have aged at least 28 calendar days and shall be surface dry for at least 24 hours before treatment begins. Concrete surfaces that become contaminated before the sealer is applied shall be re-cleaned. The Contractor shall use the equipment recommended by the manufacturer for application of the sealer. Unless otherwise specified, the sealer shall be applied with low pressure airless spray equipment operating at 15 psi to 40 psi (100 kPa to 275 kPa) pressure.



The sealer shall be applied in the manner and at the rate recommended by the manufacturer that will obtain a minimum penetration of 1/8" (3.0 mm). The rate of application shall be adjusted for vertical surfaces and surfaces that have been tined or roughened as specified by the manufacturer. The certified applicator shall determine if re-treatment is required due to weather conditions. If re-treatment is required, the re-treatment shall be performed as specified by the manufacturer and shall be at no additional cost to the Department.

No traffic of any kind will be permitted on bridge decks until the sealer has completely penetrated and is surface dry.

**(4) Certification.** After treatment has been completed, the Contractor shall submit a certification that the sealer was applied by personnel certified by the manufacturer and was done in compliance with these specifications.

**(c) Class 3 Protective Surface Treatment.** Surface preparation of the areas to be sealed with Class 3 Protective Surface Treatments shall be accomplished with one of the methods specified above for Class 2 Protective Surface Treatments, Subsection 803.02(b)(2), except that approval of the prepared surface by a certified applicator will not be required.

Application of the surface treatment shall not be performed when the concrete surface temperature is less than 50° F (10° C) or more than 100° F (38° C).

For treatment of individual cracks, the treatment shall be applied at a rate to completely fill the crack and repeated as necessary to bring the filler flush with the surrounding surface. Cracks wider than 1/8" (3.0 mm) shall be prefilled with fine sand according to the manufacturers' recommendations.

Traffic shall not be permitted on the treated surface until the area is tack free.

**803.04 Method of Measurement. (a) Class 1 Protective Surface Treatment.** Class 1 Protective Surface Treatment applied at the direction of the Engineer will be measured by the gallon (liter) of boiled linseed oil used in the mixture prior to thinning. The material used for thinning the mixture will not be measured.

**(b) Class 2 Protective Surface Treatment.** Class 2 Protective Surface Treatment will be measured by the square yard (square meter). Measurement will be made of the actual area covered as directed.

**(c) Class 3 Protective Surface Treatment.** Class 3 Protective Surface Treatment will be measured by the linear foot (meter) of crack sealed.

The quantities shown on the plans for Class 1 or 2 Protective Surface Treatment system will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

**803.05 Basis of Payment. (a) Class 1 Protective Surface Treatment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per gallon (liter) for Class 1 Protective Surface Treatment, which price shall be full compensation for cleaning, wetting, and other preparation of the surface to be treated; for furnishing the linseed oil and thinner; for mixing and application of the mixture; and for all labor, tools, equipment, and incidentals necessary to complete the work.

**(b) Class 2 Protective Surface Treatment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Class 2 Protective Surface Treatment, which price shall be full compensation for furnishing all materials; for cleaning and preparing the surfaces to be treated; for application of the sealer; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(c) Class 3 Protective Surface Treatment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Class 3 Protective Surface Treatment, which price shall be full compensation for furnishing all materials; for cleaning and preparing the surfaces to be treated; for application of the sealer; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Class 1 Protective Surface Treatment	Gallon (Liter)
Class 2 Protective Surface Treatment	Square Yard (Square Meter)
Class 3 Protective Surface Treatment	Linear Foot (Meter)

## **SECTION 804**

### **REINFORCING STEEL FOR STRUCTURES**

**804.01 Description.** This item shall consist of reinforcing steel and miscellaneous accessories of the quality, type, size, and quantity designated, which shall be furnished and placed in concrete structures according to these specifications and in conformity with the details shown on the plans, or as directed.

**804.02 Materials. (a) Bar Reinforcement.** Bar reinforcement for concrete in sizes up to and including #18 (No. 57) shall conform to the requirements of AASHTO M 31 or M 322 Type A. Mill test reports shall be submitted for reinforcing steel.

**(b) Wire and Wire Fabric.** Wire, when used as reinforcement in concrete, shall conform to the requirements of AASHTO M 32 or M 225.

Wire fabric, when used as reinforcement in concrete, shall conform to the requirements of AASHTO M 55 or M 221. All wire fabric shall meet the weld shear requirements for AASHTO M 55. The type of wire fabric shall be approved by the Engineer.

**(c) Bar Mat Reinforcement.** Bar mat reinforcement for concrete shall conform to the requirements of AASHTO M 54.

**(d) Epoxy Coating.** When specified, reinforcing steel bars shall be coated according to ASTM A775 using a coating material that meets the requirements of Annex A1 of ASTM A775.

The Contractor shall supply to the Engineer a written certification that properly identifies the number of each batch of coating material used in the order; the material, quantity represented, date of manufacture, and name and address of the manufacturer; and a

statement that the supplied coating material meets the requirements of Annex A1 of ASTM A775.

Patching material, compatible with coating material, inert in concrete, and meeting the requirements of Annex A2 of ASTM A775, shall be provided by the epoxy coating manufacturer.

**804.03 Bar Lists and Bending Diagrams.** All reinforcing steel shall be fabricated to conform to the details shown on the plans. Pins used for bending reinforcing steel shall be equal to or larger than that shown on the plans. Bar lists and bending diagrams for reinforcing steel and bar supports will not be reviewed or approved by the Engineer. The Contractor shall be responsible for the accuracy of the fabricated reinforcing steel.

**804.04 Fabrication.** Bar reinforcement shall be bent to the shapes shown on the plans.

Bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field bent, except as shown on the plans or specifically permitted by the Engineer.

Radii for bends shall be as shown on the plans. When not shown on the plans, radii bends on the inside of bars shall be as specified below.

Bar Number		Minimum Radii
U.S. Standard	Metric (SI)	
Stirrups and Ties		4 bar diameters
3, 4, 5, 6, 7, or 8	10, 13, 16, 19, 22, or 25	6 bar diameters
9, 10, or 11	29, 32, or 36	8 bar diameters
14 or 18	43 or 57	10 bar diameters

The Engineer or his representative shall have free access to the shop for inspection, and every facility shall be extended to him for this purpose. On a random basis, samples of bars, other than the additional test bars, may be taken by the Engineer.

Epoxy coating applicators shall be CRSI certified. The Contractor shall inform the Engineer, in writing, at least 10 days

prior to performing any of the cleaning or coating operations. The Contractor shall furnish to the Engineer the coating applicator's certification certifying that all materials used, the preparation of the bars, coating, and curing were done according to these specifications and that no bars contain more than six holidays per yard (meter). The certification shall include or have attached specific results of tests of coating thickness and flexibility of coating.

**804.05 Shipping, Handling, and Protection of Material.** Bar reinforcement shall be shipped in standard bundles, tagged and marked according to the *Code of Standard Practice* of the Concrete Reinforcement Steel Institute.

Epoxy coated bars shall be prepared for shipment by use of excelsior or equivalent padded metal bands, or other methods that will prevent damage during shipment. Caution shall be used to avoid dragging or dropping the bundles. If bundled together for shipment, the bundles should be small, tightly banded with padded bands, and should be lifted with a strong back, multiple supports, or a platform bridge to prevent bar to bar abrasion from sags in the bar bundle. Epoxy coated bars shall be stored on padded and/or wooden supports. All systems for handling coated bars shall have padded contact areas. If, in the judgment of the Engineer, the coating is damaged to the extent that the coating no longer provides the intended protection, the material shall be returned to the coating applicator for repair or replacement. Patching materials or any required repair of the coating shall be at no cost to the Department.

Steel reinforcement shall be protected from damage. When placed in the work, it shall be free from dirt, detrimental rust or scale, paint, oil, or other foreign substance. Steel reinforcement shall be stored above the ground on skids, platforms, or other supports. Epoxy coated reinforcing steel that is not incorporated into the work within 90 calendar days after delivery to the project shall be protected from exposure to the sun.

Epoxy coating damaged during fabrication, shipping, or installation shall be repaired according to ASTM A775. Damaged areas less than 0.10 square inch (65 sq mm) need not be repaired but all areas larger than 0.10 square inch (65 sq mm) shall be repaired. The maximum amount of damage shall not exceed 2% of the surface area of each bar. All damaged areas shall be repaired with the material specified in Subsection 804.02(d) and according to the manufacturer's instructions. Repairs will be required on all sheared

or cut ends of bars, end areas left bare during the coating process, and any areas where the entire coating is removed. All repairs shall be completed as soon as practicable and, in the case of bare end areas and sheared ends, before visible oxidation of the surface occurs. Epoxy coated bars shall not be flame cut.

The Contractor shall exercise caution when placing and vibrating concrete to prevent any damage to epoxy coated bars. In order to prevent the vibrator from damaging the coated bars, the head shall be covered with a sheet of rubber or a similar material as approved by the Engineer.

**804.06 Placing and Fastening.** Steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete. Bars shall be tied at all intersections except where spacing is less than 12" (300 mm) in each direction, in which case alternate intersections shall be tied.

Bundled bars shall be tied together at not more than 6' (2 m) centers.

Bar positions or clearances from the forms shall be maintained by means of stays, ties, hangers, or other approved devices. Reinforcing steel shall not be welded unless detailed on the plans or authorized in writing by the Engineer. Any authorized welding shall comply with Subsection 807.26. Metal bar supports that are in contact with the exterior surface of the concrete shall have protection conforming with the CRSI Specifications, Class 1 for Plastic Protected Bar Supports or Class 2 for Stainless Steel Bar Supports, with the further provision that the plastic protection may be applied either by a dipping operation or by the addition of premolded plastic tips to the legs of the supports. Epoxy Coated Bar Supports that are coated according to the provisions of CRSI "Manual of Standard Practice" with a minimum coating thickness of 5 mils (127  $\mu\text{m}$ ) may be substituted for Plastic Protected Bar Supports or Stainless Steel Bar Supports. All high chairs and bar bolsters shall be metal.

Plastic bar supports shall not be used.

When concrete is to rest on an excavated surface, layers of bars shall be supported above the surface by metal chairs or by precast mortar or concrete blocks. The use of rocks, pieces of stone or brick, pipe, wooden blocks, or chunks of concrete will not be permitted as bar supports or spacers.

Reinforcement shall be placed by the Contractor and inspected and approved by the Engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal required. Unless otherwise shown on the plans, the spacing of supports shall conform to the recommendations of CRSI.

If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

Epoxy coated bars shall be placed on plastic coated or epoxy coated metal supports and shall be held in place by use of plastic coated tie wires or molded plastic clips especially fabricated for this purpose. Bar supports for epoxy coated bars shall be fully coated metal supports. Epoxy coated bar supports shall be coated according to the provisions of CRSI "Manual of Standard Practice" and shall have a minimum coating thickness of 5 mils (127  $\mu\text{m}$ ). In placing epoxy coated bars, care shall be maintained to prevent coated bars from being damaged.

After the coated bars are secured to bar supports, a final visual inspection shall be made and all uncoated or damaged areas coated or repaired as required by the Engineer.

Any bar supports that deform under foot traffic or other construction activities shall not be used.

Reinforcing steel that is to be doweled into existing concrete shall be installed into drilled holes and secured using an approved non-shrink grout or a resin anchoring system listed on the Department's Qualified Products List. The diameter of the drilled holes and the installation procedures shall be as recommended by the grout manufacturer or the resin anchoring system manufacturer.

**804.07 Splicing.** Reinforcing steel shall be furnished in the full lengths specified on the plans. Bars spliced as a result of unforeseen construction conditions or sequences will require the written approval of the Engineer. Splices shall meet the requirements of the current edition of the AASHTO *Standard Specifications for Highway Bridges* or AASHTO *LRFD Bridge Design Specifications*, as specified in the plans.

Secondary reinforcing used for distribution of loads, such as longitudinal bars in box culverts, retaining walls, and slabs for steel girder spans, may be lapped 32 bar diameters minimum if bars are #6 (No. 19) or smaller. Primary reinforcing for columns and

retaining walls which require splicing as a result of the lowering of footings shall be spliced at the upper end of the original bars. Required lengths of splices for primary reinforcing will be determined by the Bridge Engineer.

In lapped splices, the bars shall be placed in contact and fastened together in such a manner as to maintain the minimum distance to the surface of the concrete as shown on the plans. Welded or mechanical splices shall be made only if detailed on the plans or authorized in writing by the Engineer. Welding shall comply with Subsection 807.26. Mechanical splices shall be listed on the QPL and shall be the type specified on the plans or approved by the Engineer.

**804.08 Lapping.** Sheets of wire fabric or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The lap shall be not less than one space of wire fabric or bar.

**804.09 Substitutions.** Bar size substitutions will be permitted only with specific authorization by the Engineer. The substituted bars shall have an area equivalent to or larger than the design area.

**804.10 Method of Measurement.** Steel reinforcement properly placed and tied will be measured in pounds (kilograms) based on the total computed weight for the sizes and lengths of bars, wire fabric, or mats shown on the plans or revised by the Engineer.

Epoxy Coated Reinforcing Steel will be measured by the pound (kilogram), based on the theoretical number of pounds (kilograms) calculated on the nominal weight before application of the epoxy coating materials. No allowance will be made for the epoxy coating material, the coating process, accessories, or the testing required by the manufacturer or applicator as specified above.

The weight of wire fabric will be computed from the theoretical weight of plain wire. If the weight per square foot (square meter) is given on the plans, that weight will be used.



The weight of plain round bars and deformed bars will be calculated using the following table:

U.S. STANDARD		METRIC (SI)	
<u>Bar No.</u>	<u>Weight(lbs./ft)</u>	<u>Bar No.</u>	<u>Weight (kg/m)</u>
3	0.376	10	0.560
4	0.668	13	0.994
5	1.043	16	1.552
6	1.502	19	2.235
7	2.044	22	3.042
8	2.670	25	3.973
9	3.400	29	5.060
10	4.303	32	6.404
11	5.313	36	7.907
14	7.65	43	11.38
18	13.60	57	20.24

The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

If bars are substituted at the Contractor's request and as a result more steel is used than specified, only the amount specified will be measured for payment.

When laps are made for splices other than those shown on the plans, for the convenience of the Contractor, the extra steel will not be measured for payment.

**804.11 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price per pound (kilogram) bid for Reinforcing Steel-Bridge, Reinforcing Steel-Roadway, or Epoxy Coated Reinforcing Steel, which price shall be full compensation for furnishing, bending, fabricating, epoxy coating, and placing the reinforcement; for accessories placed in concrete; and for all labor, equipment, tools, and incidentals necessary to complete the work. Clips, metal spacers, chairs, bar supports, ties, separators, wire, and other

material used for fastening reinforcement in place will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Reinforcing Steel.

When included on the plans for separate payment, wire fabric will be paid for under the applicable item of Reinforcing Steel.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Reinforcing Steel-Bridge (Grade __)	Pound (Kilogram)
Reinforcing Steel-Roadway (Grade __)	Pound (Kilogram)
Epoxy Coated Reinforcing Steel (Grade __)	Pound (Kilogram)

**SECTION 805  
PILING**

**805.01 Description.** This item shall consist of furnishing and driving piles of the type and dimensions designated on the plans or in the Contract, including cutting off or building up piles when required. Piling shall comply with and be installed according to these specifications, and at the location, and to the elevation, penetration, and bearing capacity shown on the plans or as directed by the Engineer.

**805.02 General.** Unless otherwise specified, all references to "steel piles" shall include "steel shell piles".

Where test piles or test loading is used or required, all piles shall be of the same type, shape and size as the test pile which governs that structure or that portion of the structure.

The requirements herein for casting, curing, handling, and driving piles shall be considered as minimum requirements. Strict compliance with these minimum requirements will not relieve the Contractor of the responsibility for adopting whatever additional provisions may be necessary to ensure the successful completion of the work.

Unless otherwise shown on the plans, the embankment at bridge ends shall be made to the bottom of the cap for bents without footings and thoroughly compacted as provided in the governing

specifications before driving end bent piles. In general, foundation piles shall not be driven until after the excavation is complete. Material forced up between the piles shall be removed to the correct elevation without cost to the Department before concrete for the foundation is placed.

The pile lengths shown on the plans are for estimating and bid comparison purposes only, except where lengths to be ordered are specified. All piles shall be driven to the required penetration specified in Subsection 805.08(e).

When the plans stipulate that test piles shall be driven, the lengths of piles to be ordered shall be determined by the Engineer following observations of the resistance to driving and the results of tests.

The order lengths will generally be provided to the Contractor within three business days after all test piles for a complete structure have been driven or at an earlier date if the Engineer deems that sufficient test pile data has been obtained to establish the lengths for a portion of the structure. When Method B or C is used to determine bearing capacity, additional time will be required to analyze the test pile data and determine the order lengths.

Unless the plans stipulate that test piles shall be driven or that certain length piles shall be ordered, it shall be the responsibility of the Contractor to estimate the lengths required and to furnish and drive piles in whatever sections and lengths that may be found necessary to meet the requirements of penetration and bearing resistance as specified or as directed. Piles shall be furnished in such lengths as may reasonably be expected to develop the required bearing resistance without build-ups. The Engineer will cooperate with the Contractor in furnishing, for guidance, available boring data, soil test data, etc., and recommendations or instructions on proper pile lengths, but the actual determination of the lengths of piles to be furnished shall be the responsibility of the Contractor, except that no pile shall be furnished of a length less than that required for the minimum specified depth of penetration. Where the piles as driven prove to be of insufficient length to secure the required bearing resistance, build-ups as necessary to obtain the required bearing will be permitted, either before or after pile has been driven to required bearing.

Where a precast pile is to be driven after making build-ups, the built-up portion shall be cured at least 10 days and shall have a minimum strength of 4000 psi (28.0 MPa) before driving.

Unless otherwise specified, when steel piles extend above the ground they shall be protected by painting as specified for painting structural steel in Section 638. This protection shall extend from an elevation 18" (0.5 m) below the ground to the top of exposed pile, except no painting is required on the portion of pile encased in concrete.

The bearing capacity of piles will be determined by the Engineer as provided in the Contract by one or a combination of the following methods:

- Method A -- Empirical Pile Formulas.
- Method B -- Wave Equation Analysis (WEAP).
- Method C -- Dynamic Load Test.

These methods are described in Subsection 805.09.

Method A, Empirical Pile Formulas, will be used unless otherwise specified.

**805.03 Materials.** (a) Class S(AE) Concrete, complying with Section 802, shall be used for concrete piles, unless otherwise specified. The Contractor shall perform quality control and acceptance sampling and testing in accordance with Subsection 802.06 for piling build-ups.

(b) Reinforcing for piles shall comply with Section 804.

(c) Unless otherwise specified, steel piles shall consist of structural shapes of the section shown on the plans and shall comply with AASHTO M 270, Grade 36 (250).

(d) Unless otherwise specified, plain round steel shells shall comply with ASTM A 252, Grade 2. Shells shall be welded or seamless steel pipe. Concrete used to fill the driven steel shell shall be Class S complying with Section 802 unless otherwise noted.

Steel shells shall be uniform sections of the outside diameter and nominal thickness shown on the plans. The Contractor shall furnish shells of greater thickness, if necessary, to provide sufficient strength and rigidity and shall select equipment to permit driving without damage. Steel shells shall resist the earth pressure after being driven and retain their original form free from harmful distortions after they and adjacent shells in the bent or pier have been driven. Driving tips welded to the end of the steel shell shall

be installed according to the plans. Such welding shall form a watertight joint.

Steel shell piles shall be marked by the manufacturer near both ends of the pile. Marking shall be in accordance with ASTM A 252.

(e) Driving points, when called for on the plans, shall be listed on the QPL.

(f) Welding of steel and steel shell piles, including attachment of driving tips and points, shall be done by certified welders using the shielded metal arc method and shall comply with the governing specifications designated in Subsection 807.26. Other welding methods may be used with the written approval of the Engineer.

**805.04 Manufacture of Precast Concrete Piles. (a) General.** Precast concrete piles shall be constructed according to the details shown on the plans and the provisions of Section 802, insofar as they are applicable, supplemented by the requirements of this subsection.

Piles cast off the job site shall be subject to the same requirements as for piles cast at the job site and will be subject to further inspection after delivery. Piles manufactured off the job site must bear evidence that the component materials have been tested and approved and that the construction methods have been inspected by an inspector approved by the Engineer.

(b) **Form Work.** Forms for precast concrete piles shall comply with the general requirements for concrete form work as provided in Subsections 802.21 and 802.22. Forms shall be accessible for tamping and consolidation of the concrete. Side forms shall not be removed in less than 24 hours after placing the concrete. The entire pile shall remain supported for at least 7 calendar days and shall not be subjected to any handling stress until the concrete has cured for at least 21 calendar days. These periods may be shortened or lengthened when the Engineer has determined that the concrete has attained the minimum specified compressive strength. However, no forms shall be removed in less than 12 hours and no piles moved in less than 16 hours. For prestressed piles, form removal shall comply with Subsection 802.21(g).

(c) **Reinforcement.** For precast piles, reinforcement shall be placed according to the details shown on the plans.

(d) **Casting.** Concrete shall not be deposited in the forms until the Engineer has inspected the placing of reinforcement, anchorages,

and prestressing steel and has given approval. The piles may be cast in either a horizontal or a vertical position. Special care shall be taken to place the concrete so as to avoid displacement of and to produce a satisfactory bond with the reinforcement, and to avoid the formation of stone pockets, honeycomb, or other such defects.

The concrete in each pile shall be placed continuously and shall be consolidated by vibrating or by other means acceptable to the Engineer. The forms shall be over filled, the surplus concrete screeded off, and the top surfaces finished to a uniform texture similar to that produced by the forms.

**(e) Finish.** As soon as the forms are removed, concrete piles shall be carefully pointed with 1:2 mortar and given a Class 1 finish according to Subsection 802.19.

**(f) Curing.** Concrete piles shall be cured as provided in Subsections 802.21(g) and 802.22(f). The periods for curing and setting may be shortened or lengthened subject to such suitable tests as may be made to determine the quality and strength of the concrete. Piles may be driven when the concrete is found to have a compressive strength of not less than 4000 psi (28.0 MPa), provided further that in no case shall piles be driven in less than 10 calendar days.

**805.05 Handling and Storage of Piles. (a) Precast Concrete Piles.** Removal of forms, curing, storing, transporting, and handling precast concrete piles shall be accomplished in such manner as to avoid excessive bending stresses, cracking, spalling, or other injurious results. In raising a precast pile, it shall be suspended, as a minimum, at points as shown on the plans. For a three-point pickup, ropes or cables supported over pulleys shall be used to equalize the supporting forces.

Stored piles shall be placed on skids of timber or other suitable material. The skids, as a minimum, shall be placed at the pick-up points.

**(b) Steel Piles.** The method of storing and handling shall be such as to avoid injury to the piles. When steel piles are to be stored, they shall be placed on skids that will raise them above the ground. A sufficient number of skids shall be used to prevent excessive deflection.

**805.06 Defective Piles.** The Contractor shall not subject piles to excessive abuse that will produce cracking, crushing, spalling, or deformation of the pile. Manipulation of piles to force them into proper position, considered by the Engineer to be excessive, will not be permitted. Any pile damaged by reason of internal defects or improper driving, or any pile driven out of its proper location or driven below the elevation fixed by the plans or the Engineer, shall be corrected at no cost to the Department by one of the following methods, as approved by the Engineer:

- The pile may be withdrawn and replaced by a new and, if necessary, longer pile.
- A second pile may be driven adjacent to the defective or low pile.
- The pile may be spliced or built up as otherwise provided herein, or a sufficient portion of the footing extended to properly embed the pile.

Piles pushed up by the driving of adjacent piles or by any other cause shall be re-driven to grade.

Any crushed or damaged portion of piling may be cut off and built up or the pile completely replaced, as approved by the Engineer. Cutoff, buildup, and/or replacement of damaged piles shall be at no cost to the Department.

**805.07 Driving Equipment.** Driving equipment that damages the piling shall not be used.

**(a) Hammers.** Unless otherwise specified on the plans, all piling shall be driven with an air, steam, or diesel hammer. Gravity hammers will be permitted only when shown on the plans or as elsewhere allowed by the specifications.

The plant and equipment furnished for air or steam hammers shall have sufficient capacity to maintain, under working conditions, the pressure at the hammer specified by the manufacturer. Accurate pressure gauges shall be placed at the boiler or tank and at the hammer so that the drop in pressure between the gauges can be determined.

When a single acting diesel hammer is used, it shall be equipped with a stroke indicator or the Contractor must furnish a method approved by the Engineer for determining the actual stroke. When a

double acting diesel hammer is used, it shall be equipped with a bounce chamber pressure gauge in good working order mounted near ground level so as to be conveniently read by the Engineer when monitoring energy output of the hammer. The Contractor shall provide charts that equate the chamber pressure to equivalent energy.

**(1) Hammers for Steel Piles.** When an air, steam, or diesel hammer is used, the total energy developed by the hammer shall be not less than 10,000 foot-pounds (13 500 joules) per blow.

Gravity hammers for driving steel piles, when allowed, shall weigh not less than 4000 pounds (1800 kg) and in no case shall the weight of the hammer be less than the combined weight of driving head and pile. The fall shall be so regulated as to avoid injury to the piles and shall in no case exceed 15' (4.5 m).

**(2) Hammers for Precast Concrete and Steel Shell Piles.** Unless otherwise provided, the hammer shall have a ram weight that is at least 1/5 the weight of the pile being driven, and shall develop an energy per blow at each stroke of the piston of not less than one foot-pound for each pound (3 j/kg) of weight to be driven. In no case shall the weight of the ram be less than 2700 pounds (1200 kg) nor the total energy developed by the hammer be less than 12,500 foot-pounds (16 900 joules) per blow.

**(b) Driving Protection. (1) Hammer Cushion.** All impact pile driving equipment except gravity hammers shall be equipped with a hammer cushion of suitable thickness to prevent damage to the hammer or pile and to ensure uniform driving behavior. Hammer cushions shall be made of durable, manufactured materials, complying with the hammer manufacturer's guidelines except that all wood, wire rope, and asbestos hammer cushions are specifically prohibited. A striker plate as recommended by the hammer manufacturer shall be placed on the hammer cushion to ensure uniform compression of the cushion material. The hammer cushion shall be inspected in the presence of the Engineer before beginning pile driving at each structure or after each 100 hours of pile driving, whichever is more frequent. When the thickness of a hammer cushion is reduced by more than 25% of its original thickness, it shall be replaced by the Contractor before driving is permitted to continue.



**(2) Pile Drive Head.** A pile driven with an impact hammer requires an adequate drive head to distribute the hammer blow to the pile head. The drive head shall be axially aligned with the hammer and the pile. The drive head shall be guided by the leads and shall not be free-swinging. The drive head shall fit around the pile head in a manner that will prevent transfer of torsional forces during driving while maintaining proper alignment of hammer and pile.

For steel and timber piles, the pile heads shall be cut squarely and a drive head, as recommended by the hammer manufacturer, shall be provided to hold the axis of the pile in line with the axis of the hammer.

For precast concrete and prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts from the drive head.

For special types of piles, appropriate driving heads, mandrels, or other devices shall be provided according to the manufacturer's recommendations so that the piles may be driven without damage.

**(3) Pile Cushion.** The heads of concrete piles shall be protected by a pile cushion made of plywood. The plywood thickness placed on the pile head before driving shall not be less than 4" (100 mm). A new pile cushion shall be provided for each pile. In addition, the pile cushion shall be replaced if, during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn. The pile cushion dimensions and area shall match the cross sectional area of the pile head.

**(c) Driving Equipment Information.** The Contractor shall submit to the Engineer, for information and record purposes, pile driving equipment information at least 30 days before driving piles. The information shall be submitted on a *Pile and Driving Equipment Data Form*, which will be supplied by the Engineer. Any change in the driving system will require the Contractor to submit a new *Pile and Driving Equipment Data Form*.

**(d) Additional Equipment.** In case the required penetration is not obtained with a hammer complying with the above minimum requirements, the Contractor shall provide a different hammer and/or sufficient additional equipment at no cost to the Department. Additional equipment not otherwise provided for herein shall be approved by the Engineer prior to its use.

**(e) Leads.** Pile driver leads shall be constructed in such a manner as to provide freedom for vertical movement of the hammer and shall be held in position in such a manner as to ensure adequate support to the pile during driving. The axis of the leads and hammer shall coincide with the axis of the pile as nearly as practicable. Except where piles are driven through water, the leads shall be of sufficient length so that the use of a follower will not be necessary.

**(f) Followers.** Unless otherwise specified on the plans, the driving of piling with a follower will be allowed only with the written permission of the Engineer. All long piles designated on the plans as test piles shall be driven without a follower. The long pile(s) will be used to establish the required pile penetration for piles that are driven with a follower. All cut-offs or build-ups of long piles will be paid for as provided in Subsection 805.15.

**(g) Water Jets.** Unless otherwise shown on the plans, water jets may be used only with the written approval of the Engineer. When water jets are used, the number of jets and the volume and pressure of the water at the jet nozzles shall be of sufficient capacity to freely erode the material adjacent to the pile. Before the desired penetration is reached, the jets shall be withdrawn and the pile shall be driven with a hammer to secure its final penetration.

**(h) Special Requirements for Method B (Wave Equation Analysis) or Method C (Dynamic Load Test).** All pile driving equipment, including the pile driving hammer, hammer cushion, drive head, pile cushion, and other appurtenances to be furnished by the Contractor must be approved by the Engineer before any driving can take place. To obtain this approval, the Contractor shall submit a description of pile driving equipment to the Engineer, as required in Subsection 805.07(c).

Approval of pile driving equipment shall not relieve the Contractor of the responsibility to drive piles, free of damage, to the required bearing and penetration.

During pile driving operations, the Contractor shall use the approved driving system. Any change in the driving system will only be considered after the Contractor has submitted revised pile driving equipment data. The Contractor will be notified of the acceptance or rejection of the driving system changes within five business days of the Engineer's receipt of the requested change. The time required for submission, review, and approval of a revised

driving system shall not constitute the basis for a contract time extension to the Contractor.

