LOUISIANA
STANDARD SPECIFICATIONS
FOR
ROADS AND BRIDGES
1992 EDITION

STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT
BATON ROUGE

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Section 101
Definitions and Terms

101.01 ABBREVIATIONS. Wherever the following abbreviations are used in these specifications, project specifications, or the plans, they are to be construed to be the same as the respective expressions represented:

AA	Aluminum Association
AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturers Association
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
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWWA	American Water Works Association
AWS	American Welding Society
DOTD	Department of Transportation and Development (Louisiana)
EDSM	Department's Engineering Directives and Standards Manual
FAA	Federal Aviation Administration, Department of Transportation
FHWA	Federal Highway Administration, Department of Transportation
FSS	Federal Specifications and Standards, General Services Administration
ICC	Interstate Commerce Commission
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers Association
ITE	Institute of Transportation Engineers
MIL	Military Specifications
MUTCD	Manual on Uniform Traffic Control Devices (Louisiana)
NEC	National Electrical Code
NEMA	National Electric Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
QPL	Qualified Products List (DOTD)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
TIME	Transportation Infrastructure Model for Economic Development
UL	Underwriters Laboratories, Inc.

101.02 ADVERTISEMENT. A public announcement inviting bids containing the location and description of the work, time and place of opening bids.

101.03 ASSEMBLY PERIOD. Time the contractor is given to acquire approvals of required drawings, brochures and other submittals, and to begin the purchase and assembly of materials.

101.04 AWARD OF CONTRACT: Official written notice to the contractor that the Department has accepted the contractor's proposal.

101.05 BASE COURSE. The layer or layers of specified material of designed thickness constructed on the subgrade to support a surface course.

101.06 BIDDER. An individual, partnership, firm, corporation, or any acceptable combination thereof, or joint venture submitting a proposal.

101.07 BRIDGE. A structure, including supports, erected over a depression or obstruction, as water, highway, or railway, which has 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 feet between undercopings of abutments, spring lines of arches, or extreme ends of openings for multiple boxes. A bridge may include multiple pipes where the clear distance between openings is less than 1/2 the smaller contiguous opening.

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.

101.08 CALENDAR DAY. Every day on the calendar, beginning and ending at midnight.

101.09 CONTRACT. The written agreement between the Department and the contractor setting forth obligations of the parties thereunder for performance of the prescribed work.

The contract includes the invitation for bids, proposal, contract form and payment/performance/retainage bond, specifications, supplemental specifications, special provisions, general and detailed plans; also, any plan changes and supplemental agreements that are required to complete the work in an acceptable manner, including authorized extensions thereof, all of which constitute one instrument.

101.10 CONTRACT ITEM (Pay Item). A specific unit of work for which a price is provided in the contract.

101.11 CONTRACT TIME. The number of working days or calendar days allowed for completion of the contract, including authorized time extensions.

When a calendar date of completion is shown in the contract in lieu of a number of working or calendar days, work shall be completed by that date.

101.12 CONTRACTOR. The individual, partnership, firm, corporation or any acceptable combination thereof, or joint venture contracting for performance of prescribed work.

101.13 CONTROLLED ACCESS HIGHWAY. Any highway to or from which access is denied or controlled from or to abutting land or intersecting streets, roads, highways, alleys or other public or private ways.

101.14 CONTROLLING ITEM OF WORK. An item of work that should be in progress at the time, essential to the orderly completion of the work within the time limit specified, in accordance with the contractor's approved progress schedule.

101.15 CONTROL OF ACCESS. The condition where the right of owners or occupants of abutting land or other persons to access, light, air or view in connection with a highway is controlled by public authority.

Full Control: Preference is given to through traffic by providing access connections with selected public roads only and by prohibiting crossings at grade or direct private driveway connections.

Partial Control: Preference is given to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings at grade and some private driveway connections.

101.16 CULVERT. Any drainage structure under a roadway or other facility not defined as a bridge.

101.17 DEPARTMENT. The Department of Transportation and Development of the State of Louisiana.

101.18 DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT. The Louisiana Department of Transportation and Development through its offices and officers, responsible for developing and implementing programs to assure adequate, safe, and efficient transportation and other public works facilities and services in the state in accordance with Act 513 of the 1976 regular session of the State Legislature as amended by the Legislature.

101.19 DEDICATED STOCKPILE. A stockpile built for a specific project.

101.20 ENGINEER. The Chief Engineer, acting directly or through duly authorized representatives, who is responsible for contract administration including engineering supervision of the work. When the term "Chief Engineer" is used, it shall mean the Department's Chief Engineer in person.

101.21 ENGINEERING DIRECTIVES AND STANDARDS MANUAL. A set of manuals containing directives and standards of the Department.

101.22 EQUIPMENT. All machinery, equipment, tools and apparatus necessary for acceptable completion of the work.

101.23 EXTRA WORK. An item of work not provided for in the contract as awarded but found essential by the Department for satisfactory completion of the contract within its intended scope.

101.24 FALSEWORK. Temporary construction work on which a main work is wholly or partly built and supported until it is strong enough to support itself; a temporary framework used to support part or all of a structure during demolition.

101.25 FLUME. A structure used primarily for the passage of irrigation water.

101.26 HIGHWAY, STREET OR ROAD. A public way for vehicular travel, including the entire area within the right-of-way.

101.27 INCIDENTAL WORK. Work required by the contract for which no direct payment is provided.

101.28 INSPECTOR. The engineer's authorized representative assigned to make detailed inspections of contract performance.

101.29 INVITATION FOR BIDS. The advertisement for bids for all work or materials on which bids are required. Such advertisements will indicate the location and description of the work, and time and place of opening bid proposals.

101.30 LABORATORY. The Department's testing laboratory or any other testing laboratory approved by the engineer.

101.31 LOCAL STREET OR LOCAL ROAD. A street or road not in the state maintained system.

101.32 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD). The manual adopted by the Department for a uniform system of traffic control devices used on state highways.

101.33 MATERIALS. Any substances used in the work.

101.34 MATERIALS SAMPLING MANUAL. The manual used to establish and standardize construction and maintenance sampling and material acceptance requirements for the Department.

101.35 MEDIAN. The portion of a highway separating traveled ways for traffic in opposite directions.

101.36 NOTICE TO PROCEED. Written notice to the contractor to proceed with the contract work, including the date of beginning of contract time.

101.37 PARISH. The parish in which the specified work is to be done.

101.38 PAVEMENT STRUCTURE. The combination of subbase, base course and surface course placed on a subgrade across the roadbed.

101.39 PAYMENT/PERFORMANCE/RETAINAGE BOND. The approved form of security, executed by the contractor and surety, guaranteeing complete execution of the contract and supplemental agreements thereto, and payment of all legal debts, including liens and monies due the Department, pertaining to the contract.

101.40 PLAN CHANGE. A general term denoting changes to the contract and implemented by a Plan Change and/or Special Agreement Form.

101.41 PLAN CHANGE AND/OR SPECIAL AGREEMENT. The title of the standard form normally used to describe and detail changes to the contract. The document will establish reasons for the changes, specification requirements, method of measurement, basis of payment and contract time adjustments for the work affected by the changes. When approved and fully executed, the document becomes a part of the contract and a notice to proceed with the affected work.

101.42 PLANS. The contract drawings which show location, type, dimensions and other details of the prescribed work.

Standard Plans - Drawings approved for repetitive use, showing the details to be used where appropriate.

Working Drawings - Supplemental design sheets or similar data which the contractor is required to submit to the engineer, such as stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, and bending diagrams for reinforcing steel.

101.43 PROFILE GRADE. The trace of a vertical plane intersecting the top surface of the proposed wearing surface or other designed course usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

101.44 PROJECT. A specific undertaking of work as described by the plans and specifications within prescribed limits.

101.45 PROJECT ENGINEER. The engineer assigned to represent the Chief Engineer in the administration of the contract.

101.46 PROJECT NUMBER. A number used to identify the project.

101.47 PROPOSAL. The offer of a bidder, on the prescribed form, to perform the stated work and to furnish the labor and materials at the prices quoted.

101.48 PROPOSAL FORM. The prescribed form on which the offer of a bidder shall be submitted.

101.49 PROPOSAL GUARANTY. The required security furnished with a bid.

101.50 QUALIFIED PRODUCTS LISTS. Lists maintained by the Department's Materials and Testing Section for products which do not lend themselves to the preparation of meaningful specifications, or for which repetitive full testing is too time consuming or expensive to be practical for routine project control.

Qualification of a product is not blanket approval for its use, since qualified products are subject to certification or acceptance or verification testing as outlined in the Department's Materials Sampling Manual.

101.51 RIGHT-OF-WAY. Land, property or interest therein, acquired for or devoted to transportation purposes.

101.52 ROADBED. The graded portion of a highway within the top of the side slopes, prepared as a foundation for the pavement structure including the shoulder.

101.53 ROADSIDE. The area adjoining the outer edge of the roadway. Extensive areas between roadways of a divided highway may also be considered roadside.

101.54 ROADSIDE DEVELOPMENT. Those items necessary to the complete highway which provide for preservation of landscape materials and features; rehabilitation and protection against erosion of areas disturbed by construction through seeding, sodding, mulching and placing of other ground covers; and suitable planting or other improvements to increase the effectiveness and enhance the appearance of the highway.

101.55 ROADWAY. The portion of a highway within the limits of construction.

101.56 SECRETARY. The Secretary for the Louisiana Department of Transportation and Development.

101.57 SERVICE ROAD OR FRONTAGE ROAD. A street or road on the side of the mainline roadway for service to abutting property and adjacent areas, and for control of access.

101.58 SPECIAL PROVISIONS. Additions and revisions to the standard and supplemental specifications covering conditions applicable to the project.

101.59 SPECIFICATIONS. The compilation of provisions and requirements for the performance of prescribed work.

Standard Specifications - A book of specifications for general application and repetitive use.