The following hammer efficiencies will be used in the Wave Equation Analysis:

<b>Hammer Type</b>	<b>Efficiency in Percent</b>
Single acting air/steam	67
Double acting air/steam	50
Diesel	72

The criteria that the Engineer will use to evaluate the acceptability of the driving equipment shall consist of: 1) the required number of hammer blows per 1 inch (25 mm); and 2) the pile stresses at both the required ultimate pile capacity and at a hammer blow count of 20 blows per 1 inch (25 mm). The required number of hammer blows indicated by wave equation analysis calculations and, as applicable, pile driving analyzer measurements at the required ultimate bearing capacity shall be between 3 and 12 per 1 inch (25 mm) for the driving equipment to be acceptable. In addition, the pile stresses to be generated by the driving equipment shall not exceed the values where pile damage impends. Unless otherwise specified in the plans, the point of impending damage is defined as follows:

- For steel piles, a compressive driving stress of 90% of the yield point,  $f_y$ , of the pile material ( $0.90f_y$ ).
- For prestressed concrete piles, tensile stresses shall not exceed 912 psi (6.3 MPa) and compressive stresses shall not exceed 3550 psi (24.9 MPa).
- For non-prestressed concrete piles, tensile stresses shall not exceed 190 psi (1.3 MPa) and compressive stresses shall not exceed 3400 psi (23.8 MPa).

**805.08 Driving.** Unless otherwise specified, the use of pilot holes or other driving procedures not covered above will be permitted only when approved by the Engineer.

**(a) Preboring.** When specified, the Contractor shall prebore holes at pile locations and to depths shown on the plans or as directed by the Engineer. Prebored holes shall be smaller than the diameter or diagonal of the pile cross section and sufficient to allow penetration of the pile to the specified depth. If subsurface

obstructions, such as boulders or rock layers, are encountered, the hole diameter may be increased to the least dimension that is adequate for pile installation. Any void space remaining around the pile after completion of driving shall be filled with sand, sand grout mixture, or other approved material. Material resulting from drilled holes shall be disposed of under Section 210. The use of spuds (a short strong driven member that is removed to make a hole for inserting a pile) will not be permitted in lieu of boring, unless specifically authorized by the Engineer. When preboring is not specified, the Contractor may, with the approval of the Engineer, use preboring for his own convenience and at no cost to the Department.

**(b) Protection of Concrete.** No piles shall be driven within 20' (6 m) of a concrete placement, including placement in a steel shell, for a period of seven calendar days after placement.

**(c) Splicing Piles.** Concrete piles shall be furnished full length without splices.

Steel and steel shell piles shall be provided to the length reasonably expected to be necessary to develop the required bearing resistance and the minimum specified depth of penetration. No more than one shop-made or field welded splice will be permitted within this length. The field splice may be welded either before or after pile driving is begun, however splicing of piles after driving has begun shall be performed immediately after driving is ceased to ensure a minimum of interruption in the continuous driving of the pile. This field splice will not be considered as a build-up and no splice allowance will be paid. Should this reasonably expected pile length not be adequate to satisfy all conditions required to cease driving, up to two additional splices for build-up will be permitted. A minimum length of 5' (1.5 m) between splices shall be maintained.

Prior to field welding steel and steel shell pile splices, the sections shall be properly aligned to form a straight axis and shall be welded together in compliance with the plans and in a manner that will fully develop the section. Splices of steel shell piles shall form a watertight joint.

The splicing of steel piles and steel shell piles shall be accomplished by welding according to Subsection 805.03(f).

**(d) Accuracy of Driving.** Piles shall be driven with a variation of not more than 1/4" per foot (20 mm/m) from the vertical or from the batter shown on the plans, except that for pile bents the top of the completed pile shall be no more than 3" (75 mm) from the true position as shown on the plans. Foundation piles shall not be out of the position shown on the plans more than 4" (100 mm) after driving.

**(e) Penetration.** Piles shall be driven to the required depths of penetration shown on the plans and to greater depths if necessary to secure the bearing resistance specified.

If penetration requirements are not specified, piling shall have a minimum penetration of 20' (6 m) or be driven into the material shown on the plans or boring logs as rock. Penetration will be measured from the natural ground line for pile bents and from the bottom of footing or seal for foundation piles.

When preboring is not specified, the Contractor may, with the approval of the Engineer, use preboring to achieve the required *minimum* penetration, at his own convenience and at no cost to the Department.

**(f) Driving Inspection.** Piling shall be driven under the observation of the Engineer or his representative so that data may be obtained for determining the penetration and bearing value of the piles.

**(g) Test Piles.** When required, test piles shall be furnished and driven at locations as shown on the plans or as directed by the Engineer, and shall comply with the requirements herein provided. The driving equipment used for driving test piles shall be that which the Contractor proposes to use on the production piling.

Except as herein provided, all driving to meet the required penetration and bearing on a test pile shall be continuous. The only interruption permitted shall be that necessary for build-up of steel piling or excavating for concrete piling.

Unless otherwise specified or directed, test piles shall be made a part of the completed work and shall be cut off or built up to grade elevations as necessary. The Contractor will be given the option of driving test piles for his own information in estimating the length of piles even though they are not required or indicated on the plans; however, these piles will not be paid for as Test Piles.

If test piles were used to determine the order list according to Subsection 805.10 and the Engineer approves the use of another pile driver after the pile list has been established, the first pile driven with the new equipment shall be driven as a test pile. This pile shall be driven in a bent where a pile has been previously driven and will be used by the Engineer to establish new pile lengths. The length and location of the pile to be driven will be determined by the Engineer. If the Contract specifies that the bearing capacity will be

determined by Method C, dynamic testing of the pile will be required. The cost of such dynamic testing shall be at no cost to the Department. The pile driven as a test pile shall be paid for at the contract unit price bid for Steel Piling, Steel Shell Piling, or Concrete Piling. The Contractor has the following two options after the new pile length has been established:

1. Order new piles of the proper length. The payment will be based on this new pile length and any cut-off or build-up will be measured and paid according to Subsections 805.14 and 805.15.
2. Use the existing piles from the original established pile length.
  - If the new pile length is longer than the original length any build-up will be paid only when it exceeds the new established pile length. Any cut-off will be paid only when the final length in place is less than the original length.
  - If the new pile length is shorter than the original length any build-up will be paid only when it exceeds the original length. Any cut-off will be paid only when the final length in place is shorter than the new established length.

**805.09 Determination of Bearing Values.** The bearing capacity of piles will be determined by the Engineer as provided in the Contract by one or a combination of the following methods. Method A, Empirical Pile Formulas, will be used unless otherwise specified. At any time, the Engineer may direct that driving be discontinued to prevent damage to a pile.

(a) **Method A -- Empirical Pile Formulas.** The safe bearing values for piles will be determined by the following formulas:

Hammer Type	U.S. Standard	Metric (SI)
Gravity	$P = \frac{2WH}{S + 1.0}$	$P = \frac{WH}{612(S + 25.4)}$
Single Acting Power	$P = \frac{2WH}{S + 0.1}$	$P = \frac{WH}{612(S + 2.54)}$
Double Acting Power	$P = \frac{2E}{S + 0.1}$	$P = \frac{E}{6(S + 2.54)}$

Where:

P = safe bearing value in pounds (kilonewtons),

W = weight, in pounds (kilograms), of striking parts of hammer,

H = height of fall (stroke) in feet (mm),

S = the average penetration in inches (mm) per blow for the last 5-10 blows for gravity hammers and the last 10-20 blows for power hammers, and

E = equivalent energy per blow in foot-pounds (joules).

The above formulas are applicable only when:

- 1) The hammer has a free fall.
- 2) The head of the pile is not broomed or crushed.
- 3) The penetration is reasonably quick and uniform.
- 4) There is no detectable bounce of the hammer after the blow.
- 5) A follower is not used.

For a test pile, the penetration per blow shall be measured during initial driving. For piling other than test piling, the penetration per blow shall be measured either during initial driving or during re-driving. Re-driving, when allowed, shall be with a warmed-up hammer operated at full energy after a pile set period, as determined by the Engineer. A warmed-up hammer is defined as a hammer that has applied at least 20 blows to another pile immediately before being used.

If bounce is detected, twice the height of the bounce of the hammer shall be deducted from "H" to determine its value in the formulas.

When a double acting steam or air hammer is used, the Contractor shall furnish tables from the manufacturer to equate the operating speed to equivalent energy. The equivalent energy used in calculating the safe bearing value shall not exceed 85% of the manufacturer's maximum energy rating.

When water jets are used in connection with the driving, the bearing value shall be determined by the above formulas from the results of driving after the jets have been withdrawn.

The character of the soil penetrated; conditions of driving; distributions, sizes, lengths, and weights of piles driven; and the computed load on the pile shall also be considered in determining the safe bearing value.

**(1) Test Piles.** The required safe bearing value shall be considered to have been obtained when the value remains at or above the specified value throughout the last 5 feet (1.5 m) of driving. Driving shall continue until the top of the pile is at plan grade unless practical refusal has been reached or damage to the pile is imminent. Practical refusal for test piles occurs when the calculated safe bearing value is three times the required safe bearing value. In no case shall the pile be driven less than that specified in Subsection 805.08(e).

**(2) Piling.** Piling shall be driven until the required safe bearing is obtained. Driving shall continue until the top of the pile is at plan grade unless practical refusal has been reached or damage to the pile is imminent. The required safe bearing value shall be considered to have been obtained when the safe bearing value has been maintained for at least 5 feet (1.5 m). Practical refusal for production piling occurs when the calculated safe bearing value is two times the required safe bearing value. In no case shall the pile be driven less than that specified in Subsection 805.08(e).

If the required safe bearing value has not been obtained when the top of the pile is at plan grade, the pile shall be driven until one of the following conditions has been satisfied as approved by the Engineer:

- Soil may be excavated from around the pile, if necessary, and the pile driven until the required safe bearing has been obtained. Such excavation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Steel Piling, Steel Shell Piling, or Concrete Piling.
- The pile shall be built-up and driven until the required safe bearing has been obtained. Measurement and payment for build-up will be made under Subsections 805.14 and 805.15.

**(b) Method B -- Wave Equation Analysis (WEAP).** The ultimate bearing capacity of a pile will be determined by using a Wave Equation Analysis. Soil, pile, and driving equipment properties to be used in this analysis will be determined by the Engineer using data obtained from the Contractor, test borings, and the plans.

Driving equipment shall comply with the requirements of Subsection 805.07.



Based on the Wave Equation Analysis, the Engineer will provide a bearing graph that shows a hammer blow count relationship for the required ultimate bearing capacity. Depending on the type hammer used, the bearing graph will be one of the following types: 1) stroke vs. blow count; 2) bounce chamber pressure vs. blow count; or 3) capacity vs. blow count.

The design bearing capacity of a pile shall be 0.364 of the calculated ultimate bearing capacity as determined from a Wave Equation Analysis.

From the beginning of driving until the end of driving, the Engineer will measure the stroke and/or chamber pressure and count the number of hammer blows in 12" (300 mm) increments. Measurement of stroke and/or chamber pressure will not be required when a capacity vs. blow count type bearing graph is used.

**(1) Test Piles.** Test piles shall be driven using driving equipment established by the Wave Equation Analysis before other piles are ordered or driven.

Test piles shall be driven until: 1) the required ultimate bearing capacity or greater, as determined by the bearing graph, has been obtained for 3 feet (1.0 m); and 2) the top of the pile is at plan grade; but not to more than when 3) a hammer blow count of 20 blows per 1 inch (25 mm) has been obtained. In no case shall the pile be driven less than that specified in Subsection 805.08(e).

If the test pile has been driven to plan grade and has not satisfied conditions required to cease driving, the Engineer may direct the Contractor to excavate around a concrete pile to below plan grade to facilitate additional driving and testing in order to satisfy conditions required to cease driving. Steel piles shall be built-up and driving continued. The excavation or build-up and additional driving must be completed during the same day as the initial driving. The excavation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Test Pile.

If the conditions to cease driving on a concrete test pile are not obtained with the excavation and additional driving, or if additional excavation is not allowed by the Engineer, the pile will be considered an unsuccessful test pile and the Engineer shall order a new test pile be driven. The length and location of the new test pile shall be determined by the Engineer.

The unsuccessful test pile shall be paid for at the contract unit price bid for Test Pile, and shall be built-up and driven to meet the requirements for piling as specified in Subsection 805.09(b)(2). Payment for the build-up will be made at the unit price bid for Concrete Piling.

The new test pile will be paid for at the contract unit price bid for Test Pile. Payment for build-up of a successful test pile will be made at the contract unit price for Test Pile.

**(2) Piling.** Except as noted herein, piling shall be driven continuously until: 1) the required ultimate bearing capacity or greater, as determined by bearing graph, has been obtained; and 2) the top of the pile is at plan grade; but not to more than when 3) a hammer blow count of 20 blows per 1 inch (25 mm) has been obtained. In no case shall the pile be driven less than that specified in Subsection 805.08(e). Steel piling shall be driven until: 1) the required ultimate bearing capacity or greater, as determined by bearing graph, has been obtained; but not to more than when 2) a hammer blow count of 20 blows per 1 inch (25 mm) has been obtained. If directed by the Engineer, the top of the pile shall be driven to plan grade. In no case shall the pile be driven less than that specified in subsection 805.08(e).

If the required ultimate bearing capacity has not been obtained when the top of the pile is 6" (150 mm) above the plan grade, the pile shall be driven until one of the following conditions has been satisfied as approved by the Engineer:

- Soil may be excavated from around the pile, if necessary, and the pile driven until the required ultimate bearing capacity has been obtained. Such excavation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Steel Piling, Steel Shell Piling, or Concrete Piling.
- The pile shall be built-up and driven until the required ultimate capacity has been obtained. Measurement and payment for build-up will be made under Subsections 805.14 and 805.15.
- After a 24 hour waiting period, the pile shall be struck with 20 blows from a warmed-up hammer and the penetration measured to determine if the required

ultimate bearing capacity has been obtained. A warmed-up hammer is defined as a hammer that has applied at least 20 blows to a pile immediately before being used.

If this option is selected, initial driving shall cease when the top of the pile is 6" (150 mm) above the plan grade. An allowance of 3 linear feet (1 m) of piling will be made for each pile struck with the warmed-up hammer in addition to the actual length of accepted pile in place.

**(c) Method C -- Dynamic Load Test.** This subsection outlines the dynamic testing procedures to be used on the test piles indicated on the plans to establish a bearing graph that shows a hammer blow count relationship for 90% and 100% of the required ultimate bearing capacity for piling. The design bearing capacity of a pile shall be 0.40 of the ultimate bearing capacity as determined by dynamic testing.

**(1) General.** The Contractor shall employ a specialty engineering firm experienced in the use of the wave equation analysis of piles computer program (WEAP), dynamic testing using the Case method, a pile driving analyzer (PDA), and the *Case Pile Wave Analysis Program - Continuous Model* (CAPWAPC) to perform the dynamic testing on the test pile. This firm shall furnish all equipment and make the analysis as outlined in this subsection.

A written report as specified in ASTM D 4945 shall be furnished to the Engineer showing the results and conclusions from the test. The report shall be submitted promptly to allow ample time for the Department to consider its contents and establish the bearing graph for the required ultimate bearing capacity. PDA field results for at least every other blow shall be included in the written report for the complete driving of the test pile.

**(2) Driving Equipment.** The driving equipment shall meet the requirements of Subsection 805.07. Driving equipment meeting the requirements of a successful dynamic load test on the test piles indicated on the plans will be considered acceptable for use on all test piling and piling for bridge site(s) or substructure units specified on the plans.

If dynamic testing indicates the driving equipment is not acceptable on the first test pile driven with the proposed driving equipment, the Contractor shall drive a new test pile in that bent with a different pile driver using dynamic testing as outlined herein.

The length and location of the new test pile shall be determined by the Engineer. The new test pile driven with acceptable driving equipment will be paid for at the contract unit price bid for Test Pile and dynamic testing will be paid for at the contract unit price bid for Dynamic Pile Load Test.

The test pile driven with unacceptable driving equipment will be paid for at the contract unit price bid for Test Pile and the dynamic testing will be paid for at 50% of the contract unit price bid for Dynamic Pile Load Test. This test pile shall be built-up, if required, and driven to meet the requirements for piling as specified in Subsection 805.09(c)(8). Payment for the build-up will be based on the unit price bid for Steel Piling, Steel Shell Piling, or Concrete Piling, as the case may be.

**(3) Wave Equation Analysis.** Before driving, a wave equation analysis is required on all test piles used to check the acceptability of the driving equipment.

The above data will be used to determine the adequacy of the hammer, the axial stresses in the pile, and the required number of blows per unit of penetration the hammer must deliver to obtain the required ultimate bearing capacity.

This will be determined by the specialty engineering firm and furnished to the Engineer in the form of bearing graphs. The Contractor will be notified of the acceptance or rejection of the graphs within seven business days of their receipt by the Engineer. No test piles shall be driven before the graphs are approved by the Engineer.

After evaluation by the wave equation, any changes in the driving equipment may require reevaluation, but in all cases such changes shall be approved by the Engineer before driving.

**(4) Dynamic Pile Load Test.** The Contractor shall drive test piles requiring dynamic testing at locations indicated on the plans using driving equipment established by the wave equation analysis, subject to change due to actual hammer performance and soil strength change. Dynamic testing shall be performed on the test pile during driving and shall comply with ASTM D 4945. Pile driving shall cease when dynamic testing indicates: 1) the required ultimate bearing capacity or greater has been maintained for 3 feet (1 m); and 2) when the top of the pile is at plan grade; but not to more than when 3) a hammer blow count of 20 blows per 1 inch (25 mm) has

been obtained. In no case shall the pile be driven less than that specified in Subsection 805.08(e).

The Engineer will measure the stroke and/or chamber pressure and count the number of hammer blows in 12" (300 mm) increments from the beginning of driving until the required ultimate bearing capacity is first obtained and in 3" (75 mm) increments for the remainder of driving. Measurement of stroke and/or chamber pressure will not be required when a capacity vs. blow count type bearing graph is used. Approval of the driving equipment shall be based on the average blow count per 1 inch (25 mm) measured for the first 3" (75 mm) increment where the required ultimate bearing capacity has been maintained by the PDA. Also, the CAPWAPC analysis must indicate a capacity at least 90% of the required ultimate bearing capacity.

If the test pile has been driven to plan grade and has not satisfied conditions required to cease driving, the Engineer may direct the Contractor to excavate around a concrete pile to below plan grade to facilitate additional driving and testing in order to satisfy conditions required to cease driving. Steel piles shall be built-up and driving continued. The excavation or build-up and additional driving must be completed during the same day as the initial driving. The excavation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Test Pile. The additional driving and testing will not be considered a successive dynamic pile load test but a continuation of the initial drive.

If the conditions to cease driving on a concrete test pile are not obtained with the excavation and additional driving, or if additional excavation is not allowed by the Engineer, the pile will be considered an unsuccessful test pile and the Engineer shall order a new test pile be driven with dynamic testing. The length and location of the new test pile shall be determined by the Engineer.

The unsuccessful test pile shall be paid for at the contract unit price bid for Test Pile, and shall be built-up and driven to meet the requirements for piling as specified in Subsection 805.09(c)(8). Payment for the build-up will be made at the unit price bid for Concrete Piling. Dynamic testing for the unsuccessful test pile will be paid for at the contract unit price bid for Dynamic Pile Load Test.

The new test pile will be paid for at the contract unit price bid for Test Pile. Dynamic testing for the new test pile will be paid for at the contract unit price bid for Dynamic Pile Load Test. Payment for build-up of a successful test pile will be made at the contract unit price for Test Pile.

The Case method using a PDA shall be used to evaluate hammer and driving system performance, pile driving stresses, pile structural integrity, and pile bearing capacity.

If necessary, the Contractor shall reduce the driving energy transmitted to the pile by using additional cushions or reducing the energy of the hammer in order to obtain acceptable stresses in the pile as specified in Subsection 805.07. If non-axial driving is indicated by dynamic test measurements, the Contractor shall immediately realign the driving system.

**(5) CAPWAPC Analysis.** The CAPWAPC analysis made after driving shall be used to predict the test pile's static bearing capacity and resistance distribution. This information shall be used to check Case method assumptions and to indicate the distribution of soil static resistance, quakes, and damping factors required for a wave equation analysis.

A CAPWAPC analysis will be required for each test pile requiring dynamic testing. The blow for a CAPWAPC analysis shall be selected from the last blows in the first 3" (75 mm) increment where the required ultimate bearing capacity was maintained by PDA. If the CAPWAPC analysis indicates an ultimate bearing capacity less than 90% of the required ultimate bearing capacity, a blow shall be selected from the last blows for each successive 3" (75 mm) increment for a CAPWAPC analysis until 90% of the required ultimate bearing capacity is obtained.

If the CAPWAPC analysis still indicates a bearing capacity less than 90% of the required ultimate bearing capacity at the point where driving was stopped, the test pile shall be driven until one of the following conditions has been satisfied: 1) the pile shall be driven a minimum of 2' (0.6 m) additional, or deeper, to obtain the required ultimate bearing capacity; or 2) after waiting up to 24 hours and after the first 20 blows of the hammer, the bearing capacity shall be determined based on 1 inch (25 mm) of penetration or 20 blows of the hammer, whichever occurs first. Dynamic testing and a CAPWAPC analysis will be required during the redriving and will

be considered a successive dynamic pile load test. If necessary, the soil may be excavated from around the pile below plan grade, as approved by the Engineer, to facilitate driving and testing.

After a CAPWAPC analysis has been made at the end of driving a test pile, the Specialty Engineering firm shall establish a hammer blow count relationship for the required ultimate bearing capacity. A bearing graph shall be provided that shows the relationship for 90% and 100% for the required ultimate bearing capacity for piling. Depending on the type of hammer used, the bearing graph shall be one of the following types: 1) stroke vs. blow count; 2) bounce chamber pressure vs. blow count; or 3) capacity vs. blow count. This information shall be developed using the refined wave equation (WEAP) with input data obtained from the CAPWAPC analysis.

**(6) Successful Dynamic Load Test.** A successful dynamic load test is one where: 1) the test pile has been driven with acceptable driving equipment to the proper length; and 2) at least 100% of the required ultimate bearing capacity as determined by dynamic testing and at least 90% of the required ultimate bearing capacity as verified by the CAPWAPC analysis has been obtained.

**(7) Test Piling not Requiring Dynamic Testing.** Test piles not requiring dynamic testing shall be driven until: 1) the required ultimate bearing capacity or greater, as established by the bearing graph, has been maintained for 3 feet (1.0 m); and 2) the top of the pile is at plan grade; but not to more than when 3) a hammer blow count of 20 blows per 1 inch (25 mm) has been obtained. In no case shall the pile be driven less than that specified in Subsection 805.08(e).

If the top of a test pile has been driven to plan grade and has not satisfied conditions required to cease driving, the Engineer may direct the Contractor to excavate around a concrete pile to below plan grade to facilitate additional driving and testing in order to satisfy conditions required to cease driving. Steel piles shall be built-up and driving continued. The excavation or build-up and additional driving must be completed during the same day as the initial driving. The excavation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Test Pile.

If the conditions to cease driving on a concrete test pile are not obtained with the excavation and additional driving, or if additional

excavation is not allowed by the Engineer, the pile will be considered an unsuccessful test pile and the Engineer shall order a new test pile be driven. The length and location of the new test pile shall be determined by the Engineer.

The unsuccessful test pile shall be paid for at the contract unit price bid for Test Pile, and shall be built-up and driven to meet the requirements for piling as specified in Subsection 805.09(c)(8). Payment for the build-up will be made at the unit price bid for Concrete Piling.

The new test pile will be paid for at the contract unit price bid for Test Pile. Payment for build-up of a successful test pile will be made at the contract unit price for Test Pile.

The Engineer will observe all pile driving from beginning to end. Before the pile obtains the required ultimate bearing capacity, the Engineer will measure the stroke and/or chamber pressure and count the number of hammer blows in 12" (300 mm) increments. Measurement of stroke and/or chamber pressure will not be required when a capacity vs. blow count type bearing graph is used.

**(8) Piling.** Piling shall be driven continuously until: 1) at least 90% of the required ultimate bearing capacity, as determined by the bearing graph, has been obtained; and 2) the top of the pile is at plan grade but not to more than when 3) a hammer blow count of 20 blows per 1 inch (25 mm) has been obtained. In no case shall the pile be driven less than that specified in Subsection 805.08(e).

If 90% of the required ultimate bearing capacity has not been obtained when the top of the pile is 6" (150 mm) above the plan grade, the pile shall be driven until one of the following conditions has been satisfied as approved by the Engineer:

- Soil may be excavated from around the pile and the pile driven until at least 90% of the required ultimate bearing capacity has been obtained. The excavation will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Steel Piling, Steel Shell Piling, or Concrete Piling.
- After a 24 hour waiting period, the pile shall be struck with 20 blows from a warmed-up hammer. The results from the re-strike will be used to ascertain if at least 90% of the required ultimate bearing capacity, as



determined by the bearing graph, has been obtained. A warmed-up hammer is defined as a hammer that has applied at least 20 blows to a pile immediately before being used.

If this option is selected, initial driving shall cease when the top of the pile is 6" (150 mm) above the plan grade. An allowance of 3 linear feet (1.0 m) of piling will be made for each pile struck with the warmed up hammer in addition to the actual length of accepted pile in place.

- The pile shall be built-up and driven until at least 90% of the required ultimate capacity has been obtained.

The Engineer will observe all pile driving from beginning to end. Before the pile obtains the required ultimate bearing capacity, the Engineer will measure the stroke and/or chamber pressure and count the number of blows in 12" (300 mm) increments. Measurement of stroke and/or chamber pressure will not be required when a capacity vs. blow count type bearing graph is used.

**805.10 Order Lists for Piling.** The Contractor shall furnish piles according to an itemized list, which will be furnished by the Engineer, except as otherwise provided in Subsection 805.02, showing the number and length of piles. In determining lengths of piles for ordering and for quantities to be included in the Contract, the lengths given in the order list shall be based on the lengths that are assumed to remain in the completed structure. If the minimum bearing is not attained with the length of piling established by the Engineer, the Engineer will establish the length of pile build-up.

The Contractor may, at no cost to the Department, increase the lengths given to provide for fresh heading and for such additional length as may be necessary to suit the Contractor's method of operation.

**805.11 Cut-off and Build-up of Piles. (a) Steel and Steel Shell Piles.** After the pile has been driven to the minimum specified penetration and bearing resistance, it shall be driven, cut off, or built up, as necessary, to bring the finished top to plan grade. When the full approved pile length has been driven without attaining minimum bearing, the length of build-up shall be according to Subsection 805.10.

Cut-offs shall be made with a cutting torch or other acceptable method that will produce the desired smooth, level end of pile at the

proper elevation. Build-ups shall be made by welding a splice on a section of pile in such manner as to fully develop the section of the pile according to the plans. Welding shall comply with Subsection 805.03(f).

Where the top of the pile is appreciably deformed or otherwise damaged below plan grade, the damaged portion shall be cut off and replaced with a new section spliced in place. No additional compensation will be allowed for the material and work for this replacement.

**(b) Concrete Piles.** After the pile has been driven to the minimum specified penetration and bearing resistance, it shall be driven, cut off, or built up, as necessary, to bring the finished top to plan grade. When the full approved pile length has been driven without attaining minimum bearing, the pile shall be built up according to Subsection 805.10.

Cut-offs shall be accomplished by methods that will produce the desired end of pile at the proper elevation. The use of explosives to accomplish cut-off will not be allowed. Cut-off material shall not be used as piling but shall be disposed of according to Section 201.

When build-up is required, the concrete at the end of the pile shall be cut away leaving the reinforcing steel exposed for a length as shown on the plans. The final cut of the concrete shall be perpendicular to the axis of the pile. Reinforcement, as required by the plans, shall be securely fastened to the projecting steel and the necessary form work shall be placed, care being taken to prevent leakage along the pile. Prestressed piles may be built up using reinforcing shown for precast piles of the same size or an equivalent area of steel. The concrete used for the build-up shall comply with Section 802 for Class S(AE) concrete. Just before placing concrete, the top of the pile shall be thoroughly wetted and covered with a thin coating of neat cement, mortar, or other suitable bonding material. The forms shall remain in place a minimum of 24 hours, then carefully removed and the entire build-up finished and cured according to Subsection 805.04.

**805.12 Pile Encasement** When specified on the plans, a reinforced concrete encasement shall be placed around a driven steel pile. The encasement shall be constructed according to the details and at the locations shown on the plans. Lengths of pile encasement

may be adjusted by the Engineer to fit the conditions at the time of construction.

The materials and construction requirements for this item shall comply with Section 802 and Section 804 for concrete and reinforcing steel respectively. The encased portion of a pile will not require painting.

**805.13 Filling Steel Shell Piles.** After driving and splicing is completed, the steel shell shall be free of buckles, water, and other foreign matter, and shall be of required shape and dimensions before filling with concrete. The Contractor shall provide electric lights that may be lowered into the shell, mirrors, and other equipment and facilities necessary for the proper inspection of the shells. The tops of the shells shall be kept covered after inspection until placement of the concrete begins.

Concrete shall be placed in each shell in a single continuous operation with the flow of concrete directed down the center of the shell so as to consolidate the concrete by impact. The use of a tremie will not be required. Vibration or rodding of concrete will only be required to a depth of 5' (1.5 m) below the top of the shell. Placement of concrete shall continue after the shell is full until good quality concrete is evident at the top of the shell. The concrete shall be struck off flush with the top of the shell and finished to a smooth surface.

**805.14 Method of Measurement. (a) General.** Steel Piling, Steel Shell Piling, Concrete Piling, and Test Piles will be measured by the actual number of linear feet (meters) of accepted pile remaining in the finished structure after build-ups and/or cut-offs have been made, based upon lengths shown on the plans or established by the Engineer.