Supplemental Specifications - Additions and revisions to the Standard Specifications.

Project Specifications - All Standard Specifications, Supplemental Specifications, Special Provisions and other provisions applicable to the project.

101.60 SPECIFIED. Set forth or stipulated in the plans or specifications or elsewhere in the contract such as, materials, equipment or methods.

101.61 STATE. The State of Louisiana, acting through its authorized representative.

101.62 STRUCTURES. Bridges, culverts, catch basins, junction boxes, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other similar features encountered in the work.

101.63 SUBBASE. The layer or layers of specified material placed on a subgrade to support a base course.

101.64 SUBCONTRACTOR. An individual, partnership, firm, corporation, or any acceptable combination thereof, or joint venture, to which the contractor sublets part of the work.

101.65 SUBGRADE. The surface upon which the pavement structure, including shoulders, are constructed.

101.66 SUBGRADE LAYER. The surface layer of the subgrade which requires treatment with lime, portland cement or portland-pozzolan cement. The subgrade layer may be constructed with stone, crushed slag, recycled portland cement concrete, shell, sand-shell, or asphaltic concrete.

101.67 SUBSTRUCTURE. That part of the structure below the bearings of simple and continuous spans, skewbacks or arches and tops of footings of rigid frames, including backwalls, wingwalls and wing protection railings.

101.68 SUPERINTENDENT. The contractor's authorized representative in responsible charge of the work.

101.69 SUPERSTRUCTURE. The entire structure except the substructure.

101.70 SUPPLEMENTAL AGREEMENT. A written agreement between the contractor and the Department covering work not otherwise provided for, revisions in or amendments to terms of the contract or conditions specifically prescribed in the specifications as requiring supplemental agreements. Such supplemental agreement becomes a part of the contract when approved and properly executed.

101.71 SURETY. The corporation, partnership or individual, other than the contractor, executing a bond furnished by the contractor.

101.72 SURFACE COURSE. The top course of the pavement structure.

101.73 TECHNICIAN. The contractor's representative who shall be either certified or authorized as required in the specifications.

101.74 TESTING PROCEDURES MANUAL. The manual in which specific testing procedures used by the DOTD Laboratories are published. This manual is used to standardize testing procedures used by DOTD Laboratories.

101.75 THROUGH AND LOCAL TRAFFIC.

(a) Through Traffic - That traffic which has neither its origin nor destination within the limits of the project.

(b) Local Traffic - That traffic which has either its origin or destination, or both, within the limits of the project.

101.76 TITLES (OR HEADINGS). The titles or headings of Parts, Sections and Subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their content or interpretation.

101.77 TRAFFIC LANE. The portion of traveled way for movement of a single lane of vehicles.

101.78 TRAVELED WAY. The portion of roadway for movement of vehicles, exclusive of shoulders and auxiliary lanes.

101.79 UNDERSTOOD EXPRESSIONS. In order to avoid cumbersome repetition of expressions in the contract or plans, it is provided that whenever anything is, or is to be done, if, as, or, when or where "contemplated, required, determined, directed, 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, condemned, waived, or written consent," it shall be understood as if the expression were followed by the words "by the engineer" or "to the engineer."

101.80 WORK. The furnishing of labor, materials, services, equipment and incidentals necessary for successful completion of the project and the carrying out of all obligations imposed by the contract.

101.81 WORKING DAY. A calendar day, on which weather or other conditions not under control of the contractor will permit construction operations to proceed.

101.82 WORK ORDER. See "Notice to Proceed," Subsection 101.36.

Section 102
Bidding Requirements

102.01 PREQUALIFICATION OF BIDDERS. To qualify for submission of a bid, the bidder shall comply with all rules and regulations of the Louisiana State Licensing Board for Contractors.

102.02 CONTRACTORS' LICENSING LAWS. Attention is directed to the rules and regulations of the State Licensing Board for Contractors. Information relative to licensing may be obtained from the offices of said Board in Baton Rouge.

If the estimated project cost is $50,000 or more, only licensed contractors may receive bid forms, unless federal funds are involved. When federal funds are involved, nonlicensed contractors may receive bid forms and submit bids; however, if the contractor's bid is $50,000 or more, the successful nonlicensed bidder will be required to obtain the proper license before beginning work under the contract.

The contractor shall show his license number on the bid envelope. The contractor awarding a subcontract becomes an awarding authority; consequently, if the subcontract amount is $50,000 or more, both the contractor and subcontractor are subject to rules and regulations of the State Licensing Board for Contractors.°

102.03 CONTENTS OF PROPOSAL FORMS. Upon request, the Department will furnish prospective bidders with proposal forms. This form will state the location and description of the contemplated work, will show the approximate estimate of the quantities and kinds of work to be performed, 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, time and place of opening proposals. The form will also include any specifications or requirements which 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 must 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.

The prospective bidder will be required to pay the Department the sum stated in the Notice to Contractors for each set of plans.

102.04 ISSUANCE OF PROPOSAL FORM. The Department will refuse to issue a proposal form to a bidder for any of the following reasons:

(1) Failure of the bidder to comply with the prequalification requirements of the Department.

(2) Disqualification of the bidder in accordance with Subsection 108.04.

(3) If the bidder is in default of a contract resulting in the contract currently being completed by others.

(4) On Federal-Aid Projects, the bidder being included on the List of FHWA Suspension/Debarment Actions or having been found unacceptable for employment on Federal-Aid Projects.

(5) When requested, within 24 hours before the opening of bids.

102.05 INTERPRETATION OF QUANTITIES IN BID SCHEDULE. The quantities in the bid schedule are prepared for comparison of bids and may be approximate. Payment will be made in accordance with measurement and payment requirements for bid items and other requirements of the project specifications. Bid item quantities may be increased, decreased or omitted as provided in these specifications.

102.06 EXAMINATION OF PLANS, SPECIFICATIONS AND SITE OF WORK. The bidder is expected to examine carefully the site of the proposed work, the proposal, plans, project specifications and contract forms before submitting a proposal. Submission of a bid shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to conditions to be encountered in performing the work and as to requirements of the plans, project specifications and contract forms.

Any subsurface tests and boring data which have been compiled by the Department and furnished to the bidder shall not be considered as fully representative of subsurface conditions existing throughout the area tested nor shall they in any way be binding upon the Department.

102.07 PREPARATION OF PROPOSAL. Proposals shall be submitted on forms provided by the Department. A unit bid price shall be specified in words, either typed or printed in ink, in the spaces provided for each pay item or alternate pay item.

If no alternate items are included in the "Schedule of Items" in the proposal form, bidders shall bid on all items; if alternate items are included, bidders shall bid on all "General Items" and on one of the groups of items under each set of "Alternate Items."

Any revisions to the unit bid prices by the contractor shall be initialed by the individual signing the proposal.

The proposal shall be signed with ink by the individual; or one or more members of the partnership; or one or more members or officers of each firm representing a joint venture; or one or more officers of a corporation; or an agent of the contractor legally qualified and acceptable to the state. When the proposal is made by an individual, the individual's name and post office address shall be shown; by a partnership, the name and post office address of each partnership member; by a joint venture, the name and post office address of each member or officer of the firm represented by the joint venture; or by a corporation, the name of the corporation and business address of its corporate officials.

102.08 IRREGULAR PROPOSALS. Proposals will be considered irregular and will be rejected for any of the following conditions:

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

(2) If there are unauthorized additions, conditional or alternate bids or irregularities which make the proposal incomplete, indefinite or ambiguous as to its meaning.

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

(4) If the proposal does not contain a unit price for each pay item listed, except in the case of authorized alternate pay items.

(5) If the proposal is submitted as a bid by a bidder other than the one to whom the proposal was issued.

(6) If an owner or a principal officer of the bidding firm is an owner or a principal officer of a contracting firm which has been declared by the Department to be ineligible to bid.

(7) If the proposal guaranty does not meet requirements of Subsection 102.09.

(8) If the bidder fails to initial any revisions to the unit bid prices.

(9) If more than one proposal for the same work is received from an individual, partner, firm, corporation, joint venture or combination thereof under the same or a different name.

(10) On Federal-Aid Projects, if the Bidder's Affidavit or Noncollusion Statement and the Equal Employment Opportunity Certification forms in the proposal are not properly executed and submitted with the bid.

(11) If unit prices are obviously distorted to reflect an advantage to the contractor which would result in undue expenditure of public funds and/or overrun of total cost of project.

(12) When the plans, specifications or proposal contain an obvious error or omission which could have been cause for nonuniform bidding.

102.09 PROPOSAL GUARANTY. Each bid shall be accompanied by a proposal guaranty in an amount not less than the amount specified in the Notice to Contractors included in the proposal form. The proposal guaranty shall be either a certified check, cashier's check, postal money order, bank money order, or bid bond.

When the proposal guaranty submitted by a bidder is in the form of a bid bond, this bond shall be similar in all respects to the form of the "Bid Bond" sheet in the proposal; shall be filled out in dollars and cents; shall be signed by the authorized officer, owner or partner of the bidding firm, or each firm representing a joint venture; shall be signed by the surety's agent or attorney-in-fact; and shall be accompanied by a notarized document granting general power of attorney to the surety's signer. The bid bond shall not contain any conditions which limit the face amount of the bond.

When a bid bond is used, it shall be written either by a surety or insurance company currently qualified to do business in Louisiana and currently on the U. S. Department of the Treasury Financial Management Service list of approved bonding companies published annually in the Federal Register, or by an insurance company currently qualified to do business in Louisiana with at least an A- rating in the latest printing of the A.M. Best's Key Rating Guide to write individual bonds up to 10 percent of policyholders' surplus as shown in the A.M. Best's Key Rating Guide and which shall have a satisfactory record with the Department.

Each bid bond shall be countersigned by a person who is under contract with the surety company or bond issuer as an agent of the company or issuer, a licensed agent in Louisiana, and is residing in Louisiana.