**(b) Cut-off and Build-up.** Allowance for pile cut-off, where piles have been furnished or built up according to the lengths shown on the plans or established by the Engineer, will be as follows:

Steel Piles	50% of cut-off length, plus 1 foot (0.3 m)
Concrete Piles	50% of cut-off length, plus 3 feet (1 m)

No allowance for cut-off will be made on piling for any length in excess of the lengths shown on the plans or established by the Engineer.

For piles furnished according to the lengths shown on the plans or established by the Engineer that are found to be too short and are spliced according to these specifications, an allowance of 3 linear feet (1 m) of piling will be made for each steel pile splice and 6 linear feet (2 m) for each concrete pile splice in addition to the actual length of accepted pile in place.

No allowance will be made for cut-off or build-up in any portion of a pile that has been damaged, for splices made for the convenience of the Contractor, for extra length ordered for the Contractor's convenience, or for cutback necessary for splicing. Cut-off material shall be the property and responsibility of the Contractor.

**(c) Steel Piles Over 18 m (60') in Length.** When the order length for steel piling established according to Subsection 805.10 is greater than 60' (18 m), the Contractor may, at his option:

- 1) Furnish a pile that is spliced to obtain the specified order length. An allowance of 3 linear feet (1 m) will be made for this spliced pile in addition to the actual length of the pile furnished; or
- 2) Furnish an un-spliced pile of the specified order length.

For either of the above options, cut-off and/or additional build-up will be measured according to Subsection 805.14(b).

**(d) Pile Encasement.** Pile Encasement will be measured by the linear foot (meter). The measurement will be made parallel to the longitudinal centerline of the steel pile.

**(e) Dynamic Pile Load Test.** Dynamic Pile Load Test will be measured by the unit.

**(f) Preboring.** Preboring, when specified on the plans or in the Contract, will be measured by the linear foot (meter). Preboring performed for the Contractor's convenience will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit price bid for other items in the Contract.

**805.15 Basis of Payment. (a) Piling.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Steel Piling, Steel

Shell Piling, Concrete Piling, or Test Pile, as the case may be, of the size and type actually furnished. The price shall be full compensation for furnishing materials, including reinforcing steel in concrete piling; brackets, lugs, cap plates, pile tips, and driving points on steel piling; for transportation; for casting and handling; for driving, jetting, drilling, excavating, and painting; for furnishing and placing concrete in steel shell piling; for cut-off, splicing, and build-up; and for all labor, equipment, tools, and incidentals necessary to complete the work. Unless otherwise specified, cut-off and build-up of successful test piles will be paid for at the contract unit price bid for Test Pile. Unless otherwise specified, cut-off and build-up of unsuccessful test piles will be paid for at the contract unit price bid for Steel Piling, Steel Shell Piling, or Concrete Piling, as applicable.

**(b) Pile Encasement.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Pile Encasement, which price shall be full compensation for furnishing materials, forms, and bracing; for any required excavation; for placing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(c) Dynamic Pile Load Test.** Work completed and accepted and measured as provided above for the wave equation analysis, the dynamic pile load test, and the CAPWAPC analysis will be paid for at the contract unit price bid each for Dynamic Pile Load Test, which price shall be full compensation for furnishing materials and for all labor, equipment, tools, and incidentals necessary to complete the work. Each successive dynamic pile load test on the same pile will be paid for at 50% of the unit price bid for Dynamic Pile Load Test.

**(d) Preboring.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Preboring, which price shall be full compensation for boring holes as required; for disposal of excess material; for furnishing and placing material in the void around the pile; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Steel Piling (___)	Linear Foot (Meter)
Steel Shell Piling (___" [___mm]dia.)	Linear Foot (Meter)
Concrete Piling (___" [___mm]___)	Linear Foot (Meter)
Test Pile (___)(___)	Linear Foot (Meter)
File Encasement	Linear Foot (Meter)
Dynamic Pile Load Test	Each
Preboring	Linear Foot (Meter)

## **SECTION 806 BRIDGE RAILINGS**

**806.01 Description.** This item shall consist of railings for approaches, bridges, headwalls, wingwalls, retaining walls, etc., of the material or combination of materials specified, constructed according to the plans and specifications.

**806.02 Materials. (a) Aluminum Products.** Aluminum railing, including tubing, pipe, extrusions, posts, and fastenings, shall be aluminum alloy meeting the requirements shown on the plans.

Aluminum alloy surfaces contacting concrete shall be coated with an aluminum impregnated caulking compound or other suitable material approved in writing by the Engineer.

The outside surfaces of flanges and edges of flanges of cast aluminum posts shall be given a #220 grit finish, after which all exposed surfaces of the cast posts shall be given a coat of clear lacquer suitable for use on aluminum materials. The inside surfaces of posts shall have no special finish.

Welding, where shown on the plans, shall be accomplished by an arc welding process in which no welding flux is used. AWS D 1.2, Welding of Aluminum Alloys, shall be the governing specification for aluminum products.

**(b) Aluminum Coated Steel Products.** Hot dip aluminum coating applied to steel products, including fasteners and accessories which will be in contact with aluminum surfaces, shall comply with the following specifications:

The material used for coating shall be 99% pure aluminum conforming to the specifications for Aluminum Association Alloy No. 1100.

The thickness of the coating shall be not less than 0.002" (0.05 mm) on any one individual specimen and the average of the specimens tested shall be not less than 0.0023" (0.058 mm). The thickness of coating may be determined by the use of a magnetic thickness gauge.

Surfaces to be coated shall be subjected to such cleaning, pickling, fluxing, or abrasive blasting as are necessary to properly prepare such surfaces for the hot dip aluminum coat to follow. After being cleaned by abrasive blasting or other satisfactory methods, welds and welded areas shall be free from weld slag or other contamination.

After having been properly cleaned, the parts shall be dipped in the molten aluminum bath for such period as is necessary to obtain the proper coating. Upon removal from the bath, the items shall be processed to remove excess coating, followed by a water rinse and other supplementary treatments as required.

After coating, parts shall be tested to determine that the specified strength and ductility of the base metal have been retained. Parts that fail to meet the specified requirements may be tempered to restore any losses. After retesting, the parts shall conform to the specified requirements.

The aluminum coating on threads, except on tapped threads, shall not be subjected to a cutting, rolling, or finishing tool operation, unless specifically authorized by the Engineer. Nuts shall be tapped oversize sufficiently to permit hand turning.

The coating shall be continuous and uniform in thickness. The coating shall adhere tenaciously to the surface of the base metal.

Bolts shall be shipped with nuts assembled. The manufacturer shall employ such methods of packing coated products as may reasonably be required to ensure their receipt by the purchaser in a satisfactory condition.

**(c) Steel Products.** Steel railing, including tubing, pipe, extrusions, posts, and fastenings, shall meet the material specifications on the plans. Steel rail members shall be galvanized according to AASHTO M 111 after fabrication. Steel fasteners

other than stainless steel shall be galvanized according to AASHTO M 232 or ASTM B695, Class 40 or 50.

**(d) Concrete.** Concrete shall comply with the requirements for Class S concrete of Section 802.

**(e) Reinforcing Steel.** Reinforcing steel shall comply with the requirements of Section 804.

**(f) Class 1 Protective Surface Treatment.** Class 1 Protective Surface Treatment shall comply with the requirements of Section 803.

**806.03 Line and Grade.** The line and grade of the railing shall be true to that shown on the plans. Vertical members, including posts, shall be plumb unless otherwise noted on the plans.

**806.04 Expansion Joints.** Expansion joints shall be so constructed as to permit freedom of movement. After work has been completed, loose or thin shells of mortar likely to spall under movement shall be carefully removed from expansion joints by means of a sharp chisel.

**806.05 Construction Requirements. (a) General.** When spans are supported by falsework, railings shall not be placed until the falsework for the span has been removed and the span is in its final position.

**(b) Metal Rail Members.** Fabrication and erection of metal rail members shall be accomplished according to the requirements of Section 807. In the case of welded railing, exposed joints shall be finished after welding by grinding or filing to give a neat appearance.

Aluminum rail members shall not be painted.

Metal rail members shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout the length of the railing.

**(c) Transitional Approach Railing.** Preparation of the subgrade for placement of the transitional approach railing shall be in accordance with the requirements of Section 212. All soft and yielding material shall be removed prior to placing the concrete. The foundation shall be prepared to the required depth and forms shall be set rigidly to the proper line and grade.

Reinforcing steel and concrete shall be placed in accordance with the applicable requirements of Sections 804 and 802. Curing and



finishing the concrete shall be in accordance with Section 802. The surface finish shall match that used on the adjacent bridge railing, except as noted otherwise.

**806.06 Method of Measurement.** (a) Metal Bridge Railing will be measured by the linear foot (meter). The measurement will be made along the roadway face of the railing, from end to end of each continuous length of railing.

(b) Transitional Approach Railing will be measured by the complete unit.

The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

**806.07 Basis of Payment.** (a) Metal bridge railing completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Metal Bridge Railing of the type specified, which price shall be full compensation for furnishing all materials, including posts, fittings, and fastenings for railing; for fabrication and erection; for preparation of shop drawings; and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) Transitional approach railing completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Transitional Approach Railing, which price shall be full compensation for subgrade preparation, excavation and backfill; for furnishing, preparing, hauling, and placing all materials, including reinforcing steel and Class 1 Protective Surface Treatment; for forming, mixing, placing, curing, and finishing concrete; and for all equipment, tools, labor, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Metal Bridge Railing (Type___)	Linear Foot (Meter)
Transitional Approach Railing	Each

## SECTION 807

### STEEL STRUCTURES

**807.01 Description.** This item shall consist of furnishing, fabricating, assembling, erecting, and painting structural metals for bridge structures and other steel products according to these specifications and the plans.

#### GENERAL

**807.02 Sufficiency of Fabricator.** All structural steel fabricators shall be certified for AISC Category SBR (Simple Steel Bridge Structures), CBR (Major Steel Bridges), or CPT (Bridge Component Standard), as appropriate, except as provided herein. In addition, the fabricator shall have the appropriate Paint Endorsement (P1, P2, or P3) which qualifies them for the application of sophisticated coating systems.

When the Contractor elects to purchase items of structural steel manufactured outside the United States, such materials shall be furnished only from those foreign manufacturers who have previously established, to the satisfaction of the Engineer, the sufficiency of their in-plant quality control to give satisfactory assurance of their ability to furnish material uniformly and consistently in conformance with the Specifications and according to Subsection 106.01.

Proof of sufficiency must be provided to the Engineer by the Contractor and the Engineer's approval obtained before foreign manufactured structural steel items are incorporated into the work. Proof may be established by: 1) the Contractor providing the Engineer with a detailed written certification by an established and approved independent testing and inspection laboratory or agency showing evidence that the foreign manufacturer has previously established in-plant quality control to give assurance of their ability to furnish material uniformly and consistently in conformance with the specifications, or 2) a thorough in-plant inspection of the foreign manufacturer's facilities by the Engineer or his appointed representative as deemed necessary by the Engineer.

The cost of determining sufficiency, established either by detailed written evidence or a thorough in-plant inspection by the Engineer or his appointed representative, shall be borne by the Contractor. Payment of all expenses incurred by the Engineer or his

appointed representative in making such in-plant inspection as deemed necessary by the Engineer shall be made by the Contractor to the Department upon receipt of detailed billing prepared by the Department and presented to the Contractor.

Prior to shipment or fabrication of any foreign produced structural steel, the Contractor shall obtain all the Certified Mill Test Reports, clearly identifiable to the lot of material to be shipped by heat numbers and color-coding, and submit these to the Engineer for complete review and analysis, and shall have received approval of them.

Structural steel materials that are manufactured outside the United States shall be delivered to the fabrication site where it shall be retained a sufficient period of time to permit inspection, sampling, and testing as deemed necessary by the Engineer prior to fabrication. The Contractor shall make all pieces of all materials available to the Engineer for inspection, sampling, and testing.

**807.03 Governing Specifications.** In case of conflict between the Standard Specifications and any referenced specifications in this Section, the Standard Specifications shall govern.

**807.04 Shop Drawings Required of the Contractor.**  
**(a) Submission for Approval.** Prints of the shop drawings for all steel product fabrication work shall be submitted to the Engineer for approval before work is begun in the shop. Material ordered or work accomplished prior to the approval of these drawings shall be at the Contractor's risk. Shop drawings for steel products and structures shall give full detailed dimensions and sizes of component parts of the product or structure, and details of miscellaneous parts, such as pins, nuts, bolts, rivets, drains, etc.

Shop drawings shall identify each piece of steel with an erection or assembly mark. Pieces made of different grades of steel shall not be given the same assembling or erecting mark, even though they are of identical dimensions and detail.

**(b) Approved Drawings.** Prints of the approved shop drawings for all work shall be furnished to the Engineer. The approval of shop drawings will cover only the general design features, and in no case shall this approval be considered to cover errors or omissions in shop details. The Contractor shall be responsible for the accuracy of the shop drawings, the fabrication of material, and the fit of all connections and shall bear the cost of all extra work in erection

caused by errors in shop drawings and for any changes in fabrication necessary for satisfactory erection. After shop drawings have been approved, no changes in dimensions or substitutions of sections shall be made without written approval.

## MATERIALS

**807.05 Structural Steel.** Unless otherwise specified, structural steel shall conform to the requirements of Structural Steel for Bridges, AASHTO M 270, except that the Charpy V-Notch Impact test requirements shall apply only to materials designated on the contract drawings as main load carrying member components. When Charpy V-Notch tests are required, the test results shall conform to the requirements specified for Zone I minimum service temperature.

Grade 36 (250) shall be furnished unless otherwise specified.

Steel shall be furnished according to the following specifications:

**(a) Carbon Steel.** Unless otherwise specified, structural carbon steel for bolted or welded construction shall conform to AASHTO M 270, Grade 36 (250). Fill or shim plates ¼" (6 mm) or less in thickness used in high strength bolted connections may be ASTM A 1011, SS, Grade 36 (250), Type 2, Grade 40 (275), Grade 50 (340), or Grade 55 (380) or ASTM A 1011 HSLAS, Grade 50 (340), Class 1 or Grade 55 (380), Class 1.

**(b) High-Strength Low-Alloy Structural Steel.** High strength low alloy structural steel shall conform to AASHTO M 270, Grades 50 (345) or 50W (345W). Fill or shim plates ¼" (6 mm) or less in thickness used in high strength bolted connections of painted bridges may be ASTM A 1011, SS, Grade 50 (340), or Grade 55 (380) or ASTM A 1011 HSLAS, Grade 50 (340), Class 1 or Grade 55 (380), Class 1.

Fill or shim plates ¼" (6 mm) or less in thickness used in high strength bolted connections of unpainted weathering steel may be ASTM A 606, Type 4.

**(c) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate.** High yield strength, quenched and tempered alloy steel plate shall conform to AASHTO M 270, Grade 100 (690).

Quenched and tempered alloy steel structural shapes and seamless mechanical tubing shall meet all of the mechanical and

chemical requirements of AASHTO M 270, Grade 100 (690), except that the specified maximum tensile strength may be 140,000 psi (965 MPa) for structural shapes and 145,000 psi (1000 MPa) for seamless mechanical tubing.

**(d) Structural Steel for Eyebars.** Steel for eyebars shall be of a weldable quality conforming to AASHTO M 270, Grade 36 (250), Grade 50 (345), or Grade 50W (345W).

**807.06 High Strength Bolts, Nuts, and Washers for Structural Steel Connections. (a) Specifications.** High strength bolts shall be heavy hex and shall conform to the requirements of ASTM A325, except as modified herein. Type 1 bolts shall be provided when used with painted structural steel or when galvanized bolts are specified. Type 3 bolts shall be provided when used with unpainted weathering structural steel. The maximum hardness of high strength bolts shall be 33 Hardness Rockwell C .

Nuts shall be heavy hex and shall conform to the requirements of ASTM A563 or AASHTO M 292. Nuts for plain, uncoated Type 1 bolts shall be Grade 2H, Grade DH or DH3 (Grade 10S, or 10S3). Nuts for Type 3 bolts shall be Grade DH3 (Grade 10S3). Nuts for galvanized bolts shall be Grade 2H or Grade DH (Grade 10S). When galvanized nuts are furnished, the zinc coating, overtapping, lubrication, and proof loading shall be in accordance with ASTM A563.

Washers shall conform to the requirements of ASTM F436. Where necessary, washers may be clipped on one side to a point not closer than 7/8 of the bolt diameter from the center of the washer. Beveled washers shall be used in the flanges of American Standard beams and channels. Weathering steel washers shall be used with Type 3 bolts.

When galvanized bolt assemblies are specified, the bolts, nuts, and washers shall be galvanized according to AASHTO M232, Class C, or ASTM B595, Class 50. All components in a fastener assembly shall be galvanized by the same process.

Galvanized nuts shall be provided with a lubricant that is clean and dry to the touch. The lubricant shall contain a visible dye so that a visual check can be made for the lubricant at the time of field installation. Plain, uncoated bolts, nuts, and washers must be "oily" to the touch when installed.

**(b) Required Tests.** High strength fasteners, plain and galvanized, shall be subjected to a rotational capacity test according to ASTM A325, Section 6.3, and shall meet the following requirements:

1. Go through two times the required number of turns (from snug tight conditions) indicated in Table 807-1, in a Skidmore-Wilhelm Calibrator or equivalent tension measuring device, without stripping or failure.
2. During this test, the maximum recorded tension shall be equal to or greater than 1.15 times the Minimum Bolt Tension as shown in Table 807-3.
3. The measured torque needed to produce the Minimum Bolt Tension shall not exceed the value obtained by the following equation:

$$Torque = 0.25 * P * D$$

where:

Torque = Maximum Measured Torque  
(Foot-pounds [newton meter])

P = Measured Bolt Tension (pounds [kilonewtons])

D = Nominal Diameter (Feet [mm])

Proof load tests according to ASTM F 606M (F 606) Method 1 are required for the bolts. Wedge tests of full size bolts are required according to Section 8.3 of ASTM A325. Galvanized bolts shall be wedge tested after galvanizing. Proof load tests according to ASTM A563 are required for the nuts. The proof load tests for nuts to be used with galvanized bolts shall be performed after galvanizing, overtapping, and lubricating.

The Engineer shall be furnished with a manufacturer's certification for all high strength bolts, nuts, and washers used on the project. This certification shall provide a lot number, shop order number, or other identification such that the heat number from which the items were made can be traced. This identifying number shall also appear on the sealed shipping containers. The certification shall indicate when and where all testing was done, including the rotational capacity tests, and shall include the zinc thickness when galvanized bolts, nuts, and washers are used.

**TABLE 807-1**  
**NUT ROTATION\* FROM SNUG TIGHT CONDITION**

<b>Bolt Length</b> (as measured from underside of head to extreme end of point)	<b>Orientation of Outer Faces of Bolted Parts</b>		
	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (bevel washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis (bevel washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn

\* Applicable to coarse thread heavy hex structural bolts of all sizes and lengths up to 12 diameters and heavy hex semi-finished nuts. Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation: 30° (one-twelfth) turn over or under.

**807.07 Bridge Anchor Bolts.** Unless otherwise specified, anchor bolts for bridges shall conform to AASHTO M 314, Grade 36 including supplementary requirement S1. Heavy Hex nuts shall conform to ASTM A563, Grade C or better, or to AASHTO M 292, Grade 2H. Washers shall conform to ASTM F436. All anchor bolts, nuts, and washers shall be galvanized according to AASHTO M 232, Class C, or ASTM B695, Class 50. Anchor bolts and nuts shall be galvanized by the same process. Nuts shall be provided with a lubricant that is clean and dry to the touch. The lubricant shall contain a visible dye so that a visual check can be made for the lubricant at the time of field installation.

**807.08 Welded Stud Shear Connectors.** Shear connector studs shall conform to the requirements of Steel Bars, Carbon, Cold Finished Standard Quality, AASHTO M 169, cold-drawn bars, Grades 1015, 1018, and 1020, either semi-killed or killed. If flux retaining caps are used, the steel for the caps shall be of a low carbon grade suitable for welding and shall comply with Steel, Carbon, Cold-rolled Strip, ASTM A 109M (A 109).

Tensile properties, as determined by tests of bar stock after drawing or of finished studs, shall conform to the following minimum requirements:

Tensile Strength	60,000 psi (415 MPa)
Yield Strength	50,000 psi (345 MPa) (0.2% offset)
Elongation	20% in 2" (50 mm)
Reduction of area	50%

Tensile properties shall be determined according to the applicable sections of AASHTO T 244. Tensile tests of finished studs shall be made on studs welded to test plates using a test fixture conforming to ANSI/AASHTO/AWS D1.5 Bridge Welding Code requirements. If fracture occurs outside the middle half of the gage length, the test shall be repeated.

Finished studs shall be of uniform quality and condition, free from laps, fins, seams, cracks, twists, bends, or other injurious defects. Finish shall be as produced by cold drawing, cold rolling, or machining. Studs shall be marked to identify the manufacturer.

The manufacturer shall certify that the studs as delivered are in accordance with the material requirements of this Section. Certified



copies of in-plant quality control test reports shall be furnished to the Engineer.

Samples of studs of each type and size used may be selected, as necessary, for checking the requirements of this Section.

**807.09 Steel Forgings and Steel Shafting. (a) Carbon Steel Forgings.** Steel forgings shall conform to AASHTO M 102. Class C forgings shall be furnished unless otherwise specified.

**(b) Cold Finished Carbon Steel Shafting.** Cold finished carbon steel shafting shall conform to AASHTO M 169. Grades 10160 through 10300 shall be furnished unless otherwise specified.

**(c) Alloy Steel Forgings.** Alloy steel forgings shall conform to AASHTO M 102. Class G forging shall be furnished unless otherwise specified.

**807.10 Steel Castings. (a) General.** Steel castings for use in highway bridge components shall conform to AASHTO M 103. Grade 70-36 (485-250) steel shall be used unless otherwise specified.

**(b) Chromium Alloy Castings.** Chromium alloy steel castings shall conform to AASHTO M 163. Grade CA 15 shall be furnished unless otherwise specified.

**807.11 Iron Castings. (a) General.** Iron castings shall be gray iron castings conforming to AASHTO M 105, Class No. 30 unless otherwise specified.

**(b) Workmanship and Finish.** Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects.

Castings shall be boldly filleted at angles and the arrises shall be sharp.

**(c) Cleaning.** All castings shall be sandblasted or otherwise effectively cleaned of scale and sand and have a smooth, clean, and uniform surface.

**807.12 Ductile Iron Castings. (a) General.** Ductile iron castings shall conform to ASTM A 536, Grade 414-276-18, unless otherwise specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings weighing more than 1000 pounds (454 kg) to

determine that the required quality is obtained throughout the casting.

**(b) Workmanship and Finish.** Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects.

Castings shall be boldly filleted at angles and the arrises shall be sharp.

**(c) Cleaning.** All castings shall be sandblasted or otherwise effectively cleaned of scale and sand and have a smooth, clean, and uniform surface.

**807.13 Malleable Castings. (a) General.** Malleable castings shall conform to ASTM A 47 (A 47M). Grade No. 35018 shall be furnished unless otherwise specified.

**(b) Workmanship and Finish.** Malleable castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects.

Castings shall be boldly filleted at angles and the arrises shall be sharp.

**(c) Cleaning.** All castings shall be sandblasted or otherwise effectively cleaned of scale and sand and have a smooth, clean, and uniform surface.

**807.14 Bronze or Copper-Alloy Bearing and Expansion Plates. (a) Bronze Bearing Plates.** Bronze bearing and expansion plates shall conform to ASTM B22. Alloy C91100 shall be furnished unless otherwise specified.

**(b) Copper-Alloy Bearing Plates.** Rolled copper-alloy bearing and expansion plates shall conform to ASTM B100. Alloy No. C51000 shall be furnished unless otherwise specified.

**(c) Self-Lubricating Bronze Bearing Plates.** Bronze bearing plates shall be self-lubricating plates of rolled bronze alloy conforming to ASTM B100, Alloy No. C51000, or cast bronze alloy conforming to ASTM B22, Alloy C91100. The frictional coefficient shall not exceed 0.10.

Lubricating compounds shall be compressed into the trepanned recesses under sufficient pressure to form a non-plastic lubricating inset. The lubricating inset shall comprise not less than 25% of the total area of the plate. The graphite and metallic substances of the

compound shall be free of material that will cause abrasive and corrosive action upon the metal surfaces, and shall also be able to withstand extremely high pressures and the atmospheric elements over long periods of time.

All items shall be the standard products of the manufacturer of such materials for this application.

Prior to assembly, the steel surface that will bear on the self-lubricating bearing plate shall be thoroughly lubricated with additional lubricant according to the manufacturer's recommendation.

**807.15 Bearing Pads. (a) Preformed Fabric Pads.** Preformed fabric pads shall be composed of multiple layers of 8 ounce (270 g/sq m) cotton duck impregnated and bound with high quality natural rubber, or of equivalent and equally suitable materials, compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 psi (70 MPa) without detrimental reduction in thickness or extrusion. The Contractor shall obtain from the manufacturer a certificate of compliance with these requirements. This certificate shall be maintained on file by the Contractor and furnished to the Engineer upon request.

**(b) Elastomeric Pads.** Elastomeric pads shall be unreinforced pads (consisting of elastomer only) meeting the requirements of Section 808 except that instantaneous thermal stiffening and shear modulus are not required. The Contractor shall obtain from the manufacturer a certificate of compliance with these requirements. This certificate shall be maintained on file by the Contractor and furnished to the Engineer upon request.

**807.16 Paint.** Paint for metal shall be as specified in Subsection 807.75.

**807.17 Sheet Metal for Water Stops and General Use.**

**(a) Sheet Copper.** Sheet copper shall conform to ASTM B152.

**(b) Sheet Zinc.** Sheet Zinc shall conform to the requirements of ASTM B 69, Type II.

**807.18 Welding Materials.** Materials used for welding shall conform to the AASHTO/AWS D1.5 Bridge Welding Code, and shall be listed on the Department's QPL.

**807.19 Galvanizing.** When galvanizing is specified, ferrous metal products shall be galvanized according to AASHTO M 111.

**807.20 Nylon Reinforced Neoprene Trough.** Neoprene shall be 100% virgin polychloroprene meeting the requirements of Subsection 808.02 for 50-durometer hardness except that the Instantaneous Thermal Stiffening requirements (ASTM D 1043 Test) are not required. In addition to the requirements of Subsection 808.02, the elastomer shall have no failure when tested for brittleness according to ASTM D 2137, Method B (-40° F [-40° C]).

The woven nylon reinforcement fabric shall conform to the following minimum requirements:

- 1) Nominal Thickness      0.017" (0.43 mm)
- 2) Weight                      10 oz./sq. yd. (340 g/sq m)
- 3) Weave Count              30 x 20/square inch  
   (30 x 20/645 sq mm)
- 4) Tensile Strength        450 x 440 lbs. (1" strip)  
   (2000 x 1960 Newtons [25 mm strip])
- 5) Mullen Burst Strength 1100 psi (7600 kPa)

Tensile Strength will be tested according to ASTM D 751. Mullen Burst Strength will be tested according to ASTM D 751, Procedure A (under Hydrostatic Resistance).

The Contractor shall require that the manufacturer be responsible for pretesting and submitting to the Engineer a certified copy of the test results for the physical properties specified above.

### **SHOP INSPECTION AND FABRICATION**

**807.21 Inspection of Fabrication.** Upon award of the Contract, the Contractor shall inform the Engineer of the location where the fabrication of structural steel will be performed. This information must be received at the earliest possible date in order that provisions may be made to provide structural steel fabrication inspection.

The Department will make arrangements for all structural steel fabrication inspection, sampling, and testing, as deemed necessary by the Engineer.

The Contractor shall furnish facilities for the inspection of material and workmanship in the mill and shop. Inspectors shall be allowed free access to all necessary areas of the plant.

Inspectors shall have the authority to reject any material or work that does not meet the requirements of these specifications.

**807.22 Notice of Beginning Work.** The Contractor shall give the Engineer ample notice of the beginning of work in the shop so that inspection may be provided. No work shall be performed in the shop before the Engineer has been notified.

**807.23 Quality Control of Fabrication. (a) General.** The Contractor shall be responsible for the Quality Control of structural steel fabrication, as required by contract documents and/or referenced specifications. The Contractor and/or the Fabricator shall submit a Quality Control Plan for the fabrication of structural steel on each project directly to the Materials Engineer for approval. The Plan shall detail the inspection and testing proposed to comply with this Specification, and it shall be submitted sufficiently in advance to allow a complete review by the Engineer. Fabrication of structural steel shall not be started until approval of the Plan has been obtained. In lieu of this, the Contractor and/or the Fabricator may utilize a previously approved Quality Control Plan already on file with the Department.

The Contractor shall be responsible for the costs involved in development and execution of this Quality Control Plan, including non-destructive testing specified in the AASHTO/AWS D1.5 Bridge Welding Code, the Standard Specifications, the plans, and in other referenced specifications. Further, the Contractor shall be responsible for the cost of the necessary correction of all deficiencies.

Any extra non-destructive testing necessitated by welds performed for the convenience of the Contractor or Fabricator shall be at no cost to the Department. When due to material deficiency or fabrication errors, the cost of any extra non-destructive testing deemed necessary by the Engineer to assure specification compliance or maintain the integrity of the structural steel shall be at no cost to the Department.

The Fabricator shall have, either in his employ or available under contract, a welding inspector who is a current AWS Certified

Welding Inspector or one who by other experience or qualification is acceptable to the Engineer.

**(b) Non-destructive Testing.** Non-destructive testing shall be performed according to the AASHTO/AWS D1.5 Bridge Welding Code, as modified in Subsection 807.26. The Engineer may review the qualifications of the personnel and testing agency that will be performing the non-destructive testing. The Engineer may review the making of non-destructive tests, examine and evaluate the test results, approve or reject all welds, and approve or reject methods proposed by the Contractor for repairing unacceptable welds or correcting material deficiencies. Radiographic film shall be maintained by the Fabricator and available to the Department upon request.