The check, money order or bid bond shall be made payable to the Louisiana Department of Transportation and Development or as specified.

102.10 DELIVERY OF PROPOSALS. Each proposal should be submitted in the envelope furnished by the Department. The blank spaces on the envelope shall be filled in correctly to clearly indicate its content. When an envelope other than the one furnished by the Department is used, it shall be the same general size and shape and be similarly marked to indicate its contents. Proposals shall be received no later than the time and at the place specified in the Notice to Contractors. Proposals received after the time set for opening bids will be returned to bidders unopened.

102.11 WITHDRAWAL OR REVISION OF PROPOSALS. A bidder may withdraw or revise a proposal after it has been deposited with the Department, provided the request for such withdrawal or revision is received by the Department in person, in writing, or by telegram, before the time set for opening bids and at the location set forth in the Notice to Contractors.

102.12 COMBINATION OR CONDITIONAL PROPOSALS. Proposal forms may be issued for projects in combination or on separate units of the combination. The Department reserves the right to make awards on combination bids or separate bids to the best advantage of the Department. No combination bids other than those specified by the Department will be considered.

Conditional proposals will be considered only when so stated in the project specifications.

102.13 PUBLIC OPENING OF PROPOSALS. Proposals will be publicly opened and read at the time and place indicated in the Notice to Contractors.

102.14 MATERIAL GUARANTY. The successful bidder may be required to furnish samples and a statement of the origin, composition and manufacture of materials to be used in the work. These samples may be subjected to the tests provided for in the project specifications to determine their quality and fitness for the work.

102.15 WITHDRAWAL OF BIDS--MISTAKE:

(a) Criteria for Withdrawal of a Bid: The Department may allow a bidder to withdraw a bid after the scheduled time of bid opening in accordance with state law upon a determination that:

(1) A mistake was in fact made in preparation of the bid;

(2) The mistake in the bid is of a mechanical, clerical or mathematical nature and not one of bad judgment, careless inspection of the work site, or in reading the plans and specifications;

(3) The mistake is found to be in good faith and was not deliberate or by reason of gross negligence;

(4) The mistake is patently obvious on the face of the bid;

(5) The notice of the mistake, request for withdrawal of the bid by reason of the mistake, and written evidence of the mistake, is delivered to the DOTD Chief Engineer within 48 hours after the bid opening, excluding Saturdays, Sundays, and legal holidays. The written evidence of the mistake supplied to the DOTD Chief Engineer shall be duly sworn before a Notary Public as original, unaltered documents used in the preparation of the bid or any other facts relevant to the bidder's request to withdraw the bid as evidence of the existence of a mistake;

(6) The sworn, written evidence furnished to the DOTD Chief Engineer within 48 hours of the bid opening, excluding Saturdays, Sundays, and legal holidays, constitutes clear and convincing evidence of the bidder's mistake; and,

(7) The Department will not be prejudiced or damaged except for the loss of the bid.

(b) Hearing by the DOTD Chief Engineer--Prior to Contract: If a bidder files a notice of mistake along with a request to withdraw the bid, or protests in a timely manner any other matter regarding the bidding or award of the contract, the DOTD Chief Engineer, or designee, will hold a hearing within a reasonable period of time after a request has been delivered. The DOTD Chief Engineer will give the requesting bidder reasonable notice of the time and place of the hearing. The bidder may appear at the hearing and present evidence together with other facts and arguments in support of the request, except, for a request to withdraw a bid for reason of mistake, the bidder making such request will be limited to the sworn written evidence submitted within the time period prescribed in this Subsection.

(c) Action by the Secretary--Prior to Contract: The DOTD Chief Engineer will present findings to the Secretary for action on the bidder's request or protest. A determination may be made by the Secretary that a bidder meets the criteria for withdrawal of the bid as set forth in this Subsection upon the basis of the evidence supplied within the period specified in this Subsection, or for other protests of matters involving bidding or award of contracts, upon the evidence submitted to the DOTD Chief Engineer at hearing of protest. The DOTD Chief Engineer will advise the bidder of the Secretary's decision prior to the Department's consideration of award of the contract for matters involving bidding and, for matters involving award of the contract, prior to execution of the contract.

(d) Proposal Guaranty: When notice of a bid mistake and a request to withdraw the bid is made, the proposal guaranty shall continue in full force and effect until and unless there is a determination by the Secretary that the conditions of this Subsection 102.15 have been met. If the Secretary determines that a mistake occurred in the preparation of the bid in compliance with the statutory and contractual requirements, the Department shall return the proposal guaranty to the contractor.

Section 103
Award and Execution of Contract

103.01 CONSIDERATION OF PROPOSALS. After proposals are opened and read, they will be compared on the basis of the summation of the products of the quantities and the unit bid prices in the schedule of items. Results of such comparisons will be available to the public.

The right is reserved to reject proposals, waive technicalities and informalities, or advertise for new proposals.

On projects not involving federal funds, preference will be given to proposals of contractors domiciled in Louisiana over contractors domiciled in other states in accordance with existing State laws.

103.02 AWARD OF CONTRACT. The award of contract, if awarded, will be made to the lowest qualified bidder whose proposal complies with all requirements prescribed within 45 calendar days after opening proposals. However, when the contract is to be financed by bonds which are required to be sold after receipt of bids, or when the contract is to be financed in whole or in part by federal or other funds not available at the time bids are received, the time will not start until receipt of federal concurrence or concurrence of the other funding source. Award will be within 15 calendar days after the sale of bonds or receipt of concurrence in award from the federal agency or other funding source. The successful bidder will be notified by letter mailed to the address shown in the proposal that the bidder is awarded the contract.

The award of contract for projects financed either partially or entirely with State bonds will be contingent on approval by the State Bond Commission.

On projects involving federal funds the award of contract will also be contingent upon concurrence by the appropriate federal agency.

103.03 CANCELLATION OF AWARD. The Department reserves the right to cancel the award of contract at any time before execution of said contract by all parties without liability against the Department.

103.04 RETURN OF PROPOSAL GUARANTY. Proposal guaranties of unsuccessful bidders will be returned to them within 15 calendar days after opening bids. The proposal guaranty of the successful bidder will be returned after satisfactory contract/retainage bond has been furnished and the contract has been executed.

103.05 PAYMENT/PERFORMANCE/RETAINAGE BOND. At the time of execution of the contract, the successful bidder shall furnish a payment/performance/retainage bond or bonds, on the form or forms provided by the Department in a sum equal to the amount of the contract. This bond shall be similar in all respects to the form of the "Payment/Performance/Retainage Bond" sheet in the successful bidder's bid and the security shall be satisfactory to the Department.

The bond shall be written by a surety or insurance company that is currently licensed to do business in the State of Louisiana.

The bond shall be written either by a surety or insurance company currently on the U. S. Department of the Treasury Financial Management Service list of approved bonding companies published annually in the Federal Register, or a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A.M. Best's Key Rating Guide to write bonds up to 10 percent of policyholders' surplus as shown in the A.M. Best's Key Rating Guide.

Bond amount limitations specified in Louisiana Revised Statutes 38:2219(b) shall apply.

Each bond shall be countersigned by a person who is under contract with the surety company or bond issuer as an agent of the company or issuer, a licensed agent in Louisiana, and residing in Louisiana.

103.06 EXECUTION AND APPROVAL OF CONTRACT. The contract shall be signed by the successful bidder and returned, with the payment/performance/retainage bond, within 10 calendar days after the contract has been mailed to the bidder. If the contract is not executed by the Department within 30 calendar days following receipt from the bidder of the signed contract and bond, the bidder shall have the right to withdraw his bid without penalty.

103.07 FAILURE TO EXECUTE CONTRACT. Failure by the bidder to execute the contract and file acceptable payment/performance/retainage bond within 10 calendar days after the contract has been mailed to the bidder will be cause for cancellation of the award and forfeiture of the proposal guaranty which shall become the property of the Department 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 readvertised for bids, at the Department's discretion.

103.08 NOTICE TO PROCEED: The Department will issue the Notice to Proceed not later than 14 calendar days after execution of the contract unless it is in the best interest of the Department to issue an extension.

If the Notice to Proceed is not issued within 90 calendar days after execution of the contract, the contractor may at any time thereafter demand cancellation of the contract, unless an extension is approved in writing by the Department and contractor.

Section 104
Scope of Work

104.01 INTENT OF CONTRACT. The intent of the contract is to provide for performance and completion of the work described. The contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, project specifications and terms of the contract.

When an item in the contract contains a choice to be made by the contractor, the contractor shall indicate the choice to the engineer in writing.

When the project specifications reference or require the use of "manufacturer's recommendations or specifications", the contractor shall supply the engineer with a current copy of these recommendations or specifications.

104.02 ALTERATION OF THE CONTRACT. The Department reserves the right to order such alterations in quantities and plans, within the general scope of the contract, including alterations in grade and alignment, as deemed necessary or desirable in order to complete the work as contemplated. Contract items affected by such alterations shall be performed in accordance with the project specifications and payment will be made at the same unit prices as other parts of the work, except as provided in Subsections 109.03 and 109.04.

The Department reserves the right to order work not provided for in the contract whenever such work is found essential or desirable to satisfactory completion of the contract within its intended scope. Such work shall be performed in accordance with specifications and as directed. Payment for such work will be made as provided in Subsection 109.04.

The Department reserves the right to order changes in details, including changes in materials, processes and sequences, whenever such changes are in the best interests of the public or are necessary or desirable to satisfactory completion of the work. Such changes in details shall be performed in accordance with the specifications and as directed, and payment will be made as provided in Subsection 109.04. Changes ordered in details, when such changes are allowed or required by the contract, are not alterations to the contract and payment for the affected work will be made at the contract unit prices.

Alterations to the contract as provided for by this Subsection shall not invalidate the contract nor release the surety, and the contractor agrees to accept the work as altered, as if it had been part of the original contract. The contractor shall notify the surety of any alterations to the contract.