**(c) Contractor Responsibilities-Quality Control Inspection.** The Contractor shall be responsible for, as a minimum, the following inspection items according to the Quality Control Plan:

- Review of all certified mill test reports for material used in the fabrication and ensure that these materials meet Specifications
- Maintenance of mill test records for structural steel used on each structure
- Visual inspection of material delivered before any fabrication or welding
- Required non-destructive testing
- Verification of conformance for:
  - welders
  - welding procedures
  - weld consumables
  - sizes of material used
  - cutting and grinding
  - all punching and reaming
  - general layout
  - dimensions
  - paint materials used
  - cleaning and painting of all members
- Checking fit-up of members in lay-down position

These records shall be maintained and provided to the Engineer for review and approval upon request.

Records of non-conforming material at any stage of fabrication shall be maintained and provided to the Engineer for review. No repairs or corrections of non-conforming material or fabrication shall be made without the review and approval of the Engineer other than those normally allowed by the referenced specifications.

The Contractor/Fabricator shall certify that all fabrication and structural steel materials meet the requirements of the Specifications, plans, and other referenced specifications. Costs incurred by the Contractor in complying with these requirements will not be paid directly, but will be considered as included in the price bid for Structural Steel.

**(d) Department Responsibilities- Quality Assurance Inspection.** The Engineer, or his Designated Quality Assurance Inspector, will review the Contractor/Fabricator inspection, sampling, testing and the resultant reports, and verify compliance of fabrication and structural steel materials to the Specifications. This review and verification shall be complete prior to the fabricated steel being incorporated into the work. In addition, the Engineer will review weld procedures, weld tests, welder certifications, and non-destructive test reports and will reject any non-conforming materials, fabrication, or reports. Mill tests for structural steel will be reviewed by the Engineer as deemed necessary to ensure compliance of materials. The Engineer reserves the right to observe or to independently check any Contractor/Fabricator quality control inspection activities or to perform quality assurance inspection at the fabrication plant. The Engineer will make all arrangements for the Quality Assurance Inspection of structural steel fabrication.

**807.24 Quality of Workmanship.** Workmanship and finish shall be equal to the best general practice in modern fabrication shops. Fabrication shall be accomplished in a controlled environment with adequate protection from the weather.

**807.25 Identification of Steels.** Each piece of steel to be fabricated for the project shall be properly identified.

Shop drawings shall identify each piece of steel with an erection or assembly mark. Pieces made of different grades of steel shall not be given the same assembling or erecting mark, even though they are of identical dimensions and detail.

The Contractor's system of assembly-marking individual pieces and the issuance of cutting instructions to the shop shall be such as

to maintain the identity of the mill test number for primary members.

During fabrication, up to the point of assembling members, each piece of steel other than Grade 36 (250) steel shall show clearly and legibly its identification color code as shown in the following Color Coding chart:

**COLOR CODING**

Grade 100 (690)	Red
Grade 50 (345)	Green & Yellow
Grade 50W (345W)	Blue & Yellow

Other grades of steel, except Grade 36 (250), not covered above nor included in the ASTM A6 specifications shall have an individual color code which shall be established and on record for the Engineer.

Individually marked pieces of steel that are reduced from furnished size may be used without further color coding provided that the heat number and color code remain legible. Pieces for secondary members that are cut to smaller sizes shall, before cutting, be legibly marked with the identification color code. Pieces that are furnished in tagged lifts or bundles shall be marked with the identification color code immediately upon being removed from the lift or bundle.

Pieces of steel that, prior to assembling into members, will be subjected to fabricating operations such as blast cleaning, galvanizing, heating, or painting which may obliterate the identification color code or heat number shall be marked by steel die stamping or by a substantial tag firmly attached. If steel die stamping is used, it shall be the low stress type and high stress areas of the pieces shall be avoided.

The Contractor may furnish material from stock for secondary members if the material can be identified by heat number and mill test report.

Excess material placed in stock for later use shall be marked with the mill heat number and its identification color code when separated from the full-size piece furnished by the supplier.

**807.26 Welding. (a) General.** Welding of steel structures shall be accomplished by the electric arc process according to the



AASHTO/AWS D1.5 Bridge Welding Code, except as modified herein.

Welding shall be done by certified welders or certified welding operators approved by the Engineer, except that shop or field applied stud shear connectors welded using automatically timed stud welding equipment shall be accomplished by operators qualified according to Section 7 of the AASHTO/AWS D1.5 Bridge Welding Code.

The Engineer will consider a welder/welder operator qualified if (1) the requirements of the standard qualification procedure of Section 5 of the AASHTO/AWS D1.5 Bridge Welding Code are met, or (2) the Contractor provides a copy of the individual welder's certified test report issued by an agency or authority on the Department's Qualified Products List and the Contractor provides a certified statement of qualification for each welder stating that the welder has been doing satisfactory welding of the required type within the six month period prior to beginning work on the subject project. The certified statement of qualification will not be required during the six month period following a welder's initial testing at a QPL listed agency.

The certified test report issued by the agency or authority recognized by the Department shall contain the name of the welder/welder operator, the name and title of the person who conducted the examination, the kind of specimens, the position of welds, the results of the tests, and the date of examination. Re-examination/re-certification will be required if welding of the required type has not been performed in the six month period prior to beginning work on the subject project.

In lieu of a certification for each project, the fabrication shop may submit an updated list of qualified welders/welder operators annually to the Materials Engineer. Addendum or additions to this list, along with the appropriate welder/welder operator certification, shall be submitted in a timely manner.

The approval and use of consumable welding materials shall be according to the Department's *Manual of Field Sampling and Testing Procedures*.

**(b) Modification of Structural Welding Code.** The following changes and modifications to the AASHTO/AWS D1.5 Bridge Welding Code shall be made:

(1) Subparagraph 1.3.2 is modified to include:

Electroslag welding shall not be used as a welding process on bridge structures.

(2) Subparagraph 3.2.1 is expanded to include:

Surfaces on which flange-to-web welds are made shall be cleaned in the immediate weld area by power wire wheel brushing, grinding, or other methods approved by the Engineer.

(3) Section 6, Part B, Radiographic Testing of Groove Welds in Butt Joints is expanded to include:

Edge blocks shall be used when radiographing butt welds greater than 1/2" (12 mm) thickness. The edge blocks shall have a length sufficient to extend beyond each side of the weld centerline for a minimum distance equal to the weld thickness, but no less than 2" (50 mm), and shall have a thickness equal to or greater than the thickness of the weld. The minimum width of the edge blocks shall be equal to half the weld thickness, but not less than 1" (25 mm). The edge blocks shall be centered on the weld with a snug fit against the plate being radiographed, allowing no more than 1/16" (1.5 mm) gap. Edge blocks shall be made of radiographically clean steel and the surface shall have a finish of 0.12 mils (3  $\mu$ m) or smoother.

(4) Subparagraph 6.7.1 is modified as follows:

All complete joint penetration groove welds in butt joints in main members shall be examined by radiographic testing, except as provided in 6.7.1.2 (2)(d).

(5) Subparagraph 6.7.1.2(2) is amended as follows:

Twenty-five percent of each joint subject to compression or shear.

(6) Section 7, Stud Welding-Inspection Requirements is expanded to include:

A minimum of 5% but not less than 5 studs on each member shall be tested by being struck with a hammer and bent 15° off vertical. Additionally, any stud that by visual inspection does not show a full 360° weld, has been repaired by welding, or has an abnormal reduction in height due to welding shall be tested in the same manner. Where applicable, the direction of bending shall

be opposite to the lack of weld. Studs that crack either in the weld or the shank after bending shall be replaced.

The remaining studs not subjected to the bend test shall be struck forcibly with a hammer. Any stud that does not yield a solid ringing sound shall be tested according to the above prescribed procedure.

The Engineer may select additional studs to be subjected to the bend test specified above. A visual inspection of the studs and welds shall be made by the Engineer prior to placement of the concrete deck slab. Any damage that may have occurred during shipment and erection shall be satisfactorily repaired.

All tests on studs shall be performed by the Contractor in the presence of an authorized representative of the Department.

If, during the progress of the work, inspection and testing indicates that the studs are unsatisfactory, the Contractor shall be required, at no cost to the Department, to make such necessary changes in welding procedure, welding equipment, and/or type of studs as necessary to secure satisfactory results.

**807.27 Straightening Rolled Material.** Rolled material must be straight before being laid off or worked. Bends and distortions may be cause for rejection. If straightening is necessary and approved by the Engineer, it shall be accomplished by using methods that will not damage the metal. Heat straightening of materials other than Grade 100 (690) may be accomplished by careful application of localized heat. The temperature of the heated area shall not exceed 1150° F (620° C).

Heat straightening of Grade 100 (690) steel shall be accomplished only under rigidly controlled procedures. Each application shall be subject to the approval of the Engineer and in no case shall the maximum temperature of the steel exceed 1100° F (590° C).

Materials shall not be artificially cooled, except by forced air, until after the metal has cooled to 600° F (320° C). Below 600° F (320° C) the material may be cooled by forced air or mist, but may not be submerged in liquid or sprayed with liquid.

**807.28 Curving Rolled Beams and Welded Girders.**  
**(a) Materials.** Steels that are manufactured to a specified minimum yield point greater than 50,000 psi (345 MPa) shall not be heat curved.

**(b) Type of Heating.** Beams and girders may be curved by either continuous or V-type heating as approved by the Engineer. For the continuous method, a strip along the edge of the top and bottom flange shall be heated simultaneously. The strip shall be of sufficient width and temperature to obtain the required curvature. For the V-type heating, the top and bottom flanges shall be heated in truncated triangular or wedge-shaped areas having their base along the flange edge and spaced at regular intervals along each flange. The spacing and temperature shall be as required to obtain the required curvature, and heating shall progress along the top and bottom flange at approximately the same rate.

For the V-type heating, the apex of the truncated triangular area applied to the inside flange surface shall terminate just before the juncture of the web and the flange is reached. To avoid unnecessary web distortion, special care shall be taken when heating the inside flange surfaces so that heat is not applied directly to the web. When the radius of curvature is 1000' (300 m) or more, the apex of the truncated triangular heating pattern applied to the outside flange surface shall extend to the juncture of the flange and web. When the radius of curvature is less than 1000' (300 m), the apex of the truncated triangular heating pattern applied to the outside flange surface shall extend past the web for a distance equal to 1/8 of the flange width or 3" (75 mm), whichever is less. The truncated triangular pattern shall have an included angle of approximately 15°-30°, but the base of the triangle shall not exceed 10" (250 mm). Variations in the patterns prescribed above may be made with the approval of the Engineer.

For both types of heating, the flange edges to be heated are those that will be on the inside of the horizontal curve. Heating both inside and outside flange surfaces is only mandatory when the flange thickness is 1¼" (32 mm) or greater, in which case the two surfaces shall be heated concurrently. The maximum temperature shall be as prescribed below.

**(c) Temperature.** The heat-curving operation shall be conducted in such a manner that the temperature of the steel does not exceed 1150° F (620° C) as measured by temperature-indicating crayons or other suitable means. Beams and girders shall not be artificially cooled except as permitted in Subsection 807.27.

**(d) Position for Heating.** The beam or girder may be heat-curved with the web in either a vertical or a horizontal position.

When curved in the vertical position, the member must be braced or supported in such a manner that the tendency of the girder to deflect laterally during the heat-curving process will not cause the girder to overturn.

When curved in the horizontal position, the beam or girder must be supported near its ends and at intermediate points, if required, to obtain a uniform curvature. The bending stress in the flanges due to the dead weight of the member must not exceed the usual allowable design stress. When the member is positioned horizontally for heating, intermediate safety catch blocks must be maintained at the mid length of the member within 2" (50 mm) of the flanges at all times during the heating process to guard against a sudden sag due to plastic flange buckling.

**(e) Sequence of Operations.** The beam or girder shall be heat-curved in the fabrication shop before it is painted. The heat curving operation may be conducted either before or after all the required welding of transverse intermediate stiffeners is completed. However, unless provisions are made for member shrinkage, full depth connection plates and bearing stiffeners shall be located and attached after heat curving. If longitudinal stiffeners are required, they shall be heat-curved or oxygen-cut separately and then welded to the curved member. When cover plates are to be attached to rolled beams, they may be attached before heat curving if the total thickness of one flange and cover plate is less than 1½" (38 mm) and the radius of curvature is greater than 1000' (300 m). For other rolled beams with cover plates, the beams must be heat-curved before the cover plates are attached. Cover plates must be either heat curved or oxygen-cut separately, then welded to the curved beam.

**(f) Camber.** Beams and girders shall be cambered before heat curving, as the heat curving process may tend to change the vertical camber present. This effect will be most pronounced when the top and bottom flanges are of unequal widths on a given transverse cross section. Subject to the approval of the Engineer, moderate deviations from specified vertical camber may be corrected by a carefully supervised application of heat.

**(g) Measurement of Curvature.** Horizontal curvature shall not be measured for final acceptance until all welding and heating operations are completed and the flanges have cooled to a uniform temperature. Horizontal curvature shall be checked with the beam

or girder in the vertical position by measuring offsets from a string line or wire attached to both flanges, or by other suitable means.

The sweep of horizontally curved welded girders or rolled beams shall be within the following tolerances:

For flange width less than 6" (150 mm): Tolerance= 0.025" (2 mm) X total length in feet (meters)

For flange width of 6" (150 mm) or greater: Tolerance= 0.0125" (1 mm) X total length in feet (meters)

**807.29 Vertical Cambering of Beams and Girders.** Design camber of welded girders shall be cut in the web plates before girder assembly. Allowance should be made for shrinkage due to cutting and welding. Small amounts of heat may be used to correct minor differences from specified design camber.

Design camber shall be produced in rolled beams by mechanical methods and/or controlled application of heat. The size, number, shape, and placement of heating patterns shall be such that distortion is minimal and that buckling is kept within the minimum standard rolling tolerances for out-of-flatness of beam webs. Beams with severe web buckles from improper heat cambering will be rejected.

The vertical cambering operation shall be conducted in such a manner that the temperature of the steel does not exceed 1150° F (620° C) as measured by indicating crayons or other suitable means. Beams and girders shall not be artificially cooled except as permitted in Subsection 807.27.

Vertical camber will be measured for final acceptance to the nearest 1/8 inch (millimeter). Tolerance shall be ±1/4 inch (±6 mm) from the specified camber.

**807.30 Annealing and Stress Relieving.** Structural members that are specified to be annealed or normalized shall have finished machining, boring, and straightening performed subsequent to heat treatment. Normalizing and full annealing shall be as defined in ASTM A 919.

The temperatures shall be maintained uniformly throughout the furnace during the heating and cooling so that the temperature at no two points on the member will differ by more than 100° F (56° C) at any one time.

Members of Grade 100 (690) steel shall not be annealed or normalized and shall be stress relieved only with the approval of the Engineer.

A record of each furnace charge shall identify the pieces in the charge and show the temperatures and schedule actually used. Proper instruments, including recording pyrometers, shall be provided for determining the temperatures of members in the furnace at any time. The records of the treatment operation shall be available to and meet the approval of the Engineer. The holding temperature for stress relieving Grade 100 (690) steel shall not exceed 1100° F (590° C).

Members such as bridge shoes, pedestals, or other parts that are built up by welding sections of plate together shall be stress relieved, when specified, according to the procedure in the current AASHTO/AWS D1.5 Bridge Welding Code.

**807.31 Facing of Bearing Surfaces.** The surface finish of bearing or base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the ANSI surface roughness requirements as defined in ANSI B 46.1-88, Surface Roughness, Waviness and Lay, Part I:

Steel slabs.....	ANSI 2.0 mils (RMS) [50 µm]
Heavy plates in contact in	
shoes to be welded .....	ANSI 1.0 mils (RMS) [25 µm]
Milled ends of compression members, milled	
or ground ends of stiffeners	
and fillers.....	ANSI 0.5 mils (RMS) [12 µm]
Bridge rollers and rockers.....	ANSI 0.24 mils (RMS) [6 µm]
Pins and pin holes .....	ANSI 0.12 mils (RMS) [3 µm]
Sliding bearings .....	ANSI 0.12 mils (RMS) [3 µm]

**807.32 Oxygen Cutting of Structural Steel.** Steel and weld metal may be oxygen cut provided a smooth and regular surface free from cracks and notches is secured, and further provided that an accurate profile is obtained by the use of a mechanical guide. Oxygen cut surfaces of members shall have corners rounded to 1/16" (1.5 mm) radius by grinding after cutting. Hand cutting shall be according to the AASHTO/AWS D1.5 Bridge Welding Code and approved by the Engineer.

Mill scale and extraneous material shall be removed from the torch side of Grade 100 (690) steel plates along the lines to be flame cut, when necessary, to preclude excessive notches.

**807.33 Orientation of Plates.** Unless otherwise shown on the plans, steel plates for webs, flanges, cover plates, and flange splice plates shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses to which the plate will be subjected in the finished structure.

**807.34 Sheared Edges of Structural Plates. (a) Edge Planing.** Sheared edges of plates more than 5/8" (16 mm) in thickness that are subject to stress shall be planed to a depth of 1/4" (6 mm). Re-entrant corners shall be filled to a minimum radius of 3/4" (19 mm) before cutting.

**(b) Visual Inspection and Repair.** Visual inspection and repair of sheared edges of structural plates shall be according to the AASHTO/AWS D1.5 Bridge Welding Code.

**807.35 Bent Plates.** Unwelded, cold-bent, load-carrying, rolled-steel plates shall be taken from stock plates so that the bend line will be at right angles to the direction of rolling, unless otherwise noted in the plans.

Bending shall be such that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, shall be as shown in Table 807-2.

**TABLE 807-2**

Plate Thickness (t)	MINIMUM BEND RADII				
	Up to 1/2" (12 mm)	Over 1/2" to 1" (12 mm to 25 mm)	Over 1" to 1 1/2" (25 mm to 38 mm)	Over 1 1/2" to 2 1/2" (38 mm to 64 mm)	Over 2 1/2" to 4" (64 mm to 100 mm)
Radii for all structural steel grades	2t	2.5t	3t	3.5t	4t

Allowance for springback of Grade 100 (690) steel should be approximately 3 times that for structural carbon steel. For brake



press forming, the lower die span should be at least 16 times the plate thickness.

If a shorter radius is essential, the plates shall be bent hot at a temperature not greater than 1150° F (620° C), except for Grade 100 (690) steel. If Grade 100 (690) steel plates to be bent are heated to a temperature greater than 1100° F (590° C), they must be requenched and tempered according to the producing mill's practice. Hot bent plates shall conform to the requirements above. Temperature indicating crayons shall be used to prevent overheating.

Prior to bending, the corners of the plate shall be rounded to a radius of 1/16" (1.5 mm) throughout the portion of the plate at which the bending is to occur.

**807.36 Fit of Stiffeners.** Stiffeners shall be fabricated according to the details shown on the plans.

**807.37 Abutting Joints.** Abutting joints in compression members and girder flanges and, where specified, in tension members shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/4" (6 mm).

**807.38 Bolted Web Splices.** The clearance between the ends of the web plates at a bolted splice shall not exceed 3/8" (9 mm). Edge distance requirements listed in Subsection 807.42(a) shall be measured from the actual edge of web plate.

**807.39 End Connection Angles.** Floorbeams, stringers, and girders having end connection angles shall be built to the exact length shown on the plans, measured between the heels of the connection angles, with a permissible tolerance of 0 to minus 1/16" (-1.5 mm). Where continuity is required, end connections shall be faced. The thickness of the connection angles after facing shall not be less than 3/8" (9 mm) nor less than that shown on the shop drawings.

**807.40 Lacing Bars.** The ends of lacing bars shall be neatly rounded unless another form is required.

**807.41 Eyebars.** Pin holes may be flame cut at least 2" (50 mm) smaller in diameter than the finished pin diameter. Eyebars that are to be placed side by side in the structure shall be securely fastened together in the order that they will be placed on the pin and bored at both ends while fastened. Eyebars shall be packed and match marked for shipment and erection. All identifying marks shall be

stamped with steel stencils on the edge of one head of each member so as to be visible when the bars are nested in place in the structure. The eyebars shall be straight and free from twists and the pin holes shall be accurately located on the centerline of the bar. The inclination of any bar to the plane of the truss shall not exceed 1/16" per foot (5 mm/m).

The edges of eyebars that lie between the transverse centerlines of their pin holes shall be cut simultaneously with two mechanical torches operated abreast and guided by a substantial template in such a manner as to prevent distortion of the plates.

**807.42 Bolt Holes. (a) General.** Holes for bolts shall be either punched or drilled. All holes shall be cylindrical, perpendicular to the member, and have a maximum out of round tolerance of 1/16" (1.5 mm). Where shown on the plans, holes for bolts in secondary member connections may be oversize or slotted.

The minimum distance between centers of bolt holes shall be three times the diameter of the bolt but not be less than the following for:

1" bolts:	3½"	M24 bolts:	84 mm
7/8" bolts:	3"	M22 bolts:	77 mm
3/4" bolts:	2½"	M20 bolts:	70 mm
5/8" bolts:	2¼"	M16 bolts:	56 mm

The minimum distance from the center of any bolt hole to a sheared or flame cut edge shall be for:

1" bolts:	1¾"	M24 bolts:	42 mm
7/8" bolts:	1½"	M22 bolts:	38 mm
3/4" bolts:	1¼"	M20 bolts:	35 mm
5/8" bolts:	1 1/8"	M16 bolts:	28 mm

The minimum distance from the center of any bolt hole to a rolled or planed edge, except in flanges of beams and channels, shall be for:

1" bolts:	1½"	M24 bolts:	36 mm
7/8" bolts:	1¼"	M22 bolts:	33 mm
3/4" bolts:	1 1/8"	M20 bolts:	30 mm
5/8" bolts:	1"	M16 bolts:	24 mm

In the flanges of beams and channels, the minimum distance from the center of any bolt hole to a rolled or planed edge shall be for:

1" bolts:	1¼"	M24 bolts:	30 mm
7/8" bolts:	1 1/8"	M22 bolts:	27 mm
3/4" bolts:	1"	M20 bolts:	25 mm
5/8" bolts:	7/8"	M16 bolts:	20 mm

The maximum distance of the center of the first bolt hole from any edge shall be 8 times the thickness of the thinnest outside plate but shall not exceed 5" (125 mm).

**(b) Punching and Drilling.** Material forming parts of a member composed of not more than 5 thicknesses of metal may be punched with holes 1/16" (1.5 mm) larger than the nominal diameter of the bolts whenever the thickness of the material is not greater than 3/4" (19 mm) for structural steel, 5/8" (16 mm) for high-strength steel, or 1/2" (12 mm) for quenched and tempered alloy steel, unless subpunching and reaming is required under Subsection 807.45.

When there are more than 5 thicknesses, or when any of the material is thicker than 3/4" (19 mm) for structural steel, 5/8" (16 mm) for high-strength steel, or 1/2" (12 mm) for quenched and tempered alloy steel, holes shall either be subdrilled or drilled full size.

When required, holes shall be either subpunched or subdrilled 3/16" (5 mm) smaller and, after assembling, reamed 1/16" (1.5 mm) larger or drilled full size to 1/16" (1.5 mm) larger than the nominal diameter of the bolts.

Improper matching of holes will be cause for rejection.

**807.43 Punched Holes.** The diameter of the die for hole punching shall not exceed the diameter of the punch by more than 1/16" (1.5 mm). Holes that must be enlarged to admit the bolts shall be reamed. Holes must be clean cut without torn or ragged edges.

**807.44 Reamed or Drilled Holes.** Where practicable, reamers shall be directed by mechanical means. Burrs on the outside surfaces shall be removed.

Reaming and drilling shall be accomplished with twist drills. If required by the Engineer, assembled parts shall be dismantled for removal of burrs. Connecting parts requiring reamed or drilled

holes shall be assembled and securely held while being reamed or drilled and shall be match marked before disassembling.

**807.45 Subpunching, Subdrilling, and Reaming of Holes for Field Connections.** Holes for all field connections of main members shall be subpunched or subdrilled and subsequently reamed while assembled, or reamed using a steel template, as required by Subsection 807.54. Automatically controlled drilling may be used for splice plates and for one side of main member connections. The splice plate shall be used as a template to drill the opposite side of the main member connection while assembled.

Holes for floor beam and stringer end connections shall be subpunched or subdrilled and reamed using a steel template, or reamed while assembled. Reaming or drilling full size of field connection holes through a steel template shall be accomplished after the template has been accurately located and firmly bolted in place. Templates used for reaming matching members or the opposite faces of a single member shall be exact duplicates. Templates used for connections on like parts or members shall be accurately located so that the parts or members are duplicates and require no match-marking. Automatically controlled drilling may be used in lieu of using a steel template.

Steel templates shall have hardened steel bushings in the holes that are accurately dimensioned from the centerlines of the connection as inscribed on the template. The centerlines shall be used in accurately locating the template from the milled or scribed ends of the members.

**807.46 Accuracy of Subpunched and Subdrilled Holes.** Holes punched, subpunched, or subdrilled shall be accurately punched or drilled so that after assembling and before reaming, a cylindrical pin 1/8" (3 mm) smaller in diameter than the nominal size of the hole may be entered perpendicular to the face of the member, without drifting, in at least 75% of the contiguous holes in the same plane. If this requirement is not fulfilled, the member will be rejected. If a pin 3/16" (5 mm) smaller in diameter than the nominal size of any hole will not pass through the hole, this will be cause for rejection.

**807.47 Accuracy of Reamed and Drilled Holes.** When holes are reamed, drilled, or punched to full size, 85% of the holes in any contiguous group shall show no offset greater than 1/32" (0.8 mm) between adjacent thicknesses of metal.

**807.48 Bolting for Reaming.** Surfaces of metal in contact shall be cleaned before assembling. The parts of a member shall be assembled and firmly drawn together with bolts before reaming begins. After reaming, members shall be cleaned of burrs and shavings and shall be free from twists, bends, and other deformation.

**807.49 Pins and Rollers.** Pins and rollers shall be accurately turned to the specified dimensions and shall be straight, smooth, and free from flaws. Pins and rollers more than 9" (225 mm) in diameter shall be forged and annealed. Pins and rollers 9" (225 mm) or less in diameter may be either forged and annealed or cold-finished carbon-steel shafting.

In pins larger than 9" (225 mm) in diameter, a hole of the diameter specified on the plans shall be bored full length along the pin axis after the forged pin has been allowed to properly cool to a temperature below the critical range. Drilling shall be accomplished before the annealing process.

**807.50 Boring Pin Holes.** Pin holes shall be bored true to the specified diameter, smooth, straight, at right angles with the axis of the member, and parallel with each other unless otherwise specified. The final surface shall be produced by a finishing cut.

The distance outside to outside of end holes in tension members and inside to inside of end holes in compression members shall not vary from that specified more than 1/32" (0.8 mm). Boring of holes in built-up members shall be performed after fabrication is completed.

**807.51 Pin Clearances.** The diameter of the pin hole shall not exceed that of the pin by more than 1/50" (0.5 mm) for pins 5" (125 mm) or less in diameter or by 1/32" (0.8 mm) for larger pins.

**807.52 Threads for Unfinished Bolts and Pins.** Threads for bolts and pins for structural steel construction shall conform to the current Unified Standard Series UNC-ANSI B 1.1, Class 2A for external threads and Class 2B for internal threads, except that pin ends having a diameter of 1 3/8" (35 mm) or more shall be threaded 6 threads to 1" (6 threads to 25.4 mm).

**807.53 Pilot and Driving Nuts.** Two pilot nuts and two driving nuts for each size of pin shall be furnished, unless otherwise specified.

**807.54 Shop Assembling. (a) General.** The field connections of main members shall be assembled in the shop with milled ends of compression members in full bearing. After assembly, the sub-size holes shall be reamed to specified size.

**(b) Assembly.** Assembly shall be Full Truss or Girder Assembly unless Progressive Truss or Girder Assembly, Full Chord Assembly, Progressive Chord Assembly, or Special Complete Structure Assembly, is specified. The types of assembly are as described below.

**(1) Full Truss or Girder Assembly.** Full Truss or Girder Assembly shall consist of assembling all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder, or rigid frame at one time.

**(2) Progressive Truss or Girder Assembly.** Progressive Truss or Girder Assembly shall consist of assembling initially for each truss, arch rib, bent, tower face, continuous beam line, plate girder, or rigid frame at least three contiguous shop sections, or all members in at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (i.e., length between field splices), and not less than 150' (46 m) in the case of structures longer than 150' (46 m). At least one shop section or panel or as many panels as are associated with a chord length shall be added at the advancing end of the assembly before any member is removed from the rearward end so that the assembled portion of the structure is never less than that specified above. The assembly sequence for beams and girders shall include sufficient sections to include two bearings.

**(3) Full Chord Assembly.** Full Chord Assembly shall consist of assembling, with geometric angles at the joints, the full length of each chord of each truss or each leg of each bent or tower, then reaming the field connection holes while the members are assembled and reaming the web member connections using steel templates set at geometric (not cambered) angular relation to the chord lines.

At least one end of each web member shall be milled or scribed normal to the longitudinal axis of the member and the templates at both ends of the member shall be accurately located from one of the milled ends or scribed lines.

**(4) Progressive Chord Assembly.** Progressive chord assembly shall consist of assembling contiguous chord members in the manner specified for full chord assembly and in the number and length specified for progressive truss or girder assembly.

**(5) Special Complete Structure Assembly.** Special complete structure assembly shall consist of assembling the entire structure, including the floor system.

**807.55 Drifting of Holes.** The drifting accomplished during assembly shall be sufficient to bring the parts into position, but shall not enlarge the holes or distort the metal.

**807.56 Match-Marking.** Connecting parts that are assembled in the shop for the purpose of reaming field connection holes shall be match-marked. A diagram showing such marks shall be furnished to the Engineer upon request.

**807.57 Finished Members.** Finished members shall be true to line and free from twists, bends, and open joints.

When finished members are moved to storage they shall be picked up at two or more points. They shall be carefully handled to prevent damage, and placed on skids above the ground. Long members shall be supported sufficiently to prevent damage from deflection.

**807.58 Certification of Identification.** The Contractor shall furnish an affidavit certifying that throughout the fabrication operation the identification of steel has been maintained according to this specification.