Alterations of the contract shall not involve work beyond the termini of the proposed work except as necessary to satisfactorily complete the project.

104.03 MAINTENANCE OF TRAFFIC. Reasonable provisions for local traffic through the length of the project and the life of the contract shall be made by the contractor during construction, at no direct pay.

When specified, the contractor may also be required to provide for through traffic over the entire project, or designated portion thereof, at no direct pay.

The contractor shall keep the portion of the project being used by public traffic, whether through or local traffic, in such condition that traffic (including mail delivery) will be adequately accommodated. The contractor shall furnish, erect and maintain barricades, warning signs and delineators, and shall provide flaggers and pilot cars in accordance with the plans and the MUTCD. The contractor shall also provide and maintain in a safe condition all temporary approaches or crossings, intersections with roads, streets, businesses, parking lots, residences, garages and farms, at no direct pay.

When the engineer directs additional measures for the benefit of the traveling public, payment to the contractor will be made at the contract unit prices in the contract or as provided in Subsection 109.04. The engineer will be the judge of work to be classed as additional measures.

104.04 FINAL CLEANING UP. Before final acceptance, the right-of-way, borrow and local material sources, and areas occupied by the contractor in connection with the work shall be cleaned of rubbish, excess materials, temporary structures, haul roads and equipment. All parts of the work, including property adjacent to the right-of-way, which have been damaged or rendered unsightly during the work shall be left in satisfactory condition and when required, the right-of-way shall be mowed in accordance with DOTD maintenance standards, all at no direct pay.

104.05 GUARANTEES. The contractor guarantees, by signing the contract, mechanical and electrical equipment, apparatus, materials and workmanship provided under the contract for a period of 1 year after final acceptance on projects not involving federal funds and 6 months on Federal-Aid Projects.

Instruction sheets that are required to be furnished by the manufacturer for materials, supplies, and operation shall be delivered by the contractor to the engineer prior to final acceptance of the project, with the following written warranties and guarantees.

1. The manufacturer's standard warranty for each piece of mechanical and electrical equipment or apparatus furnished under the contract.
2. The contractor's guarantee that, during the guarantee period, necessary repair or replacement of the warranted equipment or apparatus will be made by the contractor at no direct pay.
3. The contractor's guarantee for satisfactory operation of the mechanical and electrical systems furnished and constructed under the contract for the guarantee period.

Section 105
Control of Work

105.01 AUTHORITY OF THE ENGINEER. The engineer will decide all questions which arise as to quality and acceptability of materials furnished and work performed, rate of progress of the work, interpretation of plans and specifications, and acceptable fulfillment of the contract by the contractor.

The engineer will have the authority to suspend the work wholly or in part due to failure of the contractor to correct conditions unsafe for workmen 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 prosecution of the work; or for other conditions or reasons deemed to be in the public interest.

Orders to suspend the work will be in writing and will include the reasons for the suspension. The order to resume work will also be in writing.

The approval or acceptance by the engineer of submissions by the contractor will be subject to satisfactory installation and performance. Such approval shall not relieve the contractor of responsibility under the contract for successful completion of the work or responsibility for compliance with the terms and conditions of the contract.

105.02 PLANS AND WORKING DRAWINGS. Plans will show lines, grades, typical cross sections, location and details of structures, and a summary of bid items. Only general features will be shown for steel bridges. The contractor shall keep one set of plans available at the work site at all times.

Standard plans required for the work, but included only by reference, will be furnished free of charge to the contractor upon request.

Working drawings, unless included in the plans, shall be furnished by the contractor and shall consist of detailed plans required to adequately control the work. They shall include stress sheets, shop drawings, erection plans, falsework plans, form drawings, cofferdam plans, bending diagrams for reinforcing steel, proposed location of construction joints or other supplementary plans or data required of the contractor. Working drawings will be approved by the engineer and such approval will not relieve the contractor of responsibility under the contract for successful completion of the work or responsibility for details shown on the working drawings to conform to the contract.

Type and size of drawings furnished shall conform to Subsection 801.03.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS. All work and materials shall conform to the lines, grades, cross sections, dimensions and material requirements of the contract.

When the engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the contract but that reasonably acceptable work has been produced, the engineer will determine to what extent the work will be accepted and remain in place. If accepted, the engineer will document the basis of acceptance by plan change and/or special agreement. The plan change and/or special agreement will contain appropriate documentation for an adjustment in the contract price for the work or materials as necessary to support the engineer's determination. Reduced pay schedules will be used when such schedules are a part of the project specifications.

If the engineer finds the materials, work performed, or the finished product not within reasonably close conformity with the contract and have resulted in an unsatisfactory or unacceptable product, the work or materials shall be removed and replaced or otherwise corrected by the contractor to the satisfaction of the engineer at no direct pay.

If due to the contractor's negligence or selected method of operation in performing the work, the engineer deems it necessary to make changes, the contractor will be liable for the additional design cost to the Department. The amount of such design cost will be the salary cost of design personnel plus 110 percent. The amount thus determined will be deducted from payments for the work.

105.04 COORDINATION OF PLANS AND SPECIFICATIONS. These specifications, the supplemental specifications, the plans, special provisions and supplementary documents are essential parts of the contract. 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, calculated dimensions will govern over scaled dimensions; plans will govern over standard specifications or supplemental specifications; supplemental specifications will govern over standard specifications; and special provisions will govern over standard specifications, supplemental specifications, and plans.

The contractor shall take no advantage of any error or omission in the plans or project specifications. If the contractor discovers such an error or omission, he shall immediately notify the engineer. The engineer will then make such corrections and interpretations as deemed necessary to fulfill the intent of the plans and project specifications.

105.05 COOPERATION BY CONTRACTOR. The contractor will be supplied a maximum of five sets of plans and contract assemblies without charge. Additional copies will be furnished upon request at the appropriate charge for reproduction services. Full-sized plans will be furnished unless reduced (half-sized) plans are requested. The contractor shall keep one complete set of plans and other contract documents available at the worksite.

The contractor shall give the work the attention necessary to facilitate the progress thereof, and shall cooperate with the engineer, inspectors and other contractors.

The contractor shall have on the work at all times, as the contractor's agent, a competent superintendent capable of reading and understanding the plans and project specifications and experienced in the type of work being performed, who shall receive instructions from the engineer. At the pre-construction conference or upon request, the contractor shall furnish the engineer written notice of the name and home telephone

number of the superintendent. The superintendent shall have authority to execute orders or directions of the engineer without delay and to promptly supply such materials, equipment, tools, labor and incidentals as required. The superintendent shall be furnished regardless of the amount of work sublet.

The contractor shall furnish the engineer written notice of the names of persons authorized to sign for him in matters pertaining to plan changes, force account or extra work, contract time charges and other documents. No work shall commence on the project until the contractor has complied with this requirement. Such written notice shall also be furnished when a person so designated is removed and replaced.

105.06 COOPERATION WITH UTILITIES. The Department will notify all known utility companies, pipeline owners or other parties affected by the work and endeavor to have the necessary adjustments of public or private utility fixtures, pipelines and other appurtenances within or adjacent to the limits of construction made as soon as possible.

Upon award of the contract, utility companies affected will be advised by the Department of the name and address of the contractor, approximate date work will begin and other pertinent information.

Except as hereinafter provided, and regardless of whether the utility is shown on the plans or referred to in the project specifications, all water lines, gas lines, wire lines, fiber optic cables, telephone lines, cable television lines, service connections, water and gas valve boxes, light standards, cableways, signals and other utility appurtenances within construction limits which prevent completion of the contractor's work will be relocated or adjusted by the owners at no expense to the contractor. The contract will indicate utility items to be relocated, adjusted or constructed by the contractor.

Where a utility crosses or otherwise occupies an area within construction limits of the project and the utility will not have the Department's required clearance when the work is completed, it shall be the Department's responsibility to arrange for necessary relocation to the required clearance. When the required clearance will exist when the work is completed, but relocation is considered necessary by the contractor for construction purposes, the contractor shall make arrangements with the owner for any relocation or adjustment necessary to the operations at no direct pay. In such cases, upon completion of the work and prior to final acceptance, the final location of the utility will be acceptable to the Department. Nothing herein shall be interpreted to mean that the Department waives its rights to control entrance onto, or location on, its right-of-way of any utility or appurtenance.

It is agreed that the contractor has considered in the bid all permanent and temporary utility appurtenances in their present or relocated positions and that no additional compensation will be allowed for delays, inconvenience or damage sustained due to interference from the said utility appurtenances or the operation of moving them.

When the engineer determines that the contractor is experiencing significant delays in the controlling items of work because of delays by others in removing, relocating or adjusting utility appurtenances, contract time credits will be considered for such delays.

On the date stipulated in the Notice to Proceed, the contractor shall begin work in connection with fencing, clearing, grubbing, removal of structures and obstructions, and relocation and demolishing of other

structures, and shall prosecute such work to completion to avoid delays in removal or adjustment of utilities. The contractor shall cooperate with the utility companies to avoid delays in completion of work due to nonremoval or nonadjustment of utilities.

105.07 COOPERATION BETWEEN CONTRACTORS. The Department reserves the right to contract for and perform additional work on or near the work covered by the contract.

When separate contracts are let within, adjoining, or adjacent to the limits of the project, each contractor shall conduct the work not to hinder the progress of work by other contractors and shall cooperate with each other as directed.

The contractor shall arrange the work and shall place and dispose of materials being used not to interfere with the operation of other contractors within, adjoining, or adjacent to the limits of the project. The contractor shall acceptably join the work with that of other contractors and shall perform the work in proper sequence to that of the others and without causing disruption or delay to the schedule of project completion.

The contractor shall assume all liability, financial or otherwise, in connection with the contract and shall hold the Department harmless and indemnify the Department from all damages or claims that may arise because of inconvenience, delay, or loss experienced by the contractor or caused to other contractors due to the presence and operations of other contractors working within, adjoining or adjacent to the limits of the projects.