**807.59 Storage of Materials.** Structural material, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease, and other foreign matter, and shall be protected as far as practicable from corrosion. Handling of materials shall not cause damage or undue stress.

**807.60 Weighing of Members.** In case it is specified that any part of the material is to be paid for by actual weight, finished work shall be weighed in the presence of the Inspector. The Contractor shall supply satisfactory scales and shall perform all work involved in handling and weighing the various parts.

**807.61 Marking and Shipping.** Each member shall be printed or marked with an erection mark for identification. An erection diagram shall be furnished showing the appropriate erection marks. If steel die stamping is used for marking, it shall be the low stress type and high stress areas of members shall be avoided.

The Contractor shall furnish sufficient copies of material orders, shipping statements, and erection diagrams as the Engineer may direct. The weights of the individual members shall be shown on the statements. Members weighing more than 3 tons (3 metric tons) shall have the weights marked thereon.

Structural members shall be loaded on trucks or cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed, or otherwise damaged.

Bolts of each size, loose nuts or washers of each size, and fasteners tested as an assembly for rotational capacity tests shall be packed separately. A list and description of the contained material shall be plainly marked on the outside of each shipping container.

## ERECTION

**807.62 Erection of Steel Structures.** When the substructure and superstructure are constructed under separate contracts, the Department will provide the substructure constructed to established lines and elevations and properly finished. When Bridge Construction Control is not included in the Contract, the Department will establish the lines and elevations required for erection of the superstructure steel.

The Contractor shall erect the structure steel, remove any designated temporary construction, and perform all work required to complete the structure or structures as provided in the Contract, including the removal of the old structure or structures when specified.

**807.63 Methods and Equipment.** Before starting the work of erection, the Contractor shall advise the Engineer, for informational and record purposes, of the method of erection he proposes to follow and the type of equipment he proposes for use. The Contractor shall be responsible for the safety of his methods and equipment and for performing the work according to the plans and specifications.



**807.64 Falsework.** Details of falsework construction for steel erection, complete with dimensions, design calculations, and kind and condition of materials, shall be submitted to the Engineer prior to construction for informational and record purposes. These details shall be prepared and/or approved by a Registered Professional Engineer. Construction shall be according to the details submitted to the Engineer for informational purposes. The Contractor shall be responsible for the results obtained by the use of the falsework design.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Falsework shall be set to give the finished structure the camber specified.

Falsework that cannot be founded on a satisfactory footing shall be supported on piling which shall be spaced, driven, and removed as specified in the Contractor's falsework details.

Upon completion of the steel erection the Contractor shall remove all falsework prior to placing the deck.

**807.65 Handling and Storing Materials.** Material to be stored shall be supported on skids above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and properly shored. Long members, such as columns and chords, shall be properly supported to prevent damage from deflection.

**807.66 Bearings and Anchorage.** Bearing plates shall not be placed upon bridge seat bearing areas that are improperly finished, deformed, or irregular. Bearing plates shall be set level and in the specified position and shall have uniform bearing on the masonry.

Bearing plates shall be accurately set on preformed fabric or elastomeric pads meeting the requirements of Subsection 807.15.

Anchor bolts shall be set in holes drilled in the bridge seat or cast in place. Bolts placed in drilled holes shall be accurately set and fixed with an approved epoxy or non-shrink grout from the QPL that completely fills the holes. The location of anchor bolts in relation to slotted holes in expansion shoes shall be determined by the air temperature and the amount of expansion at the time of erection. Nuts on anchor bolts at the expansion ends of spans shall be adjusted to permit free movement of the span.

**807.67 Field Welding.** All field welding shall be accomplished according to the applicable provisions of 807.26.

**807.68 Straightening Bent Members and Correcting Camber.**

**(a) Straightening Bent Members.** Any member that is bent or distorted will be considered unacceptable until the member is either replaced or, if appropriate, repaired by a method proposed by the Contractor and approved by the Engineer. The straightening of plates, angles, other shapes, and built-up members, when permitted by the Engineer, shall be accomplished by methods that will not produce fracture or damage. Heat straightening of Grade 100 (690) steel members shall be accomplished only under rigidly controlled procedures and each application shall be subject to the approval of the Engineer. In no case shall the maximum temperature of the Grade 100 (690) steel exceed 1100° F (590° C) nor shall the temperature exceed 950° F (510° C) at or within 6" (150 mm) of weld metal. Heat shall not be applied directly to weld metal. In all other steels, the temperature of the heated area shall not exceed 1150° F (620° C) as controlled by temperature-indicating crayons, liquids, or bi-metal thermometers.

Members to be heat straightened shall be substantially free of stress and from external forces other than stresses resulting from mechanical means used in conjunction with the application of heat. Members shall not be artificially cooled except as permitted in Subsection 807.27.

Following the straightening of a bend or distortion, the surface of the metal shall be carefully inspected for evidence of fracture. Such evidence will be cause for rejection.

**(b) Correcting Camber.** Correction of errors in camber in beams and girders shall be accomplished only under rigidly controlled procedures with each application of heat, subject to approval of the Engineer.

**807.69 Assembling Steel.** Steel members shall be accurately assembled as shown on the plans and match-marks shall be followed. Members shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering which will damage or distort the members will not be allowed. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled.

Unless erected by the cantilever method, truss spans shall be erected on blocking so as to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully bolted and all other truss connections pinned and bolted. Permanent bolts in splices of butt joints of compression members and permanent bolts in railings shall not be tightened until the span has been made self-supporting.

Field connections using high strength bolts shall comply with the following assembly requirements:

- At least 4 erection pins, installed in extreme hole locations, shall be used. The actual number of erection pins required shall be sufficient to ensure proper alignment of the remaining holes.
- A total of at least one half of the holes shall be filled with a combination of fitting-up bolts and the above required erection pins. At least 50% of this combination shall be fitting-up bolts. Fitting-up bolts shall be symmetrically placed.

For splices, the above requirements shall be applied to each element of the splice (i.e. top flange, web, bottom flange) on each side of the joint.

Fitting-up bolts may be either the same high strength bolts used for final assembly or they may be other bolts of the same nominal diameter as the high strength bolts. If non-high strength fitting-up bolts are used, they will be removed and replaced prior to the final assembly. Fitting-up bolts that are hammered into position shall not be used in the final assembly if thread damage has occurred. Erection pins shall be cylindrical and shall have a diameter 1/32" (0.8 mm) larger than the high strength bolts used in final assembly. The erection pins, as well as any fit-up bolts that are not part of the final assembly, shall be furnished by the Contractor at no cost to the Department.

**807.70 Unfinished Bolt Connections.** Unfinished bolts shall conform to the requirements of ASTM A 307, Grade A. Bolts shall have single self-locking nuts or double nuts unless otherwise specified. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis.

**807.71 High Strength Bolt Connections. (a) General.** High strength bolts meeting the requirements of ASTM A325 shall be furnished unless otherwise specified.

Bolts shall be placed with heads on the outside face of exterior girders and the bottom of girder flanges.

High strength fasteners, other than those used in bolted field splices for main load-carrying members, may be re-used one time after initial tightening to specification tension, provided that a close visual inspection indicates that there is no distress in the bolt, no damage to the threads, and that the nut runs freely on the bolt. When it becomes necessary to remove or loosen a bolt assembly after it has been tightened to specification tension twice, the assembly must be discarded and a new one substituted.

High strength fasteners used in bolted field splices for main load-carrying members may be tightened to specification tension only once.

Retightening previously tightened bolts that may have been loosened by the tightening of adjacent bolts will not be considered as re-use provided the retightening continues from the initial position and does not require greater rotation, including the tolerance, than that required by Table 807-1.

All fitting-up bolts shall be brought to a snug tight condition before installing and tightening the balance of high strength bolts. Snug tight is defined as the tightness that exists when the plies of the joint are in firm contact.

Following the initial snug tightening of the fitting-up bolts, the remaining holes shall be filled with high strength bolts and tightened to a snug tight condition. Erection pins and any fitting-up bolts not suitable for final assembly shall then be replaced with high strength bolts and installed to a snug tight condition. All bolts in the connection shall then be tightened to the specified tension.

Snug tightening and tightening shall progress systematically from the most rigid part of the joint to its free edges.

**(b) Bolts, Nuts, and Washers.** Bolts, nuts, and washers shall conform to the requirements of Subsection 807.06.

Bolts, nuts, and washers shall be shipped and stored in weather proof containers. Bolts and nuts shall be reasonably free of

corrosion or other foreign material. The nut shall run freely on the thread, using a wax type lubricant if necessary.

Fasteners shall be protected from dirt and moisture at the job site. Only as many fasteners as are anticipated to be installed and tightened during a work shift shall be taken from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Fasteners shall not be cleaned of lubricant that was present on delivery. Fasteners that accumulate rust or dirt shall be cleaned and re-lubricated prior to installation.

**(c) Bolted Components.** Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or other interposed compressible material.

Assembled joint surfaces adjacent to the bolt heads, nuts, or washers shall be free of scale, dirt, burrs, foreign material, or other defects that would prevent solid seating of the components.

Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, rust inhibitor, galvanizing, or other foreign material. The surfaces shall be cleaned by wire brushing or blasting prior to assembly of the joint.

**(d) Installation. (1) Bolt Tension.** Each bolt shall be tightened to provide, when all bolts in the joint are tight, at least the minimum bolt tension shown in Table 807-3 for the size of bolt used.

Bolts shall be tightened with properly calibrated wrenches or by the turn-of-nut method. If required because of bolt and/or wrench clearances, tightening by either procedure may be accomplished by turning the bolt while the nut is prevented from rotating.

**TABLE 807-3  
MINIMUM BOLT TENSION**

U.S. Standard		Metric (SI)	
Bolt Size (Inches)	Bolt Tension (kips)	Bolt Size	Bolt Tension (kN)
1/2	12		
5/8	19	M16	91
3/4	28	M20	142
7/8	39	M22	176
1	51	M24	205
1 1/8	56	M27	267
1 1/4	71	M30	326
1 3/8	85	M36	475
1 1/2	103		

**(2) Washers.** Bolts shall have a hardened washer under the nut, and under the bolt head if turned in tightening.

**(3) Turn-of-Nut Tightening.** When the turn-of-nut method is used to provide the bolt tension specified in paragraph (d)(1) above, all bolts in the connection shall be tightened by the applicable amount of nut rotation specified in Table 807-1. During this operation there shall be no rotation of the part not turned by the wrench.

Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table 807-1. Tightening shall progress systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

**(4) Calibrated Wrench Tightening.** When calibrated wrenches are used to provide the bolt tension specified in paragraph (d)(1) above, their setting shall be such as to induce a bolt tension 5%-10% in excess of this value. Wrenches shall be of adequate capacity to perform the required tightening of each bolt in less than 10 seconds. These wrenches shall be calibrated at least once each working day by tightening, in a device capable of indicating actual bolt tension, not less than 3 typical bolts from each lot of 500 of the same grade, size, and condition of the bolts

to be installed. Power wrenches shall be adjusted to stall or cut-out at the selected tension.

After the wrenches are adjusted to provide the required tension, the calibration selected shall be verified during actual installation of the assembled steel work to ensure that nut or bolt head rotation from snug tight is not greater than that permitted in Table 807-1, including the 30° tolerance.

If manual torque wrenches are used, the torque indication corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be returned to "touch up" any bolts. "Touch up" shall continue until all bolts are tightened to the specified tension.

**(e) Inspection.** When the calibrated wrench method of tightening is used, the Engineer shall have full opportunity to witness the calibration tests prescribed in paragraph (d)(4) above.

The Engineer will observe the installation and tightening of bolts to determine that the selected tightening procedure is properly used and will determine that all bolts are tightened as specified.

Unless otherwise specified, the following inspection procedures will be used:

(1) The Contractor, in the presence of the Engineer, shall use an inspection wrench (either torque or power) that can be accurately adjusted according to the requirements of paragraph (d)(4) above.

(2) Three typical bolts from each lot of 500 of the same grade, size, and condition as those under inspection shall be individually placed in a calibration device capable of indicating bolt tension. There shall be a washer under the part turned in tightening each bolt.

(3) When the inspecting wrench is a torque wrench, each bolt specified in paragraph (e)(2) shall be tightened in the calibration device to the minimum tension specified for its size in paragraph (d)(1). The inspecting wrench then shall be applied to the tightened bolt and the torque necessary to turn the nut or head 5° (approximately 1" [25 mm] at 12" [300 mm] radius) in the tightening direction shall be determined. The average torque measured in the tests of three bolts shall be taken as the job

inspecting torque to be used in the manner specified in paragraph (e)(5).

(4) When the inspecting wrench is a power wrench it shall be adjusted so that it will tighten each bolt specified in paragraph (e)(2) to a tension at least 5% but not more than 10% greater than the minimum tension specified for its size in paragraph (d)(1). This wrench setting shall be the job inspecting torque to be used in the manner specified in paragraph (e)(5).

(5) Bolts represented by the sample prescribed in paragraph (e)(2) and which have been tightened in the structure shall be inspected by applying the inspecting wrench and its job inspecting torque to 10% but not less than 2 of the bolts, selected at random, in each connection. If no nut or bolt head is turned by this application of the job inspecting torque, the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspecting torque, this torque shall be applied to all bolts in the connection, and all bolts whose nut or head is turned by the job inspecting torque shall be tightened and reinspected, or alternatively, the Fabricator or Erector, at his option, may retighten all of the bolts in the connection and resubmit the connection for the specified inspection.

**807.72 Pin Connections.** Pilot and driving nuts shall be used in driving pins for connections. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be screwed up tight and the threads burred at the face of the nut with a pointed tool.

**807.73 Misfits.** The correction of minor misfits involving harmless amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation that prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Engineer and his approval of the method of correction obtained. The correction shall be made in his presence. The Contractor shall be responsible for all misfits, errors, and injuries and shall make the necessary corrections and replacements.



**807.74 Profiling of Steel Beams and Girders.** Upon completion of erection and bolting of beams and girders, the Contractor shall profile each beam or girder line. The profiling shall be accomplished prior to beginning any deck forming operations. These profiles will be used to establish a finished deck elevation to provide the correct deck thickness. This may require the construction of variable haunches over the beams or girders to obtain the correct deck elevation and thickness. All required haunches are considered variable and the extra materials and work required in construction of these haunches shall be at no cost to the Department.

### PAINTING

**807.75 Painting -- General.** The painting of metal structures shall include, unless otherwise provided in the Contract, the preparation of the metal surface and the application, protection, and drying of the paint coatings. All references to this subsection at other locations in these specifications shall be deemed to include Subsections 807.75 through 807.88, as applicable.

The prime and finish coats shall be the type and color specified in the Contract.

The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent pollution of rivers, streams, or impoundments. Painting and cleaning operations conducted over or in the vicinity of water shall be controlled to prevent materials or waste, considered a contaminant by the Arkansas Department of Environmental Quality (ADEQ), from falling into the water. All material or waste that falls into the water, or onto areas where there is a likelihood that it will be picked up by rising water levels, shall be retrieved and properly disposed of in approved locations.

When paint is to be applied to a structure that spans a waterway, the Contractor shall notify the ADEQ, in writing, at least 2 weeks prior to the date work is to begin. A copy of this notification shall be furnished to the Engineer.

The Contractor shall protect pedestrian, vehicular, or other traffic upon, underneath, or in the vicinity of the bridge, and all portions of the bridge superstructure and substructure against damage or disfigurement by drift, spatters, splashes, or smirches of paint or paint materials.

All scaffolding, ladders, and other equipment, materials, or tools that restrict vertical or horizontal clearances shall be clear of all lanes and shoulders open to traffic when not in use or protected by appropriate traffic control devices.

**807.76 Paint System. (a) General.** The paint system shall consist of an Inorganic Zinc-Rich Prime Coat applied in the fabrication shop and a Finish System that shall be field applied. All coatings used shall be supplied by the same manufacturer to ensure compatibility. Lead and chromium pigments will not be permitted. All coatings shall meet the current EPA and ADEQ restrictions for Volatile Organic Compounds (VOC).

The Engineer will verify the thickness of each paint coat using a dry film thickness gauge. Dry film thickness will be determined by methods described by the Steel Structures Painting Council (SSPC). Any paint coat found to be deficient in thickness shall be corrected according to the manufacturer's recommendations. The correction shall be at no cost to the Department.

**(b) Prime Coat.** The prime coat shall be an inorganic zinc-rich paint meeting the material and composition requirements listed under Subsection 807.77. Prior to application of the prime coat, the steel shall be thoroughly blast cleaned according to Subsection 807.84(b). If rust forms after blast cleaning, the surface shall again be blast cleaned before painting. The minimum dry film thickness for the inorganic zinc-rich prime coat shall be 3.0 mils (75  $\mu\text{m}$ ).

**(c) Finish System.** The finish system shall be a two coat system composed of an epoxy tie coat and a coat of urethane paint meeting the material and composition requirements listed in Subsection 807.77. Neither the epoxy tie coat nor the urethane coat shall be applied until the preceding coat or any touch-up has cured for the minimum time as recommended by the manufacturer. The minimum dry film thickness of the epoxy tie coat shall be 2.0 mils (50  $\mu\text{m}$ ) unless otherwise recommended by the manufacturer. The minimum dry film thickness of the urethane coat shall be 3.0 mils (75  $\mu\text{m}$ ).

**(d) Manufacturer and Brand Name Approval.** Prior to approval of any paint, the following certified test reports shall be submitted to the Engineer of Materials for approval:

- 1) Certified test reports from an independent testing laboratory showing conformity with the slip coefficient requirement in Subsection 807.77(a)(1) for the inorganic zinc-rich primer. This test report shall show the manufacturer's name, brand name of the paint, and the date of manufacture of the paint used in the test, and shall certify that the paint used in the test meets all other requirements of Subsection 807.77(a).
- 2) Certified test reports from an independent testing laboratory for each paint showing compliance with all other requirements of Subsection 807.77. The certified test reports shall show the manufacturer's name, brand name of the paint, date of manufacture, and the infrared spectrum analysis of the paint used in the tests. In addition, for two component paints the test reports shall show the exact ratio, by weight, of the pigment component to the vehicle component.

Upon approval by the Engineer of Materials of these certified test reports, no further testing will be required except as hereinafter noted. New certified test reports will be required whenever the manufacturing process, paint formulation, or source of raw materials is changed.

**(e) Acceptance.** The manufacturer shall furnish a certification for each lot certifying that the materials supplied conform to all the requirements specified and stating that the material is formulated the same as the material tested for manufacturer and brand name approval. All paints used for this application shall be listed on the QPL. Random samples may be taken and tested by the Department.

**807.77 Materials. (a) Inorganic Zinc-Rich Primer.** The prime coat shall be an inorganic zinc-rich paint complying with the requirements of AASHTO M 300 for Type I or Type II.

The paint shall qualify for a Class A classification (slip coefficient of 0.33 or greater) when tested according to "Testing Methods to Determine the Slip Coefficient for Coatings used in Bolted Joints", in Appendix A of *Specification for Structural Joints Using ASTM A 325 or A 490 Bolts* as published by AISC.

**(b) Finish System.** The epoxy tie coat shall be the type as recommended by the manufacturer to ensure good bond between the

inorganic zinc-rich prime coat and the urethane top coat. The epoxy tie coat and the urethane paint for the finish system shall be manufactured by the supplier of the inorganic zinc-rich paint. The urethane paint shall be a high build aliphatic polyurethane paint that is compatible with the previous coat. The urethane paint shall not blush or excessively chalk, and shall have the following properties:

**(1) General.** The high build aliphatic polyurethane paint shall be a two-component, weather resistant topcoat, containing no free oils, and having excellent resistance to splash and spillage of acids, alkalis, solvents, salts, and water. It shall provide adequate hiding when applied in a single coat over the epoxy tie coat.

The manufacturer will establish a typical density value and tolerance for each component and for the mixed paint. The mixed urethane paint shall have a solids content of not less than 57% by volume.

**(2) Color.** The color of the urethane paint shall match the Federal Standard 595B Color Chip No. X7200, Aluminum color, unless otherwise specified on the plans. (Level of Gloss "X" shall be identified as 1, 2, or 3 finish). The same level of gloss must be used for all applications of the finish system under the Contract.

**(c) Packaging and Labeling.** Paint shall be packaged in new containers having resealable tops. Each container shall bear a label on which shall be clearly shown the name of the manufacturer, the kind of paint, the lot number, date of manufacture, net weight of contents, and equipment cleaning instructions. For two component paints, the label shall also show the mixing instructions.

**807.78 Number of Coats.** Steel shall receive one shop prime coat, one epoxy tie coat, and one field finish coat. Previously applied coats which have been damaged or skinned shall be corrected according to the manufacturer's recommendations prior to the application of any succeeding coat. The various coats shall be sufficiently different in color as to permit detection of incomplete application.

**807.79 Mixing of Paint.** Paint shall be mixed before applying in order to keep the pigments in uniform suspension.

Mechanical mixers shall be used to mix the paint. Prior to applying, the paint shall be mixed a sufficient length of time to

thoroughly mix the pigment and the vehicle together, and it shall be kept thoroughly mixed during its application.

**807.80 Thinning Paint.** Paint shall be ready for use when thoroughly mixed. However, where thinning by addition of vehicle is recommended by the manufacturer, paint may be thinned according to those recommendations. The recommendations for thinning shall be plainly marked on the paint container and the minimum dry film thickness shall be achieved. The addition of thinner shall not exceed the allowable VOC established by ADEQ.

**807.81 Weather Conditions for Painting.** Paint shall be applied according to the temperature, humidity range, and other limitations recommended by the manufacturer. Paint shall not be applied when, in the opinion of the Engineer, conditions are unsatisfactory for the work. Paint shall not be applied upon a damp or frosted surface.

**807.82 Application of Paint. (a) General.** Painting shall be accomplished in a neat and professional manner. All paint shall be applied using suitable conventional spray or airless spray equipment. A uniform coating free from runs and sags shall be produced. Brushing may be used for touch-up or in areas inaccessible for spraying.

All surfaces to be painted shall be clean and free from dust, oil, grease, or other objectionable matter.

**(b) Brushing.** When brushes are used, the paint shall be so manipulated under the brush as to produce a smooth, uniform, even coating in close contact with the metal or with previously applied paint, and shall be worked into all corners and crevices.

**(c) Spraying.** Power spraying equipment shall apply the paint in a fine, even spray. Paint applied with spray equipment shall be immediately followed by brushing when necessary to secure uniform coverage and to eliminate wrinkling, blistering, and airholes.

**(d) Inaccessible Surfaces.** On surfaces that are inaccessible for brushes, the paint shall be applied by spraying or by using appropriate daubers.

**807.83 Removal of Unsatisfactory Paint.** If any painting application produces a coat that is unsatisfactory to the Engineer, the paint shall be removed and the metal thoroughly cleaned and repainted.

**807.84 Cleaning Surfaces. (a) General.** Surfaces of metal to be painted shall be thoroughly cleaned by removing rust, loose mill scale, dirt, oil, grease, and other foreign substances.

**(b) Blast Cleaning.** Blast cleaning shall be used for the preparation of steel surfaces prior to the application of the prime coat. Steel shall be cleaned by either the centrifugal wheel or the air blast method. Blast cleaning shall produce a surface preparation conforming to SSPC-SP10, Near-White Blast Cleaning with a surface profile as recommended by the manufacturer of the paint. Blast cleaning shall include field contact surfaces of all bolted connections.

Special attention shall be given to the cleaning of corners and re-entrant angles. Before painting, metallic shot and grit or sand shall be removed from the surface. The cleaning shall be approved by the Engineer prior to painting. The material shall be painted before rust forms.

**(c) Cleaning Prior to Topcoating.** Prior to application of the epoxy tie coat and/or finish coat the surface to be painted shall be free of all dust, dirt, hardened concrete, oil, grease, and other foreign substances. The removal of dirt and hardened concrete shall be accomplished by the use of metal brushes, scrapers, chisels, hammers, or other effective means. Oil and grease shall be removed by the use of a suitable effective solvent. Bristle or wood fiber brushes shall be used for removing loose dust. Any paint damaged during cleaning shall be corrected according to the manufacturer's recommendations prior to application of succeeding coats.

**(d) Surfaces Inaccessible After Fabrication.** The inside surfaces of boxed members and other surfaces that will be inaccessible to the cleaning operation after fabrication shall be cleaned before assembly or cleaned by hand tool methods.

**(e) Unpainted Weathering Structural Steel.** Unless otherwise specified, Grade 50W (345W) structural steel that is not to be painted shall be blast cleaned to remove mill scale or other substances. Blast cleaning shall conform to SSPC-SP6, Commercial Blast Cleaning. Care shall be taken that dents, scratches, gouges, or identification marks will not appear on exposed surfaces. All steel is to remain in the unpainted condition and shall be handled so that it is kept free of all grease, oil, concrete, chalk marks, dirt, or any

other foreign material that might affect the natural and uniform weathering of the steel.

Any foreign material that adheres to the steel during the fabrication or construction process that will inhibit the formation of the oxide film shall be removed as soon as practicable according to the SSPC Surface Preparation Specifications by one of the following four methods:

- 1) SSPC-SP1, Solvent Cleaning
- 2) SSPC-SP2, Hand Tool Cleaning
- 3) SSPC-SP3, Power Tool Cleaning
- 4) SSPC-SP7, Brush-off Blast Cleaning

**807.85 Shop Painting.** Unless otherwise specified, structural steel shall be given one shop coat of approved paint before it is shipped from the plant.

Surfaces that will not be exposed to the atmosphere in the final structure, and which will be inaccessible after assembly, erection, or placement of concrete shall be given a prime coat but will not require a finish coat. Field contact surfaces of bolted connections, including all components of bolted splices, shall receive a prime coat of paint in the shop.

A shop prime coat of paint shall be applied to the top of the top flanges of all beams and girders.

Structural steel that is to be field welded shall not be painted before the field welding is complete.

Unless otherwise specified, surfaces of iron and steel castings, either milled or finished, shall be painted.

With the exception of abutting joints and base plates, machine-finished surfaces shall be coated, as soon as practicable after being accepted, with a graphite dry film lubricant or other approved coating prior to removal from the shop.

Erection and weight marks shall be painted upon surface areas that have previously been painted with the shop coat. Material shall not be loaded for shipment until it has thoroughly dried, and in no case less than 24 hours after the paint has been applied.

**807.86 Field Painting.** When erection work is complete, any adhering rust, scale, dirt, oil, grease, or other foreign materials shall be removed as specified in Subsection 807.84.

All areas of prime coat and/or shop applied epoxy tie coat that have been damaged or are otherwise defective shall be corrected according to the manufacturer's recommendations prior to application of the finish system. Areas requiring a finish coat on which the prime and/or epoxy tie coat was not applied shall be cleaned and the required coats applied prior to application of the finish coat. All surfaces shall be free of any soluble residue or excessive amounts of loose zinc before the finish or epoxy tie coat is applied.

All paint, including prime, epoxy tie coat, and urethane finish coat, shall be properly cured according to the manufacturer's recommendations; and limitations on recoat time complied with. Subsequent coatings shall be applied as soon as practical after recoat requirements are met. When application of subsequent coatings is not done within the specified time, the previously applied coating may require additional surface preparation, subject to the manufacturer's recommendations.

Epoxy tie coats and finish coats shall not be applied to the contact surfaces of bolted connections. Surfaces that will be inaccessible after erection and will be exposed to the atmosphere shall be painted with the applicable field coats prior to erection. When the paint applied for correcting the shop coat has thoroughly dried and the field cleaning has been satisfactorily completed, the required field coats shall be applied. Small cracks and cavities that were not sealed in a watertight manner by the field prime coat shall be filled with an additional application of field prime coat paint before the finish system is applied.

The following provision shall apply to the application of the field prime and the finish system: To secure a maximum coating on edges of plates, shapes, bolts, and other parts subjected to special wear, the edges shall first be coated with a longitudinal motion and the bolts with a rotary motion followed immediately by the general painting of the whole surface, including the edges and bolts.

If traffic produces an objectionable amount of dust, the Contractor shall, at no cost to the Department, settle the dust for the necessary distance on each side of the structure and take any other precautions necessary to prevent dust and dirt from coming in contact with surfaces to be painted or with freshly painted surfaces.



The application of the finish coat shall be deferred until adjoining concrete work has been placed and finished.

**807.87 Preparing Galvanized Surfaces for Painting.** When required, the painting of galvanized surfaces shall be deferred as long as possible to allow weathering of the surfaces.

Before painting, galvanized surfaces shall be prepared as follows:

All soil, concrete spatter, and other surface dirt shall be removed with a stiff brush, scraper, or other suitable means.

All surfaces shall be cleaned with alkaline detergents such as trisodium phosphate. Surfaces cleaned with detergents shall be thoroughly rinsed with hot water to remove alkaline residue. Solvents may be required to remove certain contaminants, including oil or grease. When solvents are used, special care shall be taken to assure proper ventilation and safe working conditions. Manufacturers' recommendations for the use of solvents shall be followed.

The use of gasoline, benzene, low-flash naphtha, or other highly volatile fluids, and the washing of galvanized surfaces with vinegar or other acids prior to painting will not be allowed.

As an alternative to detergent and solvent cleaning, sweep blasting of the galvanized surface will be permitted.

The field prime and finish system shall be applied according to Subsection 807.86.

**807.88 Repairing Damaged Galvanized Coatings.** Galvanizing that has been chipped off or damaged in handling, transporting, or welding shall be repaired by field galvanizing.

Field galvanizing shall be accomplished by the application of a paste composed of approved zinc powder and flux with a minimum amount of water. The areas to be coated shall be thoroughly cleaned, including removal of any slag on welds, before the paste is applied. The surface to be coated shall first be heated with a torch to a temperature sufficient that the metallics in the paste are melted when applied to the heated surface. Extreme care shall be taken to assure that surrounding surfaces are not damaged by the torch. The flux in the paste will cause a black residue on the surface of the coated parts. This black residue shall be removed by rinsing with water or wiping with a clean, damp cloth.