105.08 CONSTRUCTION STAKES, LINES AND GRADES.

The engineer will set construction stakes establishing lines and continuous profile grade in road work, and centerline and bench marks for bridge work, culvert work, protective and accessory structures and appurtenances as deemed necessary, and will furnish the contractor all necessary information relating to lines, slopes and grades. These stakes and marks shall constitute the field control by and in accordance with which the contractor shall establish other necessary controls and perform the work.

The contractor shall be responsible for preservation of all stakes and marks established by the engineer. When any construction stakes or marks have been carelessly or willfully destroyed or disturbed by the contractor, the cost of replacing same will be charged to the contractor and will be deducted from payments for the work.

105.09 AUTHORITY AND DUTIES OF PROJECT ENGINEER. As the direct representative of the Chief Engineer, the Project Engineer has immediate charge of the Department's engineering details of the construction project. The Project Engineer is responsible for administration of the contract. The Project Engineer shall have authority to give directions pertaining to the work and for consideration of the public, to reject defective materials and equipment, and to suspend work in accordance with Subsection 105.01. Except as permitted and instructed by the Chief Engineer, the Project Engineer is not authorized to alter or waive provisions of the contract, alter quantities, order extra and force account work, or accept any portion of the project. In no case will the Project Engineer perform any duties for or act as the representative of the contractor.

When the work is being done by force account, the Project Engineer shall direct the work as necessary. The authority to direct will include, but is not limited to, sequence and location of work; number, category and caliber of workers; number and type of equipment; and hours of work. These directions shall not relieve the contractor of responsibility to supervise the work and provide a product meeting the requirements of the contract.

105.10 DUTIES OF THE INSPECTOR. Inspectors representing the Department will be authorized to inspect all work. Such inspection extends to any part of the work and to preparation, fabrication or manufacture of materials to be used. The inspector will not be authorized to alter or waive contract provisions. The inspector will not be authorized to issue instructions contrary to the contract; however, the inspector will have authority to reject work or materials until any question can be referred to and decided by the engineer. In no case will the inspector perform any duties for, or act as the representative of the contractor.

105.11 INSPECTION OF WORK. All materials and each part or detail of the work shall be subject to inspection by the engineer. The engineer shall be allowed safe and convenient access to all parts of the work and shall be furnished with such information and assistance by the contractor as required to make a complete inspection. Such inspection will not relieve the contractor from the obligation to furnish acceptable materials or to perform all work in accordance with the contract.

If ordered by the engineer, the contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as directed. After examination, the contractor shall restore said portions of the work to the standard required by the project specifications. Should the work thus exposed 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; but, should the work so exposed prove unacceptable, the uncovering or removing, and the replacing of the covering or making good of the parts removed, will be at no direct pay.

Work done or materials used without supervision or inspection by an authorized Department representative may be ordered uncovered for examination and recovered, or removed and replaced, all at the contractor's expense.

When a unit of government or political subdivision or other public or private entity is to pay a portion of the cost of the work covered by the contract, its representatives shall have the right to inspect the work. Such inspection shall not make any unit of government, political subdivision or corporation a party to the contract and shall not interfere with the rights of either party thereunder.

105.12 INSPECTOR'S STAMP FOR SHIPMENT.

(a) Approval for Shipment: When materials requiring shop or plant inspection are ready for shipment, the Department's inspector shall affix the stamp of the Department. Each shipment piece, keg, box or bound pallet shall be marked by the inspector by direct stamping.

Application of the inspector's stamp implies that at the time of stamping it was the opinion of the inspector that the product was fabricated or manufactured from accepted materials by approved processes and

painted, if required, in accordance with the contract. Application of the inspector's stamp for shipment does not imply that the products will not be rejected by the Department if subsequently found to be defective.

(b) Rejection: The inspector will reject material and workmanship that does not conform to the contract.

Stamping of products by Department representatives shall not preclude further testing and inspection by the Department.

Defective materials and workmanship, whenever discovered, will be rejected and shall be repaired or replaced at no direct pay.
All repair procedures shall be approved.

(c) Shipment of Material Not Stamped: Materials and fabricated items subjected to shop inspection will not be accepted at the project site if they do not bear the inspector's stamp for shipment. If the products are not stamped because they were not offered for shop inspection, or were shipped after rejection at the shop, the products shall be returned to the shop for inspection and correction as necessary.

In lieu of this requirement, the Department may allow inspection to be performed at the project site at the contractor's expense.

105.13 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. Work not conforming to the contract will be considered unacceptable, unless otherwise determined acceptable under the provisions in Subsection 105.03.

Unacceptable work found to exist prior to final acceptance of the work shall be removed and acceptably replaced.

No work shall be done without lines and grades having been given by the engineer, except that work which is specified as construction layout. No payment will be made for work done contrary to instructions of the engineer, work done beyond lines shown on the plans or as given, or extra work done without authority. Work so done may be ordered removed or replaced at the contractor's expense.

Upon failure of the contractor to comply with any order of the engineer made under the provisions of this Subsection, the engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs from payments for the work.

105.14 LOAD RESTRICTIONS. The contractor, subcontractors and suppliers shall comply with legal load restrictions in hauling of materials or equipment on completed bridge structures, bases and pavements. A special permit will not relieve the contractor of liability for damage resulting from moving of material or equipment. In no case shall the legal load limits be exceeded unless permitted in writing.

Operation of equipment of such weight or height or so loaded as to cause damage or overstress to structures, roadways or other construction will not be permitted. Hauling of materials over the base or surface course under construction shall be limited as directed. The contractor shall be responsible for all damage done by hauling equipment.

105.15 MAINTENANCE DURING CONSTRUCTION. The contractor shall satisfactorily maintain the entire area within the right-of-way limits of the project, from the effective date of the Notice to Proceed until the date of final acceptance. The work shall consist of any existing roadways which are adjacent and parallel to the roadway under construction. This maintenance responsibility includes, but is not necessarily limited to,

periodic mowing and removing of debris and remains, to the satisfaction of the engineer, as well as such striping, patching and shoulder maintenance which will provide safe and convenient conditions at all times for the motoring public. The contractor shall continuously and effectively satisfy his maintenance responsibilities with such equipment and forces as may be necessary to maintain a safe and satisfactory condition for the duration of the project.

105.16 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE. If the contractor fails to comply with Subsections 104.03 and 105.15, the engineer will immediately notify the contractor in writing of such noncompliance. If the contractor fails to remedy the condition within 24 hours after receipt of the written notice, the engineer may immediately remedy the condition, and the cost thereof will be deducted from payments for the work.

When the condition requires more immediate remedy due to hazard to life, health and property, the engineer may immediately remedy the condition and the costs thereof will be deducted from payments for the work.

105.17 ACCEPTANCE.

(a) Partial Acceptance: When the contractor satisfactorily completes a portion of the project that can be used advantageously for traffic or other use, the contractor may request the engineer to make final inspection of that portion. When the engineer finds upon inspection that the portion has been completed in compliance with the contract, the engineer may accept that portion as being completed and the contractor will be relieved of further responsibility for that portion and from further liability to the public.

Partial acceptance of a project will not be made until the portion being accepted has been completed in its entirety, including all safety devices, signs and striping. When partial acceptance is made, the terms of acceptance, including the responsibilities of all parties and any allowance of additional contract time, shall be set forth in a plan change, mutually agreed to by the engineer and the contractor, with concurrence of any unit of government, political subdivision or corporation, including the contractor's surety, having monetary interest in the work. Such partial acceptance shall not void or alter any terms of the contract, except as set forth in the plan change.

(b) Final Acceptance: Upon notice from the contractor of presumptive completion of the entire project, the engineer will make an inspection. When the work provided for in the contract is found satisfactorily completed, that inspection will constitute the final inspection. The engineer will make final acceptance and notify the contractor in writing of this acceptance as of the date of final inspection.

When the inspection discloses any work as being unsatisfactory, the engineer will give the contractor instructions for correction of same. The contractor shall immediately comply with such instructions. Upon correction of the work, another inspection will be made which will constitute final inspection provided the work has been satisfactorily completed. In such event, the engineer will notify the contractor in writing of this acceptance as of the date of final inspection.

105.18 CLAIMS FOR ADDITIONAL COMPENSATION. If the contractor deems that additional compensation is due for work or material not covered in the

contract or not ordered as extra work, 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. Claims shall conform to the requirements of EDSM III.1.1.28. If such notification is not given and the engineer is not afforded proper facilities by the contractor for keeping account of actual cost, the contractor 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 as aforesaid shall not be construed as proving or substantiating the validity of the claim. If the claim, after consideration by the Chief Engineer, or judicial determination is found to be just, payment will be made as specified in Subsection 109.04 Nothing in this Subsection shall be construed as establishing any claim contrary to Subsection 104.02.

Section 106
Control of Materials

106.01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS. Materials used in the work shall meet all quality requirements of the contract. To expedite inspection and testing of materials, the contractor shall notify the engineer of his proposed sources of materials prior to delivery. With written authorization, 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 or make necessary changes to provide acceptable materials.

106.02 LOCAL MATERIAL SOURCES.

(a) Designated Sources: Possible sources of local materials may be designated in the plans or specifications. The quality of material in such deposits will be acceptable in general, but the contractor shall determine the amount of equipment and work required to produce a material meeting specifications. It shall be understood that it is not feasible to ascertain from samples the limits for an entire deposit and that variations are to be expected. The engineer may order procurement of material from any portion of a deposit and may reject portions of the deposit as unacceptable.

The Department may acquire and make available to the contractor the right to take materials from the sources designated in the plans or specifications, with the right to use such property as specified for plant site, stockpiles or haul roads.

When the contractor desires to use material from sources other than those designated, the contractor shall acquire the necessary rights or permits to take materials from the sources and shall pay all costs related thereto, including any which may result from increased haul length. All costs of exploring and developing such sources shall be borne by the contractor. Use of material from other than designated sources will not be permitted until representative samples taken by the engineer have been approved and written authority is issued for the use thereof.

(b) Contractor Furnished Sources: When material deposits are not designated in the plans or specifications, the contractor shall provide sources of acceptable material. When sources of materials are provided by the contractor, the Department may assume the cost of processing samples to determine suitability of material.

(c) Use of Materials Found on the Work: The contractor, with written approval, may use on the project such stone, gravel, sand, topsoil or other material determined acceptable by the engineer found in the 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. The contractor shall replace at no direct pay with acceptable material all removed material which was needed for

embankments, backfills, approaches or otherwise. No charge for materials so used will be made against the contractor. The contractor shall not excavate or remove material from within the right-of-way which is not within construction limits, as indicated by slope and grade lines, without written authorization from the engineer. If authorization is obtained, payment will not be made for excavation beyond slope and grade lines, nor will payment be made for any required replacement.

Materials from existing structures may be used temporarily by the contractor in erection of new structures. Modification of such material will not be permitted without written approval.

Prior to requesting the borrow pit to be bored, the contractor shall furnish the Department a written agreement with the property owner to allow the Department access to the property. The written agreement shall also state that the contractor has agreed to purchase the borrow material from the property owner for this particular site if the material meets contract specifications. A separate agreement shall be obtained from each property owner through which access will be necessary.

Sites from which material has been removed shall, upon completion of the work, be left in an acceptable condition.

Unless otherwise authorized in writing, borrow pits, gravel pits and quarry sites shall be located at least 300 feet from the right-of-way.

When sources of borrow are located adjacent to a stream or river listed on the National System of Wild and Scenic Rivers or the Louisiana Natural and Scenic Rivers System, borrow pits, and any stockpiled materials shall be located at least 300 feet from the natural stream or river bank.

106.03 SAMPLES, TESTS, CITED SPECIFICATIONS. Materials will be inspected, tested and approved before incorporation in the work. Work in which untested and unapproved materials are used shall be performed at the contractor's risk. Payment will not be made for materials found to be unacceptable and unauthorized and, when directed, shall be removed at no direct pay. Sampling and testing will be performed in accordance with the cited standard method of the Department's Materials Sampling Manual at the contractor's risk. Payment will not be made for materials found to be unacceptable and unauthorized and, when directed, shall be removed at no direct pay. Sampling and testing will be performed in accordance with the cited standard method of the Department's Materials Sampling Manual and Testing Procedures Manual; if not contained therein, by AASHTO methods. If a procedure is not available in AASHTO methods, the ASTM procedure will be used, except for any resampling or retesting procedures included therein. Resampling or retesting procedures shall be as determined by the Department's Materials Engineer Administrator. Sampling and testing procedures not contained in the above publications shall be as determined by the engineer. All procedures will be the most recent cited which are current on the date of advertisement for bids. Acceptance testing will be made by and at the expense of the Department. Samples will be taken by an authorized representative of the Department. Materials being used will be subject to inspection, test, retest or rejection at any time prior to final acceptance. Copies of test reports will be furnished to the contractor's representative upon request. The contractor shall be notified of failing test. A copy of the failing test report will be furnished to the contractor.

106.04 CERTIFICATES. Certificates shall include Certificates of Analysis, Certificates of Compliance, and Certificates of Delivery. These certificates shall be furnished prior to use of materials for which the certificates are required. They shall be signed by the material manufacturer, the manufacturer of assembled materials or the material supplier.

Materials used on the basis of these certificates may be sampled and tested at any time. The fact that material is used on the basis of a certificate shall not relieve the contractor of responsibility for incorporating material in the work which conforms to the plans and specifications.

Distribution of certificates and requirements for further sampling and testing of certified materials shall be as outlined in the Department's Materials Sampling Manual.

The Department reserves the right to refuse to permit the use of material on the basis of a certificate.

(a) Certificate of Analysis: A Certificate of Analysis shall be notarized and shall include actual test results of material properties. This certificate also includes "Mill Test Reports." A Certificate of Analysis shall be furnished with each lot of material delivered to the work. The lot certified shall be clearly identified on the certificate.

(b) Certificate of Compliance: A Certificate of Compliance shall be notarized and shall state that the materials conform with required specifications.

A Certificate of Compliance shall be furnished with each lot of material delivered to the work. The lot certified shall be clearly identified in the certificate.

(c) Certificate of Delivery: A Certificate of Delivery shall list particular materials included in a shipment. It may contain statements concerning the materials' conformance to specifications. This certificate also includes "Certificates of Release."

A Certificate of Delivery shall be furnished with each shipment of material delivered to the work.

106.05 CONTRACTOR QUALITY CONTROL: The contractor shall provide and maintain an adequate quality control system along with personnel, equipment, supplies, and facilities necessary to obtain samples, perform tests and provide quality control of the work.

The contractor shall perform quality control sampling, testing and inspection during the work at a rate sufficient to ensure that the work conforms to the project specifications.

106.06 PLANT INSPECTION.

The engineer may inspect materials at the source. The Department reserves the right to retest materials, prior to incorporation into the work, which have been tested and accepted at the source of supply. If plant inspection is undertaken, the following conditions shall be met:

(a) The engineer shall have the cooperation and assistance of the contractor and the producer with whom the contractor has contracted for materials.

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

(c) When required, the contractor shall arrange for an approved building for the use of the inspector. Such building shall be located

conveniently near the plant, independent of any building used by the material producer and shall conform to Section 722.

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

106.07 FIELD LABORATORY. The contractor shall provide project site and/or plant site laboratories as required by the specifications to be used exclusively for quality assurance purposes by the Department. The buildings shall be installed, equipped in accordance with Section 722, and ready for use prior to the time the contractor's operations require testing.

106.08 FOREIGN MATERIALS. Materials manufactured outside the United States shall be delivered to approved locations within the State, where they shall be retained until sampling and testing can be completed.

The contractor shall, at no direct pay, arrange for any required testing which the Department is not equipped to perform. Testing by the contractor shall be performed within the State and be subject to witnessing by the engineer.

Each lot of foreign material shall be accompanied by a Certificate of Compliance prepared in accordance with Subsection 106.04. Certificates of Analysis prepared in accordance with Subsection 106.04 shall be attached to the Certificate of Compliance for those materials for which Certificates of Analysis are required. These certificates shall clearly identify the lot to which they apply.

Structural materials requiring Certificates of Analysis (Mill Test Reports) will be accepted only from foreign manufacturers who have previously established to the satisfaction of the engineer the adequacy of their in-plant quality control.

Adequacy of quality control shall be established, at the option of the engineer, by submission of detailed written proof of adequate quality control or through a plant inspection by the engineer.

No structural materials will be accepted which cannot be properly identified with Certificates of Analysis and Certificates of Compliance.

106.09 MATERIAL STORAGE AND PLANT SITE. Materials shall be so stored as to assure preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located to facilitate their prompt inspection. Approved portions of the right-of-way may be used for storage and for placing the contractor's plant and equipment. Additional space required shall be provided by the contractor at no direct pay. Private property shall not be used for storage or plant site without written permission of the owner and lessee. Copies of such written permission shall be furnished the engineer. Storage and plant sites shall be restored to a condition acceptable to the owner or lessee by the contractor at no direct pay. A Certificate of Release, signed by the owner or lessee, shall be furnished the engineer.

106.10 HANDLING MATERIALS. Materials shall be handled to preserve their quality and fitness for the work. Materials shall be transported from storage site to the work in tight vehicles constructed to prevent loss or segregation of materials after loading and measurement in order that

there will be no inconsistencies in quantities of materials loaded and quantities received at the place of operations.

106.11 UNACCEPTABLE MATERIALS. Materials not conforming to specifications will be rejected and shall be removed immediately from the work unless otherwise directed. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

106.12 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.

The cost of handling and placing materials after they are delivered to the contractor shall be considered as included in the contract price for the item in connection with which they are used.

The contractor will be responsible for material delivered. Deductions will be made from payments for the work to make good any shortages and deficiencies, for any damage which occurs after such delivery, and for any demurrage charges.

Section 107
Legal Relations and Responsibility to Public

107.01 LAWS TO BE OBSERVED. The contractor shall keep informed of and comply with all Federal, State and local laws, ordinances and regulations, and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which affect those employed on the work or which affect the conduct of the work. The contractor shall indemnify the State and its representatives against any claim or liability arising from violation of any such law, bylaw, ordinance, code, regulation, order or decree, whether by the contractor or the contractor's employees.

Soil and soil-moving equipment operating in regulated areas will be subject to plant quarantine regulations. These regulations provide for cleaning soil from equipment before it is moved from regulated areas to prevent spread of harmful agricultural pests from areas quarantined by the State or U. S. Department of Agriculture. Complete information may be obtained from the appropriate district office of the USDA Plant Protection Division.

107.02 PERMITS, LICENSES AND TAXES. The contractor shall procure temporary permits and licenses for the work, pay charges, fees, and taxes; and give notices necessary to due and lawful prosecution of the work.

107.03 PATENTED DEVICES, MATERIALS AND PROCESSES. If the contractor uses any design, device, material or process covered by patent or copyright, the contractor shall provide for such use by legal agreement with the owner of the patent or copyright. The contractor and surety shall indemnify the State, any affected third party or political subdivision from claims for infringement due to 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 due to any infringement during prosecution or after 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 to grant permits for same, at any time, is reserved by the Department for proper authorities of the municipality in which the work is done and the contractor will not be entitled to damages either for digging up of the highway or delays occasioned thereby.

When an individual, firm or corporation is authorized through an executed permit from the Department, the contractor shall allow parties bearing such permits to make openings in the highway. The contractor shall, when ordered, make all necessary repairs due to such openings. Payment for such work will be made as extra work or as provided in these specifications, and will be subject to the same conditions as original work performed.