Other methods of repairs may be used as allowed by ASTM A 780, Repair of Hot-Dip Galvanized Coatings. Products used for repair shall be as listed on the Department's QPL or as approved by the Engineer.

Repair to damaged galvanized coatings shall be accomplished at no cost to the Department.

**807.89 Method of Measurement.** (a) Measurement for structural steel will be based on plan quantities of the weight of structural steel in the fabricated structure. When this weight is altered by the Engineer, the weight of structural steel for payment will be adjusted to account for the change. Where the Fabricator's or Contractor's calculations indicate an error in plan quantities that varies more than 1% from the planned project quantity, calculations may be submitted for checking by the Department and, if verified, the corrected weight will be used. The weight of shop and field paint, boxes, crates, and other containers used for packing, and for sills, struts, and rods used for supporting members during transportation, will be excluded.

If the scale weight of any member is less than 97.5% of the computed weight, the member will be rejected.

The weights are computed on the following basis:

(1) Unit weights in lbs./cu. ft. (kg/cu m).

<b>Unit Weights</b>		
	<b>lbs./cu. ft.</b>	<b>kg/cu m</b>
Aluminum, cast or wrought	173	2770
Bronze, cast	536	8590
Copper-Alloy	536	8590
Copper Sheet	558	8940
Iron, Cast	445	7130
Iron, Malleable	470	7530
Iron, Wrought	487	7800
Lead, Sheet	707	11 330
Steel, Cast, Copper Bearing Silicon, Nickel, and Stainless	490	7850
Zinc	450	7210
Miscellaneous Material:	as designated on the plans	

(2) The weights of all rolled shapes and of plates up to and including 36" (900 mm) in width are computed on the basis of their nominal weights and dimensions as shown on the plans, deducting for copes and cuts.

To the nominal weights of plates more than 36" (900 mm) in width, there will be added one-half the allowed percentage of overrun in weight given in ASTM A6.

(3) The weight of heads, nuts, washers, and threaded stick-through of high strength steel bolts is included on the basis of the following weights:

U.S. Standard		Metric (SI)	
Bolt Size (inches)	Weight per 100 Bolts (pounds)	Bolt Size	Weight per 100 Bolts (kg)
1/2	19.7		
5/8	31.7	M16	14.4
3/4	52.4	M20	23.8
7/8	80.4	M22	36.5
1	116.7	M24	53.0
1 1/8	165.1	M27	75.0
1 1/4	212.0	M30	96.4
1 3/8	280.0	M36	127.3
1 1/2	340.0		

(4) The weight of casting is computed from the dimensions shown. To this weight is added 10% allowance for fillets and overrun.

(5) The weight of railing will be included in the measurement unless it is paid for as a separate contract item.

(6) Steel or brass shims, when required, will be measured and paid for as structural steel.

(7) The weight of shop and field fillet and all other welds are not included in the quantities but are considered a part of the items of structural steel.

(b) The measurement of Painting Structural Steel will be based on the final allowed quantity of steel in the structure as computed in Subsection 807.89(a). Painting Structural Steel will include all field applied paint. Shop applied paint will not be measured or paid for separately, but full compensation therefor will be considered included in the contract unit price(s) bid for Structural Steel.

**807.90 Basis of Payment. (a) Structural Steel.** Work completed and accepted and measured as provided above, will be paid for at the contract unit price bid per pound (kilogram) for Structural Steel in Beam Spans, Structural Steel in Truss Spans, Structural Steel in Plate Girder Spans, or other classifications of metal for steel structures shown on the plans and in the proposal, as the case may be, which price shall be full compensation for furnishing materials; for fabrication, shop work including shop painting, transportation, falsework, erection, and repairing galvanizing; for performing quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Unless otherwise provided, metal drains, bearing and expansion plates and shapes, and rockers and shoes will be paid for at the unit price bid for the structural steel for the spans on which this material is used.

(b) **Painting Structural Steel.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Painting Structural Steel, which price shall be full compensation for furnishing materials; for cleaning and painting, including touch-up and repair of damaged shop paint; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Structural Steel in Beam Spans (___)	Pound (Kilogram)
Structural Steel in Truss Spans (___)	Pound (Kilogram)
Structural Steel in Plate Girder Spans (___)	Pound (Kilogram)
Painting Structural Steel	Ton (Metric Ton)

## SECTION 808 ELASTOMERIC BEARINGS

**808.01 Description.** This item shall consist of elastomeric bearings and shall include unreinforced pads (consisting of Elastomer only) and reinforced bearings with steel lamina, furnished and constructed according to these specifications and the details shown on the plans.

**808.02 Materials.** Elastomeric bearings shall be supplied by a manufacturer listed on the QPL. The elastomer compound shall be of 100% virgin polychloroprene (neoprene) and shall meet the minimum requirements shown in Table 808-1. The testing methods given in Table 808-1 shall be used when determining material properties. When test specimens are cut from the finished product, a 10% variation in the physical properties indicated will be allowed.

Elastomers for steel reinforced bearings shall be 50-durometer hardness. Elastomers in unreinforced pads may be 50, 60, or 70-durometer hardness.

Steel lamina shall be rolled mild steel conforming to AASHTO M 270 Grade 36 [250] (except that Charpy V-Notch Impact tests are not required), ASTM A 1011, SS or HSLAS, or equivalent, shall have a minimum yield strength of 30,000 psi (205 MPa), and shall be ordered to the nominal thickness specified on the plans.

External load plates shall conform to the requirements of AASHTO M 270, Grades 36 (250), 50 (345), or 50W (345W) as noted on the plans, except that Charpy V-Notch Impact tests are not required.

The vulcanized bond in reinforced bearings shall develop a minimum peel strength of 40 pounds per inch (6.9 kN/m). Peel strength tests shall be performed according to ASTM D429 Method B.

**808.03 Fabrication.** Bearings shall be furnished with the dimensions shown on the plans unless otherwise approved by the Engineer. Shop drawings for reinforced bearings shall be submitted to the Bridge Engineer and approval secured before fabrication is begun. Such drawings shall show the materials and fabrication procedures to be used, any changes from plan dimensions, and the bearing orientation and manner of marking the orientation when tapered external load plates are required. Unreinforced pads may be fabricated without submission or approval of shop drawings.



(-0, +12 mm)

3) Thickness of Individual Layers of Elastomer Between Steel Lamina at any point within the bearing  
(Reinforced Bearings only) .....  $\pm 1/8"$  ( $\pm 3$  mm)

4) Variations from a Plane Parallel to the Theoretical Surface (as determined by measurements at the edge of the bearings)

Top:..... Slope relative to the bottom of no more than 0.005 radians

Sides: .....  $\pm 1/4"$  ( $\pm 6$  mm)

5) Cover of Embedded Lamina: .....  $\pm 1/8"$  ( $\pm 3$  mm)

6) Size of Holes, Slots, or Inserts: .....  $\pm 1/8"$  ( $\pm 3$  mm)

7) Position of Holes, Slots, or Inserts: .....  $\pm 1/8"$  ( $\pm 3$  mm)

(b) External load plates:

1) Overall Dimensions

Thickness:.....  $\pm 1/16"$  ( $\pm 2$  mm)

Length and Width:.....  $\pm 1/4"$  ( $\pm 6$  mm)

Flatness:..... 0.001 X plan dimension

2) Bevel Slope (top of plate relative to bottom of plate:

Variation from theoretical slope as determined by measurements at edge

of plate:.....  $\pm 0.002$   
X plan dimension  
but not less than  $\pm 1/32"$  ( $\pm 0.8$  mm)

3) Size of Holes, Slots, or Inserts: .....  $\pm 1/8"$  ( $\pm 3$  mm)

4) Positions of Holes, Slots, or Inserts: .....  $\pm 1/8"$  ( $\pm 3$  mm)

**808.05 Lot Testing.** Testing for meeting the requirements of Subsection 808.02 shall be performed by the manufacturer on each production lot of bearings.

For each lot of reinforced bearings, a randomly selected sample comprising at least 10 percent of the lot shall be compression tested

by the manufacturer. Each bearing shall be individually loaded to 1.5 times its maximum design load shown on the plans for a minimum period of 15 hours. If, during the test, the load falls below 1.3 times the maximum design load, the test duration shall be increased by the period of time for which the load is below this limit. The bearing shall be examined visually at the end of the test while it is still under load. If the bulging pattern suggests lamina parallelism, a layer thickness that is outside the specified tolerances, or poor lamina bond, the bearing shall be rejected. If there are three or more surface cracks that are greater than 0.08" x 0.08" (2 mm wide and 2 mm deep), the bearing shall be rejected.

If a sample fails any test required by this subsection, all bearings of that lot will be rejected, unless the manufacturer elects to test each bearing for the failing test(s) at no cost to the Department.

A lot is defined as a group of no more than 100 bearings which are manufactured from the same batch of elastomer, cured under the same conditions and are all the same size.

**808.06 Visual Inspection and Proof Loading of Finished Bearings.** Every bearing shall be inspected for compliance with dimensional tolerances and for overall quality of manufacture. In reinforced bearings, the edges of the internal steel lamina shall be protected everywhere from corrosion.

The manufacturer shall proof load each reinforced bearing individually with a compressive load equal to 1.5 times its maximum design load shown on the plans. The load shall be held constant for five minutes, removed, and reapplied for another five minutes. The bearing shall be examined visually while under the second loading. If the bulging pattern suggests lamina parallelism, a layer thickness that is outside the specified tolerances, or poor lamina bond, the bearing shall be rejected. If there are three or more separate surface cracks that are greater than 0.08" x 0.08" (2 mm wide and 2 mm deep), the bearing shall be rejected.

**808.07 Certification and Marking.** The manufacturer shall certify that each bearing satisfies these specifications and shall supply a certified copy of all test results, including the number of reinforced bearings that failed the proof load test. Certified mill certificates for internal steel lamina and external load plates shall also be supplied.



Each reinforced bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the bent/pier number, orientation, the order number, lot number, bearing identification number, and elastomer type and grade number. Unless otherwise specified, the marking shall be on a face that is visible after erection of the bridge.

**808.08 Installation.** Reinforced bearings shall be placed on level, uniform surfaces. Any misalignment in the support shall be corrected to form a level surface. Bottom external load plates (masonry plates), when used, shall be set on unreinforced pads. Prefabricated pads meeting the requirements of Subsection 807.15(a) may be used in lieu of unreinforced pads.

Unless otherwise approved by the Engineer, the external load plate at expansion bearings may be welded to the beam/girder only when:

- the approximate average air temperature during the 24 hour period immediately preceding welding is between 40° F and 80° F (4° C and 27° C); and
- the slots in the external load plate are positioned to center on the anchor bolts; and
- no horizontal deformation of the elastomeric pad is evident.

If welding at other temperatures is required, the Engineer will provide adjustment data.

In no case shall the elastomer or the bond be subjected to temperatures higher than 400° F (204° C).

**808.09 Method of Measurement.** Reinforced elastomeric bearings will be measured by the cubic inch (cubic centimeter) of elastomer material, including required lamina. No deductions will be made for bolt holes. External load plates will not be measured or paid for separately but will be considered included in the contract unit price bid for Elastomeric Bearings.

Unreinforced pads will not be measured separately, but will be considered subsidiary to "Class S Concrete - Bridge."

**TABLE 808-1  
ELASTOMER MATERIAL PROPERTIES**

MATERIAL PROPERTY	ASTM STD. TEST	TEST REQUIREMENTS	TEST VALUES FOR :		
			50 Durometer	60 Durometer	70 Durometer
Physical Properties	D 2240	Hardness(Shore A Durometer)	50 ± 5	60 ± 5	70 ± 5
	D 412	Tensile Strength, Minimum psi (MPa)	2250 (15.5)	2250 (15.5)	2250 (15.5)
		Ultimate Elongation, Minimum %	400	350	300
Heat Resistance	D 573 70 Hours at 212°F (100°C)	Change in Durometer Hardness, Maximum Points	15	15	15
		Change in Tensile Strength, Max. %	-15	-15	-15
		Change in Ultimate Elongation, Max. %	-40	-40	-40
Compression Set	D 395 Method B	22 Hours @ 212°F (100°C), Max. %	35	35	35
Ozone	D 1149	100 pphm ozone in air by volume, 20 % strain @100°F ± 2°F (37.7°C ± 1°C) 100 Hours mounting procedure D518, Procedure A	No Cracks	No Cracks	No Cracks
Instantaneous Thermal Stiffening	D 1043	Tested @ -25°F (-31.7°C)	Stiffness at Test Temperature shall not exceed 4 times the stiffness measured at 73°F (23°C)		
Shear Modulus	D 4014	Using apparatus and procedures described in Annex A, Range, psi (MPa)	95-130 (0.66-0.90)	130-200 (0.90-1.38)	200-300 (1.38-2.07)

Note: All tests to be carried out at 73°F ± 4°F (23°C ± 2°C) unless otherwise noted. Shear modulus test is not required for unreinforced pads.

The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment, dimensions or apparent errors.

**808.10 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic inch (cubic centimeter) for Elastomeric Bearings, which price shall be full compensation for furnishing materials; for fabrication; for installation; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Elastomeric Bearings	Cubic Inch (Cubic Centimeter)

**SECTION 809  
BRIDGE EXPANSION JOINTS**

**809.01 Description.** This item shall consist of furnishing and installing expansion joints of the specified type in accordance with details shown on the plans and according to these specifications.

**809.02 Materials. (a) Preformed Joint Seal.** The joint seal shall be a preformed, cellular, elastic polychloroprene joint seal listed on the QPL and meeting the requirements of AASHTO M 297. It shall be resistant to abrasion and oxidation and to oils, gasoline, salt, and other substances that may be spilled on or applied to the bridge roadway surface. The seal shall be in one piece for the full length of the joint, including vertical face and top of curbs.

The width of the seal shall be as shown on the plans and the depth of the seal shall be approximately equal to the uncompressed width of the seal.

The manufacturer or supplier shall submit a drawing showing proposed seal dimensions and tolerances, factory made splices, and the distance from roadway surface to seating lugs to provide clearance from surface to top of seal, to the Bridge Engineer for approval.

Lubricant-adhesive shall be as recommended by the seal manufacturer. Each lot of the joint seal and lubricant adhesive shall be identified with the manufacturer's name or trademark.

**(b) Armored Joint with Neoprene Strip Seal.** The armored joint shall consist of steel extrusions with neoprene strip seal. Steel extrusions shall conform to the requirements of AASHTO M 270, Grade 50W, or as specified.

Neoprene strip seal shall be an extruded neoprene material listed on the QPL and meeting the requirements of ASTM D 2628 modified to omit the recovery test and compression-deflection test.

Lubricant-adhesive shall be in accordance with manufacturer's recommendations. Each lot of the joint seal, adhesive, and steel extrusion shall be identified with the manufacturer's name or trademark.

**(c) Silicone Joint Sealant.** Joint sealer shall be a self-leveling, two part, cold applied, rapid cure silicone joint sealant that cures to a low-modulus rubber upon exposure to atmospheric moisture. Rapid cure is defined as the development of sufficient integrity within the silicone in 8 hours or less to accommodate highway traffic and movements associated with bridges. Each lot or batch of sealing compound shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, and batch or lot number, and shall be accompanied by the manufacturer's certification. Petroleum products shall not be deleterious to the sealant. Acid cure sealants are not acceptable. Joint sealant shall meet the following requirements:

<b>Test</b>	<b>Test Method</b>	<b>Limit</b>
Extrusion Rate	ASTM C1183	10 - 20 oz./minute 275 - 550 grams/minute
Specific Gravity	ASTM D1475	1.25 - 1.35
Effects of Accelerated Weathering, 500 hours	ASTM C793*	No cracks, blisters, or bond loss
Tack-Free Time	ASTM C679	35 - 60 minutes
Joint Movement	ASTM C719	No failure
Capability & Adhesion 100% extension/50% compression		
Joint Elongation	ASTM D5329**	600% minimum
Joint Modulus at 100%	ASTM D5329**	3.0 - 12.0 psi 20.7 - 82.7 kPa

\* As an alternate to use of the twin carbon arc accelerated weathering machines, a fluorescent ultraviolet (UV) condensation type, as specified in Practice G154, may be used for evaluating the effects of accelerated weathering. The weathering apparatus shall be operated using a 4 h  $140 \pm 5.4^{\circ}\text{F}$  ( $60 \pm 3^{\circ}\text{C}$ ) UV cycle and a 2 h  $122 \pm 5.4^{\circ}\text{F}$  ( $50 \pm 3^{\circ}\text{C}$ ) condensation cycle. The bulbs used shall be the UV-B radiation type.

\*\* Cure 72 h @  $73.5 \pm 3.5^{\circ}\text{F}$  and  $50 \pm 5\%$  relative humidity.

Primer and backer rod shall be in accordance with the sealant manufacturer's recommendations. No bond shall occur between the backer material and the sealant system.

The sealant, primer and backer rod shall be accepted on the basis of the manufacturer's certification in accordance with these specifications and acceptable performance on the project. The manufacturer shall provide to the Engineer a certification for each project stating that all materials shipped will be in compliance with these specifications. Samples of the joint sealant, primer material, and backer rod may be obtained by the Materials Division for verification testing and evaluation.

#### **809.03 Construction Requirements. (a) Preformed Joint Seal.**

Prior to seal installation, the joint opening shall be measured and the Contractor shall verify that the seal size is correct for the joint opening as built. The seal shall be installed in a clean and dry joint by using specialized tools recommended by the seal manufacturer. It shall be thoroughly secured in place with an approved lubricant-adhesive that shall cover both sides of the seal over the full area in contact with the faces of the roadway joint. The adhesive may be applied to the contact surfaces of the joint or the seal or both. The seal shall be installed below the level of the roadway surface by approximately 1/4" (6 mm).

The seal may be installed immediately after the concrete curing period. Temperature limitations of the adhesive, as recommended by the manufacturer, shall be observed. Joints shall be clean and free of foreign material immediately prior to the installation of the seal.

**(b) Armored Joint with Neoprene Strip Seal.** The steel extrusions shall be shop welded to the roadway expansion channels and backwall angles as shown on the plans. Details shall be

included in the Structural Steel Shop Drawings submitted for approval.

The neoprene strip seal shall be installed in one piece across the bridge deck in accordance with the manufacturer's recommended construction methods. Joints shall be clean and free of foreign material immediately prior to the installation of the seal.

**(c) Silicone Joint Sealant.** Prior to sealant installation, the Contractor shall furnish to the Engineer a letter from the sealant manufacturer identifying the name and address of the Manufacturer's Representative; and a detail from the sealant supplier showing the size of the backer rod, the depth below the roadway surface to the backer rod, the thickness of the sealant to be used for the appropriate installation temperature, the depth below the roadway surface to the bumper plate, and joint width. In no case shall the sealant be recessed less than ½" (12 mm) below the roadway surface. The joint opening shall be measured and adjusted as necessary to meet plan dimensions at the applicable temperature.

Storage and handling of materials shall be according to the manufacturer's recommendations. Primer shall be applied as specified by the sealant manufacturer. If primer is spray applied, exposed concrete surfaces shall be protected from over spraying. The sealant shall be installed in a clean and dry joint according to the manufacturer's recommendations. Mixing and application time shall be as recommended by the manufacturer.

All work is to be performed by installers under the supervision of the Manufacturer's Representative or experienced installers that are certified by the Manufacturer's Representative. Prior to acceptance of this work, the contractor shall furnish to the Engineer a letter from the Manufacturer's Representative certifying that the joint sealant has been installed according to the manufacturer's recommendations.

**809.04 Method of Measurement.** (a) Preformed Joint Seal, Armored Joint with Neoprene Strip Seal, and Silicone Joint Sealant will be measured by the linear foot (meter). The measurement will be along the top of the seal from end to end. The quantities shown on the plans will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

**809.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Preformed Joint Seal, Armored Joint with Neoprene Strip Seal, or Silicone Joint Sealant, which price shall be full compensation for cleaning the joint, furnishing and installing all materials; for all certifications; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Preformed Joint Seal	Linear Foot (Meter)
Armored Joint With Neoprene Strip Seal	Linear Foot (Meter)
Silicone Joint Sealant	Linear Foot (Meter)

## SECTION 810 VACANT

### SECTION 811 SHEET PILES

**811.01 Description.** This item shall consist of furnishing and driving sheet piling according to these specifications and as shown on the plans, or as directed, and consists only of sheet piling that is to be left in place so that it becomes a part of the finished work.

**811.02 Materials.** Sheet piles shall be of new steel of the type and weight specified on the plans and shall comply with AASHTO M 202.

Welding for splices shall comply with Subsection 807.26.

Paint for sheet piles, when required, shall comply with Section 638.

**811.03 Construction Requirements.** Sheet piles in the completed structure shall be practically watertight at the joints. Unless otherwise provided, the tops of sheet piles that will remain exposed in the completed structure shall be a neat line. The elevation of this neat line shall be as shown on the plans or established by the Engineer.

Unless otherwise provided, sheet piles extending above the ground or water surface shall be protected by painting as specified in

Section 638. This protection shall extend from an elevation 0.5 m (18") below the finished ground line or normal water surface to the top of the exposed sheet pile.

**811.04 Method of Measurement.** Sheet Piles will be measured by the linear foot (meter) of pile in the finished structure.

**811.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Sheet Piles of the size specified, which price shall be full compensation for furnishing materials; for driving; for building up or cutting off where necessary; for painting when required; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Allowance for pile build-up and cut-off, where piles have been furnished according to the lengths shown on the plans or established by the Engineer, will be on the basis of 3 linear feet (1 m) of pile per splice for build-up, and 50% of cut-off length plus 1 linear foot (0.3 m) for cut-offs.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Sheet Piles (___)	Linear Foot (Meter)

## SECTION 812 BRIDGE NAME PLATE

**812.01 Description.** This item shall include the furnishing and placing of bridge name plates according to these specifications and conforming to the locations and details shown on the plans.

**812.02 Materials.** Bridge name plates shall be cast bronze and shall be listed on the QPL. The material for bronze plates shall comply with the following chemical requirements:

Copper	80.0	to	89.0%
Tin	3.0	to	15.0%
Lead	0	to	3.0%
Iron	0	to	0.25%
Nickel	0	to	1.0%
Sulfur	0	to	0.05%
Zinc	0	to	5.0%
Phosphorus	0	to	1.0%
Antimony	0	to	0.75%



**812.03 Construction Requirements.** The type and location of the name plate required for each bridge will be designated on the plans.

**812.04 Method of Measurement.** Bridge Name Plates will be measured by the unit.

**812.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid each for Bridge Name Plate of the type specified, which price shall be full compensation for furnishing materials and installing the plates; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Bridge Name Plate (Type____)	Each

## **SECTION 813 DAMPPROOFING**

**813.01 Description.** This item shall consist of a dampproofing or plain waterproofing composed of a primer coat followed by one or more moppings of an asphalt coating according to these specifications and at locations shown on the plans. Other dampproofing systems may be used when approved by the Engineer.

**813.02 Materials.** Asphalt materials shall conform to the requirements of Section 815.

**813.03 Construction Requirements.** The surface to which the dampproofing coating is to be applied shall be cleaned of dirt and foreign material, and shall be dry.

Dampproofing shall not be applied in wet weather or when the atmospheric temperature is below 50°F (10°C).

Priming of concrete, steel, or other surfaces shall be accomplished immediately before applying the first mopping. Additional moppings, when required by the plans, shall be applied soon after the preceding mopping has cooled.

The amount of asphalt in each mopping shall be not less than 2½ gallons per 100 square feet (1 L/sq m). Care shall be taken to

avoid overheating the asphalt. The temperature of the asphalt at the time of application shall be in the range recommended by the manufacturer. Asphalt heating kettles shall be equipped with armored or electronic sensing, digital readout thermometers so placed that the temperature of the asphalt can readily be determined at any time.

Care shall be taken to confine mopping only to the areas to be waterproofed and to prevent discoloration of other parts of the structure from dripping or spreading of the asphalt materials.

**813.04 Method of Measurement.** Dampproofing will be measured by the square foot (square meter). The area for measurement will be the entire finished area actually covered, but shall not exceed the limits shown on the plans or authorized by the Engineer.

**813.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square foot (square meter) for Dampproofing, which price shall be full compensation for furnishing materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Dampproofing	Square Foot (Square Meter)

**SECTION 814 VACANT**

**SECTION 815  
MEMBRANE WATERPROOFING**

**815.01 Description.** This item shall consist of the application of a membrane waterproofing, consisting of a membrane of the type designated, according to these specifications and in conformity with the plans.

**815.02 Types of Membranes.** The membrane shall consist of one of the following types:

Type A. One asphalt primer coat, two layers of asphalt-treated cotton fabric, and three moppings of asphalt.

Type B. One asphalt primer coat, two layers of asphalt-treated felt, one middle layer of asphalt-treated cotton fabric, and four moppings of asphalt.

Type C. A 4 mil (0.10 mm) (minimum) polyethylene film laminated to a rubberized asphalt mastic material (total thickness of 50 mils [1.3 mm], minimum). A primer shall be used as specified by the manufacturer and a rubberized asphalt mastic shall be used for sealing seams and exposed edges.

Type D. One-part, cold applied, asphalt modified, urethane coating. Final cured thickness of this membrane shall be approximately 50 mils (1.3 mm) (multiple applications may be required to obtain this final cured thickness). This material shall not be used with asphalt impregnated joint filler.

Type E. Two layers of trowel applied, fiber-modified asphalt compound, either solvent based or a mineral colloid emulsion, and one layer of asphalt-treated cotton fabric placed between the layers of the modified asphalt.

Other types of membrane may be used subject to the approval of the Engineer.

When the type is not specified on the plans or in the Special Provisions, the Contractor may select any of the above types of membrane.

**815.03 Materials. (a) Asphalt.** Asphalt shall be mopped-on material and shall be the same type of asphalt as that with which the felt or fabric is treated.

**(1) Asphalt Primer.** Asphalt primer for use with asphalt for waterproofing, either above or below ground, shall conform to ASTM D 41.

**(2) Asphalt for Mopping Above Ground.** Asphalt for mopping above ground shall conform to ASTM D 449 for Type III Asphalt.

**(3) Asphalt for Mopping Below Ground.** Asphalt for mopping below ground shall conform to ASTM D 449 for Type I Asphalt.

**(b) Fabric.** Fabric shall conform to ASTM D 173.

**(c) Felt.** Felt shall consist of rag felt conforming to ASTM D 226, Type II.

**(d) Insulating Paper.** Insulating paper shall be waterproof paper approximately 36" (1 m) wide, weighing not less than 10 pounds per 100 square feet (0.5 kg/sq m).

**(e)** Self-adhering polyethylene (Type C membrane) shall have a protective sheeting for the adhesive surface until ready for use. Primer and mastic used shall be as specified by the manufacturer.

**(f)** The one-part, moisture curing, cold applied, modified polyurethane shall be trowel applied. The material shall not evidence any lumping or skinning or any separation of pigments or fillers that cannot be easily redispersed by stirring. On a vertical surface there shall be no flow or sag of a 30 mil (0.8 mm) thick coating.

**(g)** The trowel applied, fiber-modified, solvent based, asphalt compound shall meet requirements of ASTM D 4586; the mineral colloid emulsion asphalt shall meet the requirements of ASTM D 1227, Type II, Class I.

**(h) Labeling and Delivery.** All materials shall be delivered to the work in the original packages bearing the manufacturer's brand or label. The kind of material and the purpose for which it is to be used shall be indicated on the label.

**815.04 Construction Requirements.** At the time of application, surfaces to be membrane waterproofed shall be dry and clean and the temperature of the surface shall not be less than 50°F (10°C). Projections shall be removed. There shall be no punctures, depressions, pockets, or folds in the horizontal surfaces of the finished waterproofing.

Concrete curing requirements shall be completed before the waterproofing is applied.

On vertical surfaces, the strips of fabric or felt may be laid vertically. On sloping surfaces, the strips shall be placed shingle fashion, beginning at the lowest part of the surface to be waterproofed. Sufficient fabric or felt shall be allowed for a suitable lap or anchorage at the upper edge of the surface to be waterproofed. Side laps shall not be less than 2" (50 mm) and end laps shall be staggered with laps not less than 12" (300 mm) or as recommended by the manufacturer.

Surfaces to be waterproofed with Types A or B membranes shall be given one coat of asphalt primer before the first mopping. The

primer shall be applied to the surface to give a uniform coating. The prime coat shall be applied approximately 24 hours before applying the waterproofing membrane and shall be dry before the first mopping is applied.

Surfaces to be waterproofed with Types A or B membranes shall be mopped in sections. While the first mopping of asphalt is still hot, a strip of fabric or felt shall be placed on the mopping and pressed into place. Each mopping thereafter shall be applied so that it will completely cover and seal the fabric or felt. The amount of asphalt used for each mopping shall be not less than 4½ gallons per 100 square feet (1.8 L/sq m) of surface. Asphalt heating kettles shall be equipped with armored or electronic sensing, digital readout thermometers so placed that the temperature of the asphalt can be readily determined at any time.

The temperature at the time of application shall be in the range recommended by the manufacturer.

Patching shall not be accomplished without permission of the Engineer. Where patching is permitted for repair of defective waterproofing, it shall extend at least 12" (300 mm) beyond the outermost edge of the defective area. Each succeeding ply of the patch shall extend at least 3" (75 mm) beyond the preceding ply.

At construction joints, where specified, the primer (if required) shall be omitted for a width of 18" (500 mm) of the surface and a strip of insulating paper laid thereon before waterproofing is applied.

**815.05 Method of Measurement.** Membrane Waterproofing will be measured by the square foot (square meter). The area for measurement will be the entire finished surface area actually covered but shall not exceed the limits shown on the plans or authorized by the Engineer.

**815.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square foot (square meter) for Membrane Waterproofing of the type specified, which price shall be full compensation for furnishing and applying materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Membrane Waterproofing (Type____)	Square Foot (Square Meter)

## **SECTION 816 FILTER BLANKET AND RIPRAP**

**816.01 Description.** This item shall consist of a protective layer of riprap of the type specified, placed according to these specifications, and to the line, grade, thickness, and location shown on the plans or as directed.

**816.02 Materials. (a) Stone.** Stone for filter blanket and riprap shall be obtained from an approved source and shall consist of sandstone, limestone, or other hard and durable stone that will be resistant to the action of air and water. Riprap stone shall consist of field stone or quarry stone with angular or fractured faces, weighing not less than 140 pounds per solid cubic foot (2200 kg per solid cubic meter). As an alternate to stone, steel slag from an approved source and with the same weight requirements as above may be used. Material for filter blanket and riprap shall be hard and durable and from a source with a percent of wear not greater than 45 by the Los Angeles Test (AASHTO T 96).

**(1) Filter Blanket.** Filter blanket material shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Engineer, and shall consist of sand, gravel, crushed stone, or steel slag, reasonably well graded from coarse to fine according to the following gradation requirements:

<b><u>SIEVE SIZE, (mm)</u></b>	<b><u>PERCENT PASSING</u></b>
2" (50 mm)	100
#4 (4.75 mm)	25-65
#200 (0.075 mm)	0-12

In lieu of the material described above, material conforming to the grading requirements of Section 303 for Aggregate Base Course, Class 4, may be used.

**(2) Dumped Riprap.** Dumped riprap shall be reasonably free of fines and reasonably well graded between the maximum and minimum rock sizes so as to produce a minimum of voids. In

general, the maximum piece size shall be not greater than 18" (0.5 m) in any dimension and approximately 50% of the material shall consist of pieces weighing 35 pounds (15 kg) or more.

Broken concrete conforming to the above requirements may be used in lieu of dumped riprap when specified on the plans or approved by the Engineer. Broken concrete material shall be free of protrusions of reinforcing steel.

**(3) Foundation Protection Riprap.** Pieces of stone or steel slag for foundation protection riprap shall range in size from approximately 35 pounds to 300 pounds (15 kg to 140 kg) each, and shall be graded from coarse to fine in such manner as to produce a minimum of voids.

**(b) Concrete.** Concrete for concrete riprap shall comply with the requirements of Section 802 for Class A concrete. The Contractor shall perform quality control and acceptance sampling and testing in accordance with Subsection 802.06.

**(c) Sacked Sand-Cement.** Sand shall comply with the fine aggregate requirement of Subsection 802.02(b). Cement shall conform to Subsection 802.02(a). Water shall conform to Subsection 802.02(d).

**(d) Reinforcing.** Reinforcing steel for concrete riprap, unless otherwise specified, shall be 6" x 6" W3 x W3 (150 mm x 150 mm MW19 x MW19) welded wire fabric complying with the requirements of Subsection 804.02(b).

**(e) Synthetic Fiber Fabric.** A synthetic fiber geotextile fabric complying with the requirements of Subsection 625.02, Type 5 may be used as a filter blanket under dumped riprap in lieu of a granular filter blanket material.

**(4) Dumped Riprap (Grouted).** Stone for dumped riprap shall meet the requirements for Dumped Riprap in (2) above, except that the pieces shall range in size from approximately 12" (300 mm) and 24" (600 mm) in any dimension, with the interstices filled with stone spalls and grouted with cement grout. The grout filler shall be composed of a mixture of one part portland cement and three parts sand, mixed with water to produce a workable consistency. The amount of water used shall be approved by the Engineer.

**816.03 Construction Requirements. (a) General.** Prior to placing filter blanket and riprap, the slopes shall be shaped as shown

on the plans. When rock or hard shale is encountered at the toe of the slope, the riprap shall be keyed into this material at least the depth of the riprap.

**(b) Filter Blanket.** Granular filter blanket material shall be spread uniformly on the previously prepared and approved surface to the thickness and location shown on the plans. Placement of the material by methods that will cause segregation or cause damage to the surface will not be permitted. Compaction of filter blanket will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.

When fabric is used in lieu of granular material, it shall be placed directly on the prepared surface. Fabric sections may be placed vertically or horizontally on the slope. Adjacent fabric sections shall be joined by overlapping a minimum of 2' (0.6 m) at the edges and pinning the overlapped strip with U-shaped wire pins, single shaped steel pins with metal disc heads, or similar fasteners. The fasteners shall be 6" (150 mm) or more in length and shall hold the fabric firmly in place. Fasteners shall be inserted through both strips of overlapped fabric at intervals of approximately 4' (1.2 m) along the overlap. Additional pins shall be installed as necessary to prevent displacement of the fabric.

Fabric shall be overlapped in the direction of water flow. The fabric shall be turned down and buried approximately 12" (0.3 m) deep at the exterior limits.

No construction equipment will be permitted directly on the fabric.

**(c) Dumped Riprap.** Stone, broken concrete, or steel slag for dumped riprap shall be placed in such a manner as to produce a reasonably well graded mass of rock with the minimum practicable percentage of voids and shall be constructed to the lines and grades shown on the plans or as directed by the Engineer. Material shall be placed in such a manner as to avoid displacing the underlying material. The larger pieces shall be well distributed throughout the entire mass and the finished riprap shall be free from objectionable pockets of small or large pieces. Hand placing, to a limited extent, may be required, but only to the extent necessary to secure the results specified above. Placing riprap by dumping into chutes or by similar methods likely to cause segregation will not be permitted.



Riprap stone or steel slag shall not be deposited in a manner that will cause damage to the filter blanket. Any damage to fabric during placement of riprap shall be corrected by the Contractor at no cost to the Department prior to proceeding with the work. Damaged fabric shall be repaired by placing a piece of fabric large enough to cover the damaged area and overlapping and pinning according to Subsection 816.03(b).

Dumped riprap for locations designated on the plans for detours shall be constructed to the lines and dimensions shown on the plans and in accordance with the provisions above except that:

- Synthetic fiber fabric shall be used in lieu of granular filter blanket material.
- No toe excavation, as shown in the standard drawings, will be required.
- Dumped riprap and synthetic fiber fabric shall be placed immediately after the detour embankment is constructed. The placement of any base material or pavement will not be permitted on the detour until the riprap has been placed on the detour slopes and approved by the Engineer.

Removal of the riprap and filter fabric after the detour is no longer needed will be measured and paid for as Unclassified Excavation under Section 210. Upon removal, salvaged riprap that meets the requirements of Subsection 816.02 will be paid for when reused in other areas which require the utilization of riprap.

**(d) Concrete Riprap.** Concrete for riprap shall be cast in place as shown on the plans. Except as modified herein, construction shall conform to Section 802 with a minimum concrete slump of 1" (25 mm) permitted.

Excessive cutting, washing, or other damage to the slope shall be restored before placing the concrete, using mechanical tampers to obtain compaction according to the requirements of Subsection 210.10. Surfaces of the slopes and toe walls shall be moist when the concrete is placed.

Splices in any required wire mesh fabric reinforcement shall be lapped at least 6" (150 mm). At the edge of the riprap, the wire mesh shall not be less than 1" (25 mm) nor more than 3" (75 mm) from the edge of the concrete, and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

Reinforcement shall be properly supported throughout the placement of concrete to maintain its correct vertical position, according to Subsection 804.06.

Concrete riprap shall be placed in strips of dimensions as shown on the plans. When not designated on the plans, the concrete shall be placed in alternate vertical strips with the remaining strips being filled in later. The width of strips shall be 5' (1.5 m) with 1/4" (6 mm) transverse dummy grooves on 5' (1.5 m) centers for the entire length of the strip. The joints between strips shall be normal to the slope and shall be cold joints without filler. A 1/2" (12 mm) premolded joint filler shall be placed immediately adjacent to all fixed construction before placing the concrete.

After the concrete has been placed and consolidated to the dimensions specified, and after it has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to a reasonably smooth and uniform surface. Curing shall be according to Subsection 802.17. Weep holes are to be provided as shown on the plans or as directed by the Engineer.

**(e) Foundation Protection Riprap.** Stone or steel slag shall be carefully dumped to ensure reasonable conformance with the thickness and dimensions as shown on the plans or as directed by the Engineer.

**(f) Sacked Sand-Cement Riprap.** Sand and cement for Sacked Sand-Cement riprap shall be mixed mechanically in the proportion of 15% cement to sand, measured by weight, and shall be mixed to a uniform color.

After the mixing has been completed, the sand and cement shall be placed in suitable fabric sacks of approximately 1 cubic foot (0.03 cubic meter) capacity. The sacks shall be filled, in general, to not over 3/4 full and shall be securely sewn or stapled to form a straight edge. Tying of sacks to form a knot will not be permitted.

Starting at the toe, the prepared sacks of sand-cement shall be bedded on the surface upon which they are placed with the sewn or stapled ends all in the same direction. Sacks shall be placed in horizontal courses and successive courses shall overlap preceding joints. The sacks shall be rammed and packed against each other and tamped to provide a uniform surface. Immediately after tamping, the sacked sand-cement shall be thoroughly wetted. Water for wetting shall not be applied under excessive pressure.

Sacked sand-cement riprap shall have an average thickness of 9" (225 mm) when in final position, unless otherwise specified on the plans.

**(g) Dumped Riprap (Grouted).** Dumped Riprap shall be placed in accordance with (c) above. The stones shall be thoroughly wetted immediately prior to applying the grout. The grout shall be thoroughly worked into the voids as the grout is deposited on the surface of the riprap. The stones shall then be brushed to expose the top surfaces. The grouted riprap shall then be cured in accordance with Subsection 501.05(l).

**816.04 Method of Measurement.** Filter Blanket and riprap will be measured according to the units of measure herein specified. Quantities shown on the plans for Filter Blanket, Dumped Riprap, Concrete Riprap, Sacked Sand-Cement Riprap, and Dumped Riprap (Grouted) will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors, in which case the entire in-place quantity at the affected location(s) will be measured, with measurement being made parallel to the surface. Dumped Riprap, Concrete Riprap, Sacked Sand-Cement Riprap, and Dumped Riprap (Grouted) will be measured by the cubic yard (cubic meter). Filter Blanket will be measured by the square yard (square meter). Foundation Protection Riprap will be measured by the ton (metric ton).

**816.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Filter Blanket; per cubic yard (cubic meter) for the items Dumped Riprap, Concrete Riprap, Sacked Sand-Cement Riprap, and Dumped Riprap (Grouted); or per ton (metric ton) for Foundation Protection Riprap, which prices shall be full compensation for furnishing materials, including reinforcing steel when specified on the plans; for preparation of the slope; for excavation including toe trench and backfill; for performing mix designs, and quality control and acceptance sampling and testing for concrete riprap; for placing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will not be made for excess thickness of material nor for material required to replace embankment lost due to untimely completion of the filter blanket and/or riprap.

In cases where the combined specific gravity of the material used for Foundation Protection Riprap exceeds 2.80, the quantity of material will be adjusted for payment by multiplying the quantity of the material used by a specific gravity of 2.80 and dividing by the higher specific gravity.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Filter Blanket	Square Yard (Square Meter)
Dumped Riprap	Cubic Yard (Cubic Meter)
Concrete Riprap	Cubic Yard (Cubic Meter)
Foundation Protection Riprap	Ton (Metric Ton)
Sacked Sand-Cement Riprap	Cubic Yard (Cubic Meter)
Dumped Riprap (Grouted)	Cubic Yard (Cubic Meter)

## **SECTION 817 TIMBER BRIDGES**

**817.01 Description.** This item shall consist of furnishing and erecting untreated or treated lumber and timber and hardware for bridges according to these specifications, and conforming to the lines, grades, dimensions, and details shown on the plans. Timber piling, when required or used, shall be as specified in Section 818.

**817.02 Materials. (a) Structural Lumber and Timber.**

**(1) Species of Wood.** The standard commercial names of the species of woods recognized in these specifications are as follows:

Fir, Douglas (Coast)	Oak, White, Includes:
Fir, Douglas (Inland)	White Oak
Oak, Red, includes:	Chestnut Oak
Red Oak	Post Oak
Black Oak	Bur Oak
Southern Red Oak	Overcup Oak
Water Oak	Swamp Chestnut Oak
Willow Oak	Swamp White Oak
Scarlet Oak	Live Oak
Pin Oak	Chinquapin Oak
Shumard Red Oak	Pine, Southern Yellow, includes:
Swamp Red Oak	Loblolly, Longleaf,
Blackjack Oak	Pitch, Pond, Shortleaf,
Laurel Oak	and Slash Pine
Texas Red Oak	

**(2) Limitations of Use.** Structural lumber and timber shall not be used without pressure impregnation of a preservative, unless otherwise provided on the plans or in the Special Provisions. Treated timber shall be Southern Yellow Pine or Douglas Fir.

**(3) Grading and Dimensions of Structural Timber.** Structural lumber and timber shall meet the grading and numerical stress value requirements as shown in Table 817-1.

No boxed heart pieces of Douglas fir or redwood shall be used in stringers, floor beams, caps, columns, 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 (center) lies entirely inside the four faces.

There will be no heartwood requirements for lumber and timber that is to be pressure treated, and the amount of sapwood will not be limited. Heartwood requirements for untreated lumber and timber will be designated on the plans or in the Special Provisions.

The timber sizes shown on the plans are nominal sizes unless otherwise noted.

**(4) Timber Preservatives.** Unless otherwise specified on the plans, the preservative furnished according to AWPA Standard UI shall be one of the following:

- Creosote
- Creosote solution
- Creosote-petroleum solution
- Chromated copper arsenate
- Ammoniacal copper zinc arsenate (Chemonite)
- Pentachlorophenol

**(b) Steel Items.** Bars, plates, and structural shapes shall be of steel conforming to the requirements of AASHTO M 270, Grade 36 (250), except that Charpy V-Notch Impact tests are not required.

**(c) Castings.** Castings shall conform to the current edition of the following specifications:

Steel - AASHTO M 103, Grade 65-35 (450-240), Class 2.

Chromium Alloy - AASHTO M 163, Grade CH 10.

Gray Iron - AASHTO M 105, Class No. 30B.

Malleable - ASTM A 47 (A 47M), Grade No. 24018.

**(d) Hardware.** Machine bolts, drift-bolts, and dowels may be either wrought iron or medium steel. Washers may be cast-ogee or malleable castings, or shall be cut from medium steel or wrought iron plate, when specified.

Nails, spikes, bolts, dowels, washers, and lag screws shall be of standard form and may be non-galvanized unless otherwise specified. Galvanizing, when required, shall be according to AASHTO M232 or ASTM B695, Class 40 or 50.

**(e) Timber Connectors.** Timber connectors may be one of the following types: split ring, toothed ring, shear plate, claw plate, or spike grid. The split ring and the shear plate shall be installed in precut grooves as recommended by the manufacturer. The toothed ring and the spike grid shall be forced into the contact surfaces of the timbers and joined by means of pressure equipment. Connectors of this type at a joint shall be embedded simultaneously and uniformly. The claw plate shall be installed by a combination of both methods, partially by precut grooving and partially by pressure. Other connectors may be furnished when approved by the Engineer.

**(f) Paint for Non-galvanized Steel Items and Hardware.** When specified, the exposed surfaces of all non-galvanized steel items and hardware shall be painted according to Section 638.

(g) **Pitch.** Pitch shall be Type I Coal Tar Bitumen (Pitch) conforming to ASTM D450.

**817.03 Storage and Protection of Materials.** Lumber and timber shall be stacked on supports at least 12" (0.3 m) above the ground surface to avoid absorption of ground moisture. Untreated lumber and timber shall be open-stacked and stripped to permit free circulation of air between the tiers and courses. When required by the Engineer, untreated material shall be protected from the weather with a suitable cover.

Treated lumber and timber shall be close-stacked to prevent warping or sagging. The ground underneath and in the vicinity of material stacks shall be kept reasonably clear of vegetation.

**817.04 Preservative Treatment of Lumber and Timber.**

(a) **General.** The treatment of lumber and timber shall meet the applicable requirements of the current edition of the AWWA, Standards U1.

(b) **Inspection.** Materials and processes used in the manufacture of treated lumber and timber shall be subject to inspection at the manufacturer's plant.

The Engineer reserves the right to inspect material after delivery and to reject material that does not comply with the requirements of the applicable specifications.

(c) **Handling.** Treated lumber and timber shall be carefully handled to prevent marring or damage. Peaveys, pikes, tongs, or hooks shall not be used.

(d) **Cutting, Framing, and Boring.** Cutting, framing, and boring of treated lumber and timber shall be accomplished before treatment insofar as is practicable.

(e) **Cuts, Abrasions, and Bolt Holes.** Cuts, abrasions, and bolt holes in treated lumber and timber, after having been carefully trimmed, shall be covered with 2 applications of a mixture of 60% creosote oil and 40% roofing pitch, or brush coated with at least 2 applications of hot creosote oil and covered with hot roofing pitch.

(f) **Temporary Attachment.** When forms or temporary braces are attached to treated timber, any resulting holes shall be filled with galvanized or creosote covered nails or spikes or filled and plugged as required for bolt holes.

**TABLE 817-1  
GRADES OF BRIDGE LUMBER AND TIMBER  
AND REFERENCE SPECIFICATIONS**

USE	SURFACING	NOMINAL SIZE* inches (mm)	**DOUGLAS FIR	***SOUTHERN PINE	****OAK RED AND WHITE
Filler Block Railing Bracing Bulkhead Decking***** Truss Members	S4S S4S None S2E S1S1E S4S	thickness: 2" (50) to 4" (102) width: 5" (127) or more	Structural Joists & Planks, No. 1 or better, to meet 1500f (10.3f), Par. 123-b	Structural Joists & Planks, No. 1 or better, to meet 1450f (10.0f), Par. 312	Sound, Square Edge
Posts-Rail Wheel Guard	S4S S1S1E	5" x 5" (127 x 127) and larger	Posts & Timbers, Dense No. 1 Structural or better, to meet 1400f (9.7f), Par. 131-bb	Timbers, No. 1 or better, to meet 1350f (9.3f), Par. 402	Sound, Square Edge
Columns Caps	None None	5" x 5" (127 x 127) and larger	Posts & Timbers, Select Structural or better, to meet 1550f (10.7f), Par. 131-a	Timbers, No. 1 Dense or better, to meet 1550f (10.7f), Par. 402.1	Sound, Square Edge
Stringers	S2E	thickness: ≥ 5" (127) width: 2" (50) or more greater than thickness	Beams & Stringers, Select Structural or better, to meet 1600f (11.0f), Par. 130-a	Timbers, Dense Select Structural or better, to meet 1600f (11.0f), Par. 401.1	Sound, Square Edge

f = stress in extreme fiber in bending, psi (MPa)

\*Dressed (after surfacing) widths and thickness shall conform to Table 817-2 and shall comply with standard dressing rules.

\*\*Standard Grading Rules for West Coast Lumber, West Coast Lumber Inspection Bureau No. 16.

\*\*\* Standard Grading Rules for Southern Pine Lumber, Southern Pine Inspection Bureau No. 1.

\*\*\*\*National Hardwood Lumber Association.

\*\*\*\*\*Southern Yellow Pine Decking may also be Dense Standard Decking or better to meet 1450f (10.0f), Par. 411.



**817.05 Construction Requirements. (a) Holes for Bolts, Pins, Dowels, Rods, and Lag Screws.** Holes for drift pins and dowels shall be bored with a bit 1/16" (2 mm) less in diameter than the pin or dowel to be used.

Holes for machine bolts shall be bored with a bit the same diameter as the bolt. Holes for rods shall be bored with a bit 1/16" (2 mm) greater in diameter than the rod. Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread.

Countersinking shall be accomplished wherever smooth faces are required. Horizontal recesses formed for countersinking shall be treated as specified in Subsection 817.04(e).

**(b) Bolts and Washers.** A washer, of the size and type specified, shall be used under all bolt heads and nuts that will come in contact with wood.

After tightening, nuts and bolts shall be effectively locked by burring the threads or other approved methods.

**(c) Framing.** Lumber and timber shall be accurately cut and framed to a close fit so that joints will have even bearing over the entire contact surfaces. Mortises shall be true to size for their full depth and tenons shall fit snugly. No shimming will be permitted in making joints and no open joints will be accepted.

**(d) Framed Bents. (1) Concrete Pedestals.** Concrete pedestals for the support of framed bents shall be carefully finished to provide even bearing. Dowels of not less than 3/4" (19 mm) diameter, projecting at least 6" (150 mm) above the tops, shall be set in the pedestals for the anchoring of sills or columns.

**(2) Sills.** Sills shall have true and even bearing on piles or pedestals. They shall be drift-pinned to mud sills or piles with pins of not less than 3/4" (19 mm) diameter that extend at least 6" (150 mm) into the piles. When possible, earth shall be removed from contact with sills to provide for free circulation of air.

**(3) Columns.** Columns shall be fastened to pedestals with dowels of not less than 3/4" (19 mm) diameter, extending at least 6" (150 mm) into the columns.

Columns shall be fastened to sills by one of the following methods:

- a. By dowels of not less than 3/4" (19 mm) diameter, extending at least 6" (150 mm) into the columns and sills.
- b. By drift-pins of not less than 3/4" (19 mm) diameter driven diagonally through the base of the post and extending at least 9" (225 mm) into the sill.

**(e) Caps.** Caps shall be placed, with ends aligned, in a manner to provide even and uniform bearing over the tops of the supporting columns or piles. Caps shall be secured by drift-pins of not less than 3/4" (19 mm) diameter, extending at least 9" (225 mm) into the columns or piles. The drift-pins shall be approximately in the center of the column or pile.

**(f) Bracing.** The ends and intermediate intersections of bracing shall be bolted through the pile, column, or cap with a bolt of not less than 5/8" (16 mm) diameter.

**(g) Stringers.** Stringers shall be sized at bearings and shall be placed in position so that knots near the edges will be in the top portions of the stringers.

Exterior stringers may have butt joints with the ends cut on a taper. Interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. The lapped ends of untreated stringers shall be separated at least 1/2" (12 mm) for the circulation of air and shall be securely fastened by drift-pins where specified. Exterior and alternate stringers shall be securely fastened to the cap.

Cross-bridging between stringers shall be neatly and accurately framed and securely toe-nailed with at least two nails in each end. Cross-bridging members shall have full bearing at each end against the sides of stringers. Unless otherwise specified, cross-bridging shall be placed at the center of each span.

**(h) Plank Floors.** Single ply floors shall consist of a single layer of planking supported by stringers. Two ply floors shall consist of two layers of planking supported by stringers.

Planking for the surface layer of floors shall be placed transverse or diagonal to the centerline of the bridge. For two ply floors, the lower course of planking may be placed either transverse, longitudinal, or diagonal. Planks shall be carefully graded as to thickness and laid so that the differential of two adjacent planks in the finish surface shall be no more than 1/16" (2 mm).

Planks shall be laid heart side down, with 1/4" (6 mm) openings between them for seasoned material and with tight joints for unseasoned material. Each plank of a single ply floor and each plank of the lower layer of a two-ply floor shall be spiked to each stringer or floor beam. Each plank of the surface layer of a two-ply floor shall be spiked to each stringer using long spikes. Joints shall be staggered at least 3' (1 m).

**(i) Laminated Floors.** Lamina shall be placed on edge transverse to the centerline of the roadway. Each lamina shall be spiked to the preceding lamina at each end and at approximately 18" (0.5 m) intervals with the spikes driven alternately near the top and bottom edges. The spikes shall be of sufficient length to pass through two laminas and at least half way through the third lamina.

If timber supports are used, every other lamina shall be toe-nailed to every other support. If steel supports are used, the lamina shall be securely attached by the use of approved metal clips. Care shall be taken to have each lamina vertical and tight against the preceding one with bearing evenly distributed on all the supports.

**(j) Wheel Guards and Railings.** Wheel guards and railings shall be framed according to the plans and erected true to line and grade.

Unless otherwise specified, wheel guards shall be surfaced one side and one edge (S1S1E), and rails and rail posts shall be surfaced on four sides (S4S).

Wheel guards shall be laid in sections not less than 12' (3.5 m) in length.

**(k) Painting.** Parts of a timber structure that are to be painted, including hardware, will be designated on the plans or in the Special Provisions.

**817.06 Method of Measurement.** Untreated and treated lumber and timber for bridges will be measured by the thousand feet board measure (MFBM) (cubic meter) computed from the nominal measurements according to Table 817-2. Quantities for timber, except flooring, will be computed from the dimensions shown on the plans unless changes have been authorized by the Engineer, and shall include only such timber as is a part of the completed and accepted work, and will not include cutoff or waste from

commercial lengths or sizes, or timber for erection purposes such as falsework, forms, bracing, sheeting, and other similar items.

Flooring will be measured by the thousand feet board measure (MFBM) (cubic meter) as determined by multiplying the gross floor area in square feet by the floor thickness in inches and dividing by 1000 (multiplying the gross floor area in square meters by the floor thickness in meters).

**TABLE 817-2**  
**LUMBER AND TIMBER DIMENSIONS**

<u>Nominal</u>	<u>Dressed Dry Surface</u>
2" (50 mm)	1½" (38 mm)
2½" (63 mm)	2" (51 mm)
3" (76 mm)	2½" (64 mm)
3½" (89 mm)	3" (76 mm)
4" (102 mm)	3½" (89 mm)
4½" (114 mm)	4" (102 mm)
≥5" (≥127 mm)	½" (13 mm) off

**817.07 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per thousand feet board measure (MFBM) (cubic meter) for Untreated Timber for Bridges or Treated Timber for Bridges, which price shall be full compensation for furnishing and installing materials, including hardware, connectors, painting, and preservative treatment, when specified; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Untreated Timber for Bridges	MFBM (Cubic Meter)
Treated Timber for Bridges	MFBM (Cubic Meter)

## SECTION 818

### UNTREATED AND TREATED TIMBER PILING

**818.01 Description.** This item shall consist of furnishing and driving untreated or treated timber piling according to these specifications and conforming to the lines, grades, and spacing shown on the plans.

**818.02 Materials.** Materials shall conform to the requirements of Subsection 817.02, supplemented by the following requirements.

**(a) Piling. (1) General.** Untreated timber piles may be of any species that will satisfactorily withstand driving. Treated piles shall be Southern Yellow Pine or Douglas Fir.

**(2) Quality.** Piles shall be of sound wood, free from decay or insect damage. Treated piling shall have a minimum amount of red heart. Sound knots in piles 50' (15 m) or less in length, and in the butt half of piles longer than 50' (15 m), shall be no larger than 4" (100 mm) or 1/3 of the diameter of the pile at the point where they occur, whichever is the smaller. In the tip half of length of piles longer than 50' (15 m), sound knots shall be no larger than 5" (125 mm) or 1/2 the diameter of the pile at the point where they occur, whichever is the smaller. The size of a knot shall be its diameter measured at right angles to the length of the pile. Piles may have unsound knots not exceeding 1/2 the permitted size of a sound knot, provided that the unsoundness extends to not more than 1½" (40 mm) depth, and that the adjacent areas of the trunk are not affected. Cluster knots consisting of two or more knots grouped together, the fibers of the wood being deflected around the entire unit, are prohibited. The sum of sizes of all knots in any foot (meter) of length of the pile shall not exceed six times the size of the largest permitted single knot.

Holes of 1/2" (12 mm) or less in average diameter will be permitted, provided the sum of the average diameters of all holes in any square foot (0.09 square meter) of pile surface does not exceed 1½" (40 mm).

Twist of spiral grain in any 20' (6 m) of length shall not exceed 1/2 of the circumference at the midpoint of the length measured.

Splits shall be no longer than the butt diameter. The length of any shake in the outer half of the radius of the butt of the pile, when measured along the curve of the annual ring, shall not exceed 1/3 of the circumference of the butt of the pile. The butts and tips shall be sawed square. The tips may be tapered to a point not less than 4" (100 mm) in diameter.

All piles shall be peeled by removing all of the rough bark and at least 80% of the inner bark. No strip of the inner bark remaining on the pile shall be over 3/4" (19 mm) wide and there shall be at least 1" (25 mm) of clean wood surface between any two such strips. At least 80% of the surface of any circumference shall be clean wood.

Timber to be used for piling shall be cut above the ground swell and shall taper from butt to tip. A line from the center of the tip to the center of the butt shall not fall outside of the center of the pile at any point more than 1% of the length of the pile. In short bends, the distance from the center of the pile to a line stretched from the center of the pile above the bend to the center of the pile below the bend shall not exceed 4% of the length of the bend or a maximum of 2½" (65 mm). Knots shall be trimmed flush with the body of the pile.

**(3) Dimensions.** Round piles shall have a minimum diameter at the tip, measured under the bark, as follows:

<u>Length of Pile</u>	<u>Tip Diameter</u>
Less than 40' (12 m)	8" (200 mm)
40' to 60' (12 m to 18 m)	7" (175 mm)
Over 60' (18 m)	6" (150 mm)

The minimum diameter of piles at a section 3' (1 m) from the butt, measured under the bark, shall be as follows:

<u>Length of Pile</u>	<b>Southern</b>	
	<b>Yellow Pine, Douglas Fir Diameter</b>	<b>All Other Species Diameter</b>
20' (6 m) and under	11" (280 mm)	11" (280 mm)
Over 20' to 30' (6 m to 9 m)	12" (300 mm)	12" (300 mm)
Over 30' to 40' (9 m to 12 m)	12" (300 mm)	13" (330 mm)
Over 40' (12 m)	13" (330 mm)	14" (360 mm)

The diameter of the pile at the butt shall not exceed 20" (510 mm). The diameter of a pile in cases where the tree is not exactly round shall be determined either by measuring the circumference and dividing the number of inches (millimeters) by 3.14 or by taking the average of the maximum and minimum diameters at the location specified.

**(b) Pile Head Protective Covering. (1) Sheet Zinc.** Sheet zinc shall conform to the requirements for Type II of ASTM B 69.

**(2) Fabric.** Fabric shall consist of a cotton fabric, waterproofed with a coal tar pitch saturant, conforming to AASHTO M 117.

**(3) Pitch.** Pitch shall be Type I Coal Tar Bitumen (Pitch) conforming to AASHTO M 118.

**818.03 Storage and Handling of Piles.** Storage and handling of piles shall be according to the requirements of Subsection 817.03.

**818.04 Preservative Treatment of Timber Piles.** Preservative treatment of timber piles shall be accomplished according to the requirements of Subsection 817.04.