107.05 FEDERAL AID PARTICIPATION. When the United States Government participates in the cost of the work covered by the contract, the work shall be under the supervision of the State, but subject to inspection and approval of the proper official of the United States Government, in accordance with applicable Federal Statutes, and rules and regulations pursuant thereto. Such inspection shall not make the Federal Government a party to the contract and will not interfere with the rights of either party thereunder.

On FHWA Federal-Aid Projects, when required by the project specifications, the contractor shall complete Federal-Aid Form PR-47, "Statement of Materials and Labor used by Contractors on Highway Construction Involving Federal Funds," prior to the time final inspection is requested for the project. The final estimate will not be paid until this form has been submitted to the FHWA and accepted.

107.06 SANITARY, HEALTH AND SAFETY PROVISIONS. The contractor shall provide and maintain in a neat, sanitary condition, restrooms and other such accommodations for use of employees and Department personnel. Such facilities shall comply with requirements of the State and local Boards of Health or other bodies or tribunals having jurisdiction.

The contractor shall not require any worker to work under conditions which are unsanitary, hazardous or dangerous to health or safety. The contractor shall maintain the work in a sanitary, safe and nonhazardous condition for DOTD employees.

Disposal of sewage shall be as approved by the appropriate health agency.

107.07 PUBLIC CONVENIENCE AND SAFETY. The contractor shall conduct the work to assure the least possible obstruction to traffic. The project site and haul route shall be kept reasonably free from dust and in such condition that the public can travel in safety.

When the highway under construction is to be kept open for traffic, the subgrade and surfacing shall be kept reasonably free from dust and in such condition that the public can travel in safety. Safety and convenience of the general public and the residents along the work, and protection of persons and property, shall be a primary responsibility of the contractor.

When the contractor works at night, adequate artificial lighting, signs, flaggers or other traffic controls shall be provided to protect workers, the work and the traveling public. When such work affects traffic safety, the contractor shall submit to the engineer for approval a plan of lighting, signing, flagmen or other traffic controls. If the approved plan proves inadequate after work begins, the contractor shall make such changes as directed. If the engineer finds that the night work is so hazardous as to preclude the beginning or require the discontinuing of such work, the contractor shall immediately cease all such operations. Costs of providing or making changes in the lighting, signs, flaggers or other traffic controls shall be the responsibility of the contractor.

107.08 RAILWAY-HIGHWAY PROVISIONS. All work to be performed by the contractor in construction on railway right-of-way shall be in accordance with the following provisions.

(a) The contractor shall notify the Railway's duly designated representative at least 10 days in advance of the date on which the contractor is expected to begin work on the Railway's premises.

(b) During the progress of work on or about the Railway's tracks or premises, the contractor shall maintain contact and liaison with the Railway's officers or representatives designated by the Railway so as to ascertain time of passage of trains at the work in order to clear Railway's tracks and facilities of people, equipment and obstructions to permit free flow of railway traffic. The contractor shall perform work on the Railway's premises without materially interfering with the Railway's tracks, structures and facilities or operations, or the operations of the Railway's tenants or licensees, or with communication and signal lines upon said premises, except under arrangement effected between the contractor and the Railway. The contractor shall protect the Railway's property and avoid accidents. The contractor shall keep the Railway's track and roadbed free of earth, rock, construction materials, debris and obstructions.

The contractor shall immobilize equipment parked near the Railway's track, when such equipment is unattended, to prevent its movement by unauthorized persons.

(c) The contractor shall, before entering upon the Railway's right-of-way for performance of any construction work, or work preparatory thereto, secure permission from the Railway's representative for the occupancy and use of the Railway's right-of-way outside the limits of the highway servitude area and shall confer with the Railway relative to requirements for railway clearances, operation and general safety regulations.

(d) The Railway's representative will at all times have jurisdiction over the safety of railway operation. The decision of the Railway's representative as to procedures which may affect the safety of railway operation shall be final. The contractor shall be governed by such decision.

(e) Should any damage occur to railway property, as a result of the contractor's unauthorized or negligent operations, and the Railway deems it necessary to repair such damage or perform work for protection of its property, the required materials, labor and equipment shall be furnished by the Railway. The contractor shall reimburse the Railway for costs incurred.

(f) If the contractor requires access across the Railway's right-of-way and tracks at any location which is not an existing permanent type of open public railway-highway crossing in or incident to the construction of the project, the contractor shall contact the Railway and request access across said right-of-way and tracks and execute a license agreement with the Railway. The contractor shall agree to reimburse the Railway for the cost of providing and removing any temporary at-grade and grade-separated structure access crossing, including warning devices, watchmen expense or other costs which the Railway deems necessary for protection of Railway property and operations. The type of temporary crossing required shall be determined by the Railway. The contractor shall not cross the Railway's right-of-way and tracks with vehicles or equipment except at existing open public road crossings or at such crossings established pursuant to this paragraph. The foregoing requirements include new grade crossings which will become part of the finished highway being constructed under the contract.

The contractor shall comply with requirements for insurance contained under Heading (n) hereinafter during operations hereunder.

The contractor shall cooperate with the Railway during all phases of the work including sufficient advance notice for project completion in order for the Railway to remove the temporary grade crossing and perform final grade crossing improvements under the agreement with the Department prior to final acceptance.

(g) Any engineering, inspection, flagging protection and watcher service required by the Railway for the safety of Railway operations because of work being performed by the contractor or in connection therewith, shall be provided by the Railway and the cost thereof shall be reimbursed to the Railway on the basis of the Railway's bills, to be rendered monthly. The contractor will be reimbursed for the actual incurred cost for such protection. The contractor shall furnish time record documentation before reimbursement.

The contractor shall notify the Railway 72 hours in advance of when protection services are required.

(h) The contractor will be required to reimburse monthly the Railway for the cost of all services performed by the Railway for the contractor, and furnish the Department satisfactory evidence that the Railway has acknowledged receipt of payment before final acceptance.

(i) During construction of piers or other supports or structures adjacent to any track or of drainage pipe or structure under or adjacent to any track of the Railway, the contractor shall make adequate provisions against sliding, shifting, sinking or in any way disturbing the railway embankment and track adjacent to said piers, supports or structures due to construction operations by driving temporary sheeting or by other means satisfactory to the Department and Railway.

(j) Before commencing work on any pier or structure adjacent to any track, or on any structure and parts thereof which carry Railway facilities, the contractor shall submit to the engineer for approval, prints of the proposed sheeting, shoring, bracing and falsework details for protection of the Railway's track and embankment and shall submit prints of the shop drawings or other contractor's detailed plans for structures and parts thereof which will carry Railway facilities. This submittal shall include proposed methods of construction and be accompanied by supporting data, including design computations, soil descriptions and other pertinent information.

After approval by the engineer, four prints of the above plans, shop drawings and details bearing the seal of a registered Civil Engineer, with supporting data and documents, shall be forwarded to the Railway for approval. Prior to beginning work on Railway right-of-way, the shop drawings and details, with supporting data and documents, shall be approved by the Railway.

(k) The contractor shall notify the Railway's representative in writing at least one week in advance of the proposed time of the beginning of construction of piers, supports or structures adjacent to the track or of drainage pipe or structure under or adjacent to the track.

(l) The following temporary clearances are the minimum which shall be maintained during construction operations:

Vertical: 22 feet-6 inches above top of highest rail.

Horizontal: 10 feet-0 inches from centerline of the nearest track measured at right angles thereto.

If lesser clearances are required for any part of the work, the contractor shall secure written authorization from the Railway's representative for such lesser clearances in advance of the start of work on that portion of the project along, on, over, under or across the right-of-way or tracks of the Railway.

(m) The contractor shall not store or construct falsework or store materials, supplies or equipment closer than 15 feet-0 inches from the centerline of any railway track, measured at right angles thereto, or 22 feet-6 inches vertically from top of rail.

(n) The contractor shall provide insurance of the following kinds and amounts:

(1) Regular Contractor's Public Liability and Property Damage Insurance, including automobile, issued in the name of the contractor shall be written to furnish protection to the contractor respecting operations in performing work covered by the contract in regard to the liability with respect to bodily injury to or death of persons, and injury to or destruction of property, which may be suffered by persons other than the contractor's employees as a result of operations in connection with construction of highway projects located wholly or partly within railroad right-of-way.

(2) When a contractor sublets a part of the work on any project to a subcontractor, the contractor shall be required to secure insurance protection in the contractor's own behalf under Contractor's Public Liability and Property Damage Insurance policies to cover any liability imposed on the contractor by law for damages due to bodily injury to or death of persons and injury to or destruction of property as a result of work undertaken by such subcontractors.

In addition, the contractor shall provide for, and on behalf of, any such subcontractors protection to cover like liability imposed upon the latter as a result of their operations by means of separate and individual Contractor's Public Liability and Property Damage policies. As an alternative, each subcontractor shall provide satisfactory insurance as described herein on the subcontractor's own behalf to cover the subcontractor's individual operations.

(3) Railroad Protective Liability Insurance shall be purchased on behalf of the Railway by the contractor. The standards for Railroad Protective Liability Insurance shall be in accordance with provisions of the Federal-Aid Policy Guide (FHPG) Part 646 as amended.

The limits of liability for the kinds of insurance required above shall be as follows:

NORMAL COVERAGE (other than AMTRAK)

(1), (2) and (3)

Combined Single Limit for Bodily Injury Liability, Property Damage Liability and Physical Damage to:
Property - $2,000,000 per occurrence
Aggregate Limit - $6,000,000 for the term of the policy

AMTRAK COVERAGE

(1), (2) and (3)

Combined Single Limit for Bodily Injury Liability, Property Damage Liability and Physical Damage to:
Property - $5,000,000 per occurrence
Aggregate Limit - $12,000,000 for the term of the policy

The name of the Railway and the ratio of the estimated cost of operations within the Railway's property to the total estimated project cost, expressed by percent, will be specified in the project specifications. No direct payment will be made for providing the required insurance coverages by the contractor.