**818.05 Driving Equipment.** Equipment for driving timber piling shall comply with the requirements of Subsection 805.07 with the exception that gravity hammers shall weigh not less than 2000 pounds (900 kg) and all hammers shall develop a total energy of not less than 6000 foot-pounds (8100 joules) per blow.

**818.06 Driving.** Timber piling shall be driven according to the requirements of Subsection 805.08.

**818.07 Defective Piles.** The determination and methods of correction of defective timber piles shall be according to the requirements of Subsection 805.06.

**818.08 Determination of Bearing Values.** The determination of bearing values for timber piles shall comply with the Method A, Empirical Pile Formulas requirements, of Subsection 805.09 with the exception that the minimum safe bearing value of timber piles shall be 20 tons (180 kN) unless otherwise specified.

**818.09 Pile Bents.** The piles for any one bent shall be carefully selected for size to avoid undue bending or distortion of the sway bracing. Care shall be exercised in the distribution of piles of varying sizes to secure uniform strength and rigidity in the bents of any given structure.

**818.10 Order Lists for Piling.** The Contractor shall furnish piles in compliance with the provisions of Subsection 805.10.

**818.11 Cutting Off Timber Piles.** Cut-offs shall be accurately made to ensure uniform bearing of the cap on the piles. Cut-offs shall be made at the elevation established by the Engineer. Piles that support timber caps or grillage shall be sawed to conform to the plane of the bottom of the superimposed structure. In general, the length of the pile above the elevation of the cut-off shall be sufficient to permit the complete removal of any material damaged by driving. Piles driven to near the cut-off elevation shall be carefully trimmed or broomed, splintered, or otherwise damaged material.

**818.12 Protecting Heads of Treated Timber Piles.** Pile heads not encased in concrete, after cutting and prior to placing the caps, shall be treated to prevent decay.

The heads of treated timber piles shall be protected by one of the following coverings:

1) Zinc Covering. The sawed surface shall be covered with 3 applications of a mixture of 60% creosote and 40% roofing pitch or thoroughly brush coated with 3 applications of hot creosote and covered with hot roofing pitch. Before placing the cap, a sheet of 12 gage zinc shall be placed on each pile head. The sheet zinc shall be of sufficient size to project at least 4" (100 mm) outside of the pile. The zinc shall be bent down, neatly trimmed, and securely fastened to the faces of the pile with large headed galvanized roofing nails.

2) Fabric Covering. The heads of piles shall be covered using a Type B membrane waterproofing according to the provisions of Section 815. The cover shall measure at least 6" (150 mm) more in dimension than the diameter of the pile and shall be neatly folded down over the pile and secured by large headed galvanized nails or by binding with not less than 7 complete turns of galvanized wire securely held in place by large headed galvanized nails and staples. The edges of the fabric projecting below the wire wrapping shall be neatly trimmed.

3) Approved Coverings. Other coverings that will provide satisfactory protection of the pile head may be used if approved in writing by the Engineer.

**818.13 Method of Measurement.** Untreated Timber Piling, Treated Timber Piling, and Timber Test Piles will be measured by the actual number of linear feet (meters) of accepted pile remaining in the finished work after all cut-offs or build-ups have been made, based upon lengths shown on the plans or established by the Engineer.

Allowance for pile cut-off, where piles have been furnished or built up according to the length shown on the plans or established by the Engineer, will be made at 50% of the cut-off length.

No allowance for cut-off will be made on piling for any length in excess of the lengths shown on the plans or established by the Engineer.



For piles furnished according to the lengths shown on the plans or established by the Engineer that are found to be too short and are spliced according to an approved detail, an allowance of 4 linear feet (1.2 m) of piling will be made for each timber pile splice in addition to the actual length of accepted pile in place.

No allowance will be made for cut-off or build-up of any portion of a pile that has been damaged, for splices made for the convenience of the Contractor, for extra length ordered for the Contractor's convenience, for cutback necessary for splicing, or for cut-off of 1' (0.3 m) or less necessary to establish uniform bearing of the cap on the piles. Cut-off material shall become the property and responsibility of the Contractor.

**818.14 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Untreated Timber Piling, Treated Timber Piling, or Timber Test Piles, which price shall be full compensation for furnishing material; for transporting; for handling; for driving, jetting, drilling, and excavation; for cut-off, splicing, and build-up; for protection of pile heads; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Untreated Timber Piling	Linear Foot (Meter)
Treated Timber Piling	Linear Foot (Meter)
Timber Test Piles	Linear Foot (Meter)

**SECTION 819 VACANT**

**SECTION 820  
CLEANING AND PAINTING EXISTING  
STRUCTURAL STEEL**

**820.01 General.** This item shall consist of cleaning and painting existing steel structures and shall include the proper preparation of the surfaces; the application, protection, and drying of the paint coatings; the protection of pedestrians and vehicular or other traffic upon, underneath, or in the vicinity of the structures; the protection

against disfigurement by flying sand, rust, and old paint particles; protection from drift, spatters, splashes, and smirches of paint or of paint materials; and protection of the environment.

Structural steel shall be cleaned and painted according to the type specified in the Contract and as outlined in these specifications.

At sites designated in the plans, the Special Protection of the Environment provisions of Subsection 820.04 will be required during cleaning of the existing structural steel. Protection of the environment during painting shall comply with the provisions of Section 638 or Subsection 807.75, as is appropriate for the paint system used.

**820.02 Paint System.** The paint system shall meet the requirements of Section 638 when Type I cleaning and painting is specified and Subsection 807.75 when Type II cleaning and painting is specified.

**820.03 Materials.** Paint materials shall meet the requirements of Subsection 638.02 when Type I cleaning and painting is specified and Subsection 807.77 when Type II cleaning and painting is specified.

**820.04 Special Protection of the Environment.** The requirements of this subsection shall apply only for those sites that are so designated in the plans. They cover the requirements for environmental protection, containment, handling, transporting, and disposing of solid wastes generated from bridge paint removal.

**(a) Pre-Work Conference.** A Pre-Work Conference will be required prior to beginning any paint removal operations. At the Pre-Work Conference, the Contractor shall submit to the Engineer the following information:

- The Contractor's name, address, and phone number.
- The designated hazardous waste transporter's name, address, phone number, owner's name, and US EPA ID Number.
- The designated hazardous waste disposal facility name and site; the Company name, address, and phone number; the name of the facility owner or manager; and the US EPA ID Number.
- The non-hazardous waste disposal facility name and site; the Company name, address, and phone number; the name of the facility owner or manager; and the US EPA ID Number.

The Contractor's operations shall comply with all governing environmental laws and regulations.

**(b) Containment Systems.** The Contractor shall provide a containment system for capturing all blasting waste during the paint removal operations. The classes of containment required will be either Class 2, 3, or 4, as defined by SSPC Publication 98-04, "Guides on Environmental Protection". The class of containment required for each individual site will be determined by the Department and designated on the plans.

The containment system shall:

- Prevent emissions of dust and debris that could pollute the ambient air, water, or soil.
- Be designed with consideration given to the proximity of the containment to other structures (e.g., houses, businesses, etc.) and to areas of public access (e.g., sidewalks, bike paths, etc.).
- Be capable of withstanding heavy winds and weather conditions that can be expected at project sites.
- Provide ventilation to minimize the health risks and provide adequate visibility to personnel working inside.
- Not prevent the flow of traffic either on or below the bridge unless provisions have been made in the plans for traffic detours.

If the Engineer determines that the containment system fails to comply with these requirements, cleaning and painting operations shall cease immediately and shall not resume until corrections to the containment system have been made. If the Contractor's operations result in contamination, the situation shall be remedied at no cost to the Department before operations are resumed. In addition, any and all fines and penalties assessed against and costs incurred by the Department will be assessed to the Contractor. The Department will not be responsible for any time delay due to the Contractor's failure to comply with these requirements.

The Contractor shall protect all storm and sanitary sewer systems from water borne solid waste contamination generated by cleaning operations.

**(c) Handling and Transporting Non-Hazardous and Hazardous Waste.** The Contractor shall handle, store, and transport both hazardous and non-hazardous solid waste according to the requirements of 40 CFR §§ 261, 262, 263, and 265; 49 CFR

§§ 172 and 177; and HM-181. The solid waste will be determined hazardous or non-hazardous according to Appendix II of 40 CFR § 268.3G by an accredited laboratory selected by the Department using Toxicity Characteristic Leaching Procedures (TCLP). Sampling and testing will be the responsibility of the Department.

The Engineer will notify the Contractor in writing of the TCLP results.

The Contractor shall be responsible for the proper storage of the solid waste at or near the bridge site until such time that it is transported to the treatment or disposal facility. Solid waste shall be secured from vandalism, theft, spillage, and damage by adjacent traffic. Solid waste shall not be stored in a flood plain. All appropriate authorizations, manifests, and certifications are to be correctly completed and signed prior to removal to the permitted landfill or hazardous waste facility.

The solid waste will be treated and disposed of according to the requirements of 40 CFR §§ 148, 264, 265, 268, and 302.

The waste shall be stored in sealable steel drums (approx. 55 gallon [200-liter] volume) or other U.S. Department of Transportation (DOT) approved containers. The containers shall be clearly marked with DOT approved labels clearly stating the Bridge Number, location, and number of containers from that site (e.g., 1 of 4, 2 of 4, 3 of 4, etc.). Information shall be provided on these labels according to 40 CFR § 262, 49 CFR § 172, 49 CFR § 177, and HM-181.

**(1) Non-Hazardous Waste.** If the TCLP tests show the solid waste to be non-hazardous, the Contractor shall dispose of the waste at the non-hazardous waste facility so designated at the pre-work conference.

The Department will provide the Non-Hazardous Waste Certification. The Certification shall be signed by the Testing Laboratory Representative, the Department's Environmental Division Representative, the Engineer, and the Contractor prior to removal of the waste from the storage site. Upon delivery to the non-hazardous waste disposal site, the Certification shall be signed by a responsible representative of that facility. The Certification shall be returned to and become the property of the Department.

**(2) Hazardous Waste.** If the TCLP tests show the waste to be hazardous, the Contractor shall dispose of the hazardous waste according to the following requirements:

The containers shall be clearly marked with DOT approved hazardous waste labels. Information shall be provided on these labels according to 40 CFR § 262 and 49 CFR § 172.

All hazardous solid waste shall be accompanied by an Arkansas Department of Environmental Quality (ADEQ) Manifest or an approved Hazardous Waste Manifest supplied by the Contractor's Treatment, Storage and Disposal (TSD) facility. Actions should follow 40 CFR § 268.7 "Land Ban Disposal Procedures".

The transporter shall also hold valid permits from all states in which the waste will travel between the storage site and the final hazardous waste disposal facility.

The properly executed original copy of the hazardous waste manifest shall be returned to and will become the property of the Department. All other copies of the manifest shall be distributed as designated on the manifest.

**820.05 Cleaning and Painting of Surfaces. (a) General.** Structural steel surfaces shall receive either Type I or Type II cleaning and painting as specified in the Contract.

**(b) Type I Cleaning and Painting. (1) Cleaning.** Cleaning shall consist of commercial blast cleaning all rusty areas of structural steel and brush-off blast cleaning of the remaining steel.

Steel surfaces shall be cleaned as follows:

- a. **Rusty and Deteriorated Steel Surfaces.** All rust shall be removed down to bare metal and the surface given a blast cleaning conforming to Steel Structures Painting Council Surface Preparation No. 6 (SSPC-SP 6) Commercial Blast Cleaning. The work shall include the removal of all rust that adheres to the steel surfaces after blast cleaning and that must be loosened by striking with a hammer or lifting with a putty knife.
- b. **Non-adherent Paint.** All paint not adhering to existing steel surfaces shall be removed to bare metal and the steel surface given a blast cleaning

conforming to SSPC-SP 6, Commercial Blast Cleaning. However, if upon removal of the top layer of non-adhering paint, a sound layer of paint adhering to the steel surface is exposed, that painted surface may be retained and cleaned as described in c. below.

- c. Existing Sound Paint. All paint found to be sound, with satisfactory bond to the existing steel surface, shall be blast cleaned to produce a surface conforming to SSPC-SP 7, Brush-off Blast Cleaning. Paint to be retained shall be blasted to a feather edge tapering back 3" (75 mm) into the existing sound paint to provide a smooth uniform surface.

**(2) Painting.** All steel surfaces shall be painted with an aluminum epoxy paint system as specified in Section 638 unless otherwise specified in the proposal and/or on the plans.

**(c) Type II Cleaning and Painting. (1) Cleaning.** Cleaning will consist of cleaning all structural steel surfaces to produce a surface conforming to SSPC-SP 10, Near-White Blast Cleaning.

**(2) Painting.** All steel surfaces shall be painted with a paint system as specified in Subsection 807.75 unless otherwise specified in the proposal and/or on the plans.

#### **820.06 Previously Cleaned and Painted Surfaces.**

**(a) Previously Cleaned Surfaces.** All steel surfaces that have been previously cleaned but left exposed allowing rust to form shall be re-cleaned and all rust removed prior to application of paint.

**(b) Previously Painted Surfaces.** All surfaces to be painted shall be clean and free of dust or other objectionable matter. Application of paint to the previously painted surface shall be within the time frame as recommended by the manufacturer. If this length of time is exceeded between the application of the various coats, the weathered surface of the preceding coat shall be cleaned or removed as required to assure good bonding.

**820.07 Cleaning the Bridge Roadway Surface.** The Contractor shall sweep clean the bridge roadway surface of each span prior to starting painting operations on that span and keep the bridge

roadway surface clean until all work of painting has been completed and accepted for each individual span.

**820.08 Traffic Control.** Prior to beginning work, the Contractor shall submit a traffic control plan to the Engineer for approval. Unless otherwise specified, the bridge and the roadway beneath the bridge shall be kept open to traffic at all times when paint is not being applied to the structure. Except as noted below, the Contractor may, with the approval of the Engineer, close the bridge or roadway to traffic for periods not to exceed 10 minutes. Following each closed period, the bridge or roadway shall be opened until traffic clears. The Contractor shall exert every effort to hold inconvenience to the traveling public to a minimum and shall make use of such flagging personnel, signs, and barricades as the Engineer may direct in the interest of safety and convenience. The use of barricades and warning signs shall be governed by Sections 603 and 604 and the MUTCD.

When cleaning or painting structures over a multi-lane highway, a minimum of one lane of traffic in each direction shall be left open

All scaffolding, ladders, and other equipment, materials, or tools that restrict vertical or horizontal clearances shall be clear of all travel ways and shoulders when not in use or protected by appropriate traffic control devices.

**820.09 Method of Measurement.** (a) Cleaning and Painting Existing Structural Steel will be measured by the ton (metric ton) of structural steel. Quantities of structural steel shown on the plans will be final. When both types of cleaning and painting existing structural steel are included in the Contract, the quantities of each type may vary depending upon field conditions and as determined by the Engineer.

(b) Disposal of all material classified as hazardous waste will be measured by the lump sum for each site and shall include the complete and proper disposal of all material from that site classified as hazardous waste.

Work required for containment, collection, and temporary storage of all waste material and for the disposal of all non-hazardous waste will not be measured or paid for separately but will be considered included in the contract unit price bid for Cleaning and Painting Existing Structural Steel.

**820.10 Basis of Payment. (a) Cleaning and Painting.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per ton (metric ton) for Cleaning and Painting Existing Structural Steel, Type I or Type II, which price shall be full compensation for cleaning the metal surfaces; for painting the structure; and for furnishing materials and all labor, equipment, tools, and incidentals necessary to complete the work.

**(b) Hazardous Waste.** Work completed and accepted and measured as provided above will be paid for at the contract lump sum price bid for Disposal of Hazardous Waste (Site No.\_\_\_\_) for each site, which price shall be full compensation for the complete and proper disposal of all hazardous waste generated at that site, including transporting the waste to the designated disposal site, and for furnishing materials and all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Cleaning and Painting Existing Structural Steel (Type ____)	Ton (Metric Ton)
Disposal of Hazardous Waste (Site No. ____)	Lump Sum

## **SECTION 821 MODIFICATION OF EXISTING BRIDGE STRUCTURES**

**821.01 Description.** This item shall consist of removal and modification of portions of existing bridge substructures and/or superstructures to accommodate the remodeling of the structures according to the plans and specifications.

**821.02 Construction Requirements.** The existing portions of the structure shall be removed to the lines and elevations shown on the plans or established by the Engineer.

When components of an existing bridge structure are to be retained and joined to the proposed work, their measurements and horizontal and vertical relationships to the proposed work shall be



verified by the Contractor. The results of the verification process shall be submitted in writing to the Engineer and Bridge Engineer before the new construction is started. If the verification process reveals that adjustments are required, recommendations for such adjustments shall be included in the submittal for approval.

The Contractor shall verify the span lengths and skew angles and report the results to the Engineer and the Bridge Engineer before shop drawings are approved.

The Contractor shall conduct removal operations in a manner that will not damage the portions of the structure to remain. Any damage caused by the Contractor shall be repaired or the damaged portion of the structure replaced at no cost to the Department.

Any inspection or engineering costs associated with the repair or replacement of the damaged portion of the structure will be assessed against the Contractor.

When removing a portion of the structure for widening, particular care shall be used in removing the deck slab and curbs so as to secure straight line cuts and vertical faces. A 1" (25 mm) deep slot shall be sawed in the top of the slab and 1" (25 mm) round holes, extending from the top of the slab to within 2" (50 mm) of the bottom side, shall be drilled at 8" (200 mm) centers along the cut line. In addition, a plane of weakness approximately 1" (25 mm) deep shall be sawed or cut with chisels at the cut line on the underside of the slab. The use of explosives in removing concrete will not be permitted.

Transverse slab bars that will extend into the new slab shall be cleaned of all concrete and laitance. Bars extending from the existing concrete shall not be cut but shall extend into the new concrete unless otherwise specified. Existing concrete surfaces shall be cleaned and wetted before placing new concrete against them.

Any dowel bars required shall be installed according to the plan details. Reinforcing steel that is to be doweled into existing concrete shall be installed into drilled holes and secured using an approved non-shrink grout or resin anchoring system listed on the QPL. The diameter of the drilled holes and the installation procedures shall be as recommended by the grout manufacturer or the resin anchoring system manufacturer.

Disposition of the material removed shall be according to Section 205.

**821.03 Method of Measurement.** Modification of Existing Bridge Structures will be measured on the lump sum basis for each bridge.

Work involved in remodeling bridge structures will be measured and paid for according to the applicable specifications for the particular items.

**821.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract lump sum price bid for Modification of Existing Bridge Structure, which price shall be full compensation for removal of the portions of the structure designated; for disposing of the material removed; for any necessary bending of existing bars; for furnishing and installing dowel bars; and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Modification of Existing Bridge Structure (Bridge No.____)	Lump Sum

## SECTION 822

### REPAIR AND OVERLAY OF CONCRETE BRIDGE DECKS

**822.01 Description.** This item shall consist of repair and overlay of concrete bridge decks as designated on the plans or as specified by the Engineer.

Bridge deck repair and bridge deck overlay shall be classified as follows:

**(a) Bridge Deck Repair. (1) Bridge Deck Repair Without Subsequent Overlay.** This item shall consist of removing unsound portions of the existing bridge deck concrete, disposing of the removed concrete, and replacing the removed volume with concrete meeting the requirements of Section 802 for Class S(AE) Concrete or Subsection 822.02. The concrete shall have a surface finish equivalent to that of the existing deck surface.

**(2) Bridge Deck Repair With Subsequent Overlay.** This item shall consist of removing unsound portions of the existing bridge deck concrete, disposing of the removed concrete, and replacing the removed volume with concrete meeting the requirements of Subsection 822.02 at the same time the bridge deck overlay is placed.

**(b) Bridge Deck Overlay.** This item shall consist of removing the existing deck concrete to a depth 1/2" (12 mm) below the existing finished surface, except as otherwise noted on the plans, disposing of the removed concrete, and overlaying with concrete meeting the requirements of Subsection 822.02. The thickness of the concrete overlay shall be measured from the elevation established for removal of the existing deck to the final surface elevation as shown on the plans or established by the Engineer.

**822.02 Materials.** (a) Coarse Aggregate shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/4" (19 mm)	100
1/2" (12.5 mm)	95-100
3/8" (9.5 mm)	40-90
#4 (4.75 mm)	0-30
#200 (0.075 mm)	0-2

**(b)** Fine aggregate, cement, water, air entraining agent, retarder, and all other materials shall conform to Section 802, except the use of Type IP cement or fly ash will not be allowed.

**(c)** The concrete mixture shall be proportioned by weight of dry materials in the ratio of: two parts coarse aggregate, two parts fine aggregate, and one part cement. The consistency range in slump shall be from 1"-2" (25 mm-50 mm). The air content range shall be 6%  $\pm$ 2%. Trial batches will be required according to Subsection 802.05(c).

**(d)** Grout for bonding the new concrete to previously placed concrete shall consist of equal parts by weight of portland cement and sand mixed with sufficient water to form a thin slurry of such consistency that it can be applied with a stiff brush or broom in a thin, even coating without running or puddling.

**(e)** The minimum compressive strength of the concrete used in bridge deck repair and overlay shall be 4000 psi (28.0 MPa) at 28

days. The Department will perform acceptance sampling and testing in accordance with Subsection 802.06.

(f) Reinforcing steel, when required by the plans, shall conform to the requirements of Section 804.

**822.03 Equipment.** The equipment used shall be subject to the approval of the Engineer and shall comply with the following:

(a) Surface preparation equipment shall be of the following types:

(1) Sawing equipment shall be capable of sawing concrete to the specified depth.

(2) Scarifying equipment shall be power operated and capable of uniformly removing the old surface to the depths required in a satisfactory manner.

(3) Sand blasting or other surface cleaning equipment shall be capable of removing rust and old concrete from the exposed reinforcement and concrete laitance from the existing concrete surface.

(4) Power driven hand tools for removal of concrete will be permitted. However, jackhammers heavier than nominal 30 pound (14 kg) class and chipping hammers heavier than nominal 15 pound (7 kg) class shall not be used. Jackhammers or mechanical chipping tools shall generally not be operated at an angle in excess of 45° measured from the surface of the deck.

(b) Placing and finishing equipment shall include a mechanical screed meeting the requirements of Subsection 802.20, equipped with sufficient vibrators, and having an effective weight to sufficiently consolidate the mixture.

The finishing machine shall be capable of forward and reverse motion under positive control. Provision shall be made for raising the screed to clear the screeded surface for traveling in reverse.

Supporting rails upon which the finishing machine travels will be required on all overlay work. The support for these rails shall be fully adjustable (not shimmed) to obtain the specified concrete profile.

When placing concrete that abuts a previously completed surface, that side of the screed that abuts the completed surface shall match

the grade of the completed surface. It will not be permissible to drill holes in the completed surface for the purpose of supporting a rail.

For bridge deck repair without subsequent overlay, the Contractor may utilize hand methods of placing and finishing concrete that produces satisfactory results.

**822.04 Preparation of Surface. (a) General.** Concrete shall be removed from areas designated on the plans or by the Engineer to the depth specified consistent with the classification for that area.

The use of hand tools may be required to remove final particles of concrete to achieve the required depth.

Immediately before applying grout in preparation for placement of new concrete, the concrete and reinforcing steel surfaces shall be sand blasted, followed by an air or water cleaning. The sand blasting shall be of such extent as to remove all dust, dirt, oil, and other foreign material, as well as any unsound concrete or laitance, from the surface and edges against which the overlay is to be placed.

**(b) Bridge Deck Repair.** Concrete shall be removed by chipping or by a combination of scarifying and chipping, except that final cleanup may require the use of hand tools. Removal for bridge deck repair without subsequent overlay shall extend to at least 3/4" (19 mm) below the bottom of the top reinforcing bars. Removal for bridge deck repair with subsequent overlay shall extend to at least the top of the top reinforcing bars. In either case, the depth removed shall extend deeper, if necessary, to remove unsound concrete. This removal may be accomplished coincidental with preparation for an overlay.

Where bond between existing concrete and reinforcing steel has been destroyed, the concrete adjacent to the bar shall be removed to a depth that will permit new concrete to bond to the entire periphery of the bar so exposed. A minimum of 3/4" (19 mm) clearance shall be required around the bar. Care shall be exercised to prevent cutting or damaging any exposed reinforcing steel.

The Engineer may require enlarging a designated portion of the deck should inspection indicate deterioration of the concrete or corrosion of the reinforcing steel beyond the limits previously designated.

**(c) Bridge Deck Overlay.** The entire existing concrete deck area shall be uniformly scarified and prepared to a depth as specified in Subsection 822.01.

The minimum thickness of concrete above the prepared surface or reinforcing steel shall be 1¾" (45 mm), but shall be greater when specified on the plans or by the Engineer.

The clearance of the screed over the prepared deck surface shall be checked as follows before concrete is placed: A filler block having a thickness 1/8" (3 mm) less than the overlay thickness shall be attached to the bottom of the screed, and with screed guides in place, the screed shall be passed over the area to be overlaid. As an alternate to passage of the finishing machine, an approved template, supported by the screed guides, may be passed over the overlay area. Where the intended clearance does not permit use of this method, a stringline or other means shall be used, subject to approval of the Engineer.

All old concrete that does not have sufficient clearance shall be removed. All reinforcing steel that does not have sufficient clearance shall be depressed and fastened down. It may be necessary to remove concrete beneath some reinforcement to permit depressing the reinforcement adequately. The minimum clear distance around these bars for placement of new concrete shall be ¾" (19 mm). Any damaged epoxy coating of existing reinforcing steel shall be repaired according to Subsection 804.05.

**822.05 Placing and Finishing Concrete.** After the surface has been cleaned, and immediately before placing concrete, a thin coating of bonding grout shall be scrubbed into the dry, prepared surface. Care shall be exercised to ensure that all areas receive a thorough, even coating and that the grout does not become dry before it is covered with concrete.

Concrete shall be placed in a continuous operation.

The overlay shall be consolidated to 98% of maximum theoretical density as determined by AASHTO T 121. All overlay concrete within 12" (0.3 m) of any edge of a placement shall be spaded, hand vibrated, or troweled, as required, to assure that density of the mix at the edge is obtained. The Engineer may require that sections of the overlay along the edge be removed in order to confirm proper consolidation and bonding of the overlay. The removal shall be accomplished by sawing and chipping or by

coring. The removal and replacement of the overlay or any part of the existing deck to make this confirmation will be at no cost to the Department.

To assure a neat junction, concrete in an overlay previously placed shall be sawed to a straight and vertical edge at longitudinal and transverse joints before the subsequent concrete is placed.

Joints between new overlay placements shall be sawed to provide a straight and vertical 1/4" x 1" (6 mm x 25 mm) joint. Joints adjacent to existing concrete, for both repair and overlay, may be 1/4" x 1" (6 mm x 25 mm) formed joints, or they may be sawed, provided a straight and vertical joint is obtained. These joints shall be prepared according to Subsection 501.05 and filled with Type 3 or 4 silicone sealer meeting the requirements of Subsection 501.02, unless otherwise noted on the plans.

Although repair is considered to begin 1/2" (12 mm) below the original concrete surface, repair concrete shall be placed monolithically with the concrete overlay.

The final finish of the overlay shall be a Class 5, Tined Bridge Roadway Surface Finish according to Subsection 802.19 unless otherwise noted on the plans.

For bridge deck repair without subsequent overlay, the above procedures for application of grout and placement and consolidation of concrete shall be followed, and the surface shall be finished to a surface finish equivalent to that of the existing deck surface.

**822.06 Curing Concrete.** Curing of the concrete shall be according to Subsection 802.17 except as modified by the following: A clear membrane curing compound shall be applied to the exposed concrete immediately after finishing. The overlay or repair shall be kept continuously wet and cured for at least 72 hours. In periods of cool weather the Engineer will extend this curing period as necessary to obtain 72 hours above 55° F (13° C).

**822.07 Limitation of Operations.** No concrete repair or overlay shall be placed when the air or deck temperature is below 40° F (4° C). The temperature of the concrete at the time of placement shall not exceed 85° F (29° C).

No preparation, placing, or finishing equipment will be operated on a previously placed concrete repair or overlay for at least 36 hours after placement.

Preparation for a repair or overlay may be started adjacent to a previously placed repair or overlay the day following its placement. If this preparation is started before the end of the normal 72 hour curing period, the work will be restricted as follows:

- 1) Sawing or other operations shall interfere with the curing process for the minimum practical time, and only in the immediate work area. The curing shall be resumed promptly.
- 2) No power driven tools heavier than a 15 pound (7 kg) chipping hammer shall be used.
- 3) Air compressors shall only be operated on the deck directly over the piers.
- 4) No loads other than necessary construction equipment will be permitted on any portion of the bridge deck that has undergone preparation prior to placement of the concrete.
- 5) No vehicles will be permitted on the finished concrete for 72 hours after placement and curing is complete.

**822.08 Quality Control and Acceptance.** Quality control and acceptance testing shall be according to the provisions of Subsection 802.06. In addition, the consolidation of the concrete shall be determined by ASTM C1040. The Department will perform acceptance sampling and testing in accordance with Subsection 802.06.

**822.09 Method of Measurement.** Bridge Deck Repair or Bridge Deck Overlay will be measured by the square yard (square meter) for the areas actually repaired or overlaid.

When Bridge Deck Repair is accomplished in conjunction with Bridge Deck Overlay, the respective items will be measured separately for the areas actually repaired and overlaid.

Reinforcing steel required by the plans in bridge deck repair and overlay will be measured and paid for according to Section 804.

If the Contractor's methods cause damage to existing sound concrete or to reinforcing steel that is designated to be retained, such damaged material shall be repaired or replaced by the Contractor at no cost to the Department.

**822.10 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit



price bid per square yard (square meter) for Bridge Deck Repair or Bridge Deck Overlay, which price shall be full compensation for removal and disposal of concrete; for preparation of the area to be repaired or overlaid; for furnishing, placing, consolidating, finishing, and curing concrete; and for all materials, forms, labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Bridge Deck Repair	Square Yard (Square Meter)
Bridge Deck Overlay	Square Yard (Square Meter)