The contractor shall furnish to the Railway the Railroad Protective Policy and certificates evidencing the other insurance coverage required above. The Railroad Protective Insurance Policy and all insurance certificates shall be approved by the Railway before any work may be started on the Railway's property by the contractor or subcontractors. In addition, the contractor shall furnish evidence of commitment by the insurance company to notify the Railway and the engineer in writing of any material change, expiration or cancellation of the policy not less than 30 calendar days before such change, expiration or cancellation is effective.

The insurance specified shall be kept in force until final acceptance of the contract.

(o) Upon completion of the work, the contractor shall, within 10 calendar days, remove from within the limits of the Railway's right-of-way all machinery, equipment, surplus materials, falsework, rubbish or temporary buildings of said contractor, and restore the Railway's premises substantially to their former condition satisfactory to the Railway's representative.

Should the contractor fail to make such removal and restoration within 10 calendar days, the Railway shall have the right to make such removal or restoration. The expense incurred shall be chargeable to the project on the Railway's force account statement and the Department will reimburse the Railway for such work. The amount will be deducted from payments due the contractor.

Work or operations performed by the contractor for or on account of the Railway during highway construction operations under the contract, or by the Railway in constructing and maintaining temporary or other grade crossing for the contractor's use during highway construction, or by the Railway in furnishing flaggers or other protection in accordance with agreement between the contractor and the Railway, or for cleaning up and restoring the Railway's premises as required above, or for work contained in the contract shall be included in contract prices on pay items.

Prior to final acceptance of the project, the contractor shall secure a Certificate of Release from the railroad company and furnish same to the Department stating that the contractor has satisfactorily restored the Railway's premises and has completed payments for all railway services performed for the contractor's account, and that the Railway waives all claims for damages due to the contractor's operations within railway right-of-way under the contract. If the contractor is unable to

secure a Certificate of Release from the Railway, the contractor shall submit an executed Contractor's Affidavit, to the engineer.

107.09 NAVIGABLE WATERS AND WETLANDS.

All work in, over or adjacent to navigable waters or wetlands shall be conducted in accordance with rules and regulations of the U. S. Army Corps of Engineers and U. S. Coast Guard.

Navigable clearances on waterways shall not be infringed upon, and existing navigable depths shall not be impaired except as allowed by permits issued by the responsible agency.

The Department will obtain a permit from the U. S. Coast Guard and U.S. Army Corps of Engineers relative to approval of construction plans for bridges, causeways, embankments, dredging, spoil disposal, etc., for work in navigable waters or wetlands. The contractor will be furnished a copy of the permit and shall comply with all provisions and conditions of the permit. Upon completion and before final acceptance, the contractor shall furnish the Bridge Design Engineer 8-by-10-inch color photographs of the bridge from abutment to abutment, two photographs looking upstream and two looking downstream. The prints shall be glossy finish, mounted on linen. These photographs will be furnished at no direct pay.

The contractor shall prepare reproducible drawings complying with the standards of the U. S. Coast Guard and the U. S. Army Corps of Engineers showing falsework construction, test piles or other temporary pile driving operations, erection sequence, temporary navigational lighting, location of equipment and barges in the navigable limits and other drawings required by the permit agencies. Drawing sizes shall be 8-by-10 1/2 inches with a 1-inch border on the top or short side. The drawings shall be submitted to the Bridge Design Engineer for approval and transmittal to the appropriate agency. Construction of falsework, test pile operations and erection or operation of construction equipment within the navigable limits shall not commence until drawings are approved.

The contractor shall display lights on equipment operating, berthed or moored in navigable streams, and provide temporary navigational lighting on temporary and permanent construction in the navigable limits as required by the U. S. Coast Guard.

Should the contractor sink, lose or throw overboard any material, machinery or equipment which may be dangerous to navigation, it shall be immediately removed or recovered. The contractor shall give immediate notice of such obstruction to proper authorities and, if required, shall mark or buoy such obstruction until it is removed.

The contractor shall not deposit excavated material into the waterway or wetland without a permit from the appropriate agency.

All operations in connection with the work shall be in accordance with permits, rules and regulations of the U. S. Army Corps of Engineers and the U. S. Coast Guard. Deviations therefrom shall be only by special permission or special permit which shall be the responsibility of the contractor. Failure of the contractor to become familiar with the terms, conditions and provisions of the permits, rules and regulations applicable to the work shall not relieve the contractor of responsibility under the contract.

The contractor shall conduct operations to cause minimum interference with marine operations. If such interference is necessary, the contractor shall notify the Bridge Design Engineer, in writing, sufficiently in advance so that the Department may obtain approval from the U. S. Coast Guard at least 3 weeks prior to said interference.

Copies of Department obtained permits are available in the Bridge Design Section.

Copies of any special permits obtained by the contractor shall be submitted immediately to the Bridge Design Engineer.

107.10 BARRICADES AND WARNING SIGNS. The contractor shall provide, erect and maintain necessary barricades, suitable lights, danger signals, signs and other traffic control devices, including flaggers, and shall take all necessary precautions for protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades. Obstructions shall be illuminated at night. Suitable warning signs shall be provided to direct traffic.

The contractor shall erect and maintain warning signs in advance of any place on the project where operations may interfere with traffic, and at intermediate points where new work crosses or coincides with an existing road.

Barricades, warning signs, lights, temporary signals and other protective devices shall conform to the details shown on the plans and the MUTCD.

107.11 USE OF EXPLOSIVES. Explosives shall not be used without written approval. When explosives are used, the contractor shall not endanger life or property. The use of exposives shall be in compliance with all laws and ordinances. The contractor shall be responsible for all damage resulting from the use of explosives.

Explosives shall be securely stored, in compliance with all laws and ordinances. Such storage places shall be clearly marked. When no local laws or ordinances apply, satisfactory storage shall be provided not closer than 1,000 feet from any road, building or place of human occupancy.

The contractor shall notify, in writing, each utility company and affected property owner having facilities in proximity to the site of work of the intention to use explosives. Such notices shall be given sufficiently in advance to enable them to protect their property from damage.

107.12 PRESERVATION OF PROPERTY, LANDSCAPE, AND SURVEY MONUMENTS. The contractor shall be responsible for preservation of public and private property and shall protect from disturbance and damage all land monuments, property line markers or horizontal and vertical control monuments such as those established by the United States Coast and Geodetic Survey, National Geodetic Survey, Louisiana Geodetic Survey, Louisiana DOTD, Corps of Engineers, or United States Geological Survey.

Before removing and resetting any survey monuments, the contractor shall give sufficient advance notice, in writing, to the appropriate agency responsible for the monument and to the engineer of the intention to perform the work so that such agency may have a representative present if it so desires. The contractor shall not disturb or move any such monument without approval. The engineer will designate the location and manner in which these monuments are to be reset.

The contractor shall be responsible for damage to property during the work due to any negligent act, omission or misconduct in executing the work, or due to defective work or materials. This responsibility will not end until final acceptance.

When damage is done to public or private property by the contractor due to any negligent act, omission or misconduct in execution of the work, or in consequence of nonexecution thereof by the contractor, such property shall be restored at no direct pay, to a condition similar or equal to that existing before such damage was done, by repairing, rebuilding or otherwise acceptably restoring as directed, or make good such damage in an acceptable manner.

107.13 FOREST PROTECTION. In carrying out work within or adjacent to State or National Forests, the contractor shall comply with all regulations of the State Fire Marshal, Conservation Commission, Forestry Department or other authority having jurisdiction governing protection of forests and performance of work within forests. The contractor shall observe all sanitary laws and regulations with respect to performance of work in forest areas. The contractor shall keep the areas in an orderly condition, dispose of all refuse, obtain permits for construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks and other structures in accordance with requirements of the forest supervisor.

The contractor shall take reasonable precaution to prevent and suppress forest fires and shall require employees and subcontractors, both independently and at the request of forest officials, to do all reasonable within their power to prevent and suppress forest fires and to notify a forest official at the earliest possible moment of the location and extent of any fire seen by them.

107.14 PREVENTION OF SOIL EROSION AND WATER POLLUTION. The contractor shall protect the project and adjoining properties from soil erosion and siltation by effective and continuous erosion control methods. The area of bare soil exposed by construction operations shall be kept to a minimum.

Attention is directed to Subsection 107.15 and Section 204.

107.15 ENVIRONMENTAL PROTECTION. The contractor shall comply with federal, state and local laws and regulations controlling pollution of the environment, including air, water and noise. The contractor shall take precautions to prevent pollution of waters and wetlands with fuels, oils, asphalts, chemicals or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

Attention is directed to Subsection 107.14 and Section 204.

Construction operations in rivers, streams, lakes, tidal waters, reservoirs, canals and other impoundments will be restricted to areas where it is necessary to perform filling or excavation to accomplish the work and areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, streams and impoundments shall be cleared of obstructions placed therein or caused by construction operations.

Frequent fording of streams with construction equipment will not be permitted.

No residue from dust collectors or washers shall be dumped into a stream.

Attention is further directed to the federal, state and local air pollution control programs and their rules and regulations regarding air

pollution, especially open burning, fugitive dust and asphaltic concrete plant restrictions.

The contractor shall maintain and operate equipment to minimize noise. Engines shall be equipped with properly functioning mufflers. The contractor shall limit activity near noise sensitive areas, such as churches, hospitals and schools, so normal activities are not unduly disrupted.

107.16 AIR NAVIGATION. The Department will obtain a permit (or a determination of no hazard to air navigation) from the FAA for all permanent structures. The contractor will be furnished a copy of the permit, if requested. If the contractor's equipment, falsework, etc. is classified as a hazard to aerial navigation, the contractor shall prepare, on tracing cloth or approved reproducible medium, drawings complying with the FAA current requirements for temporary lighting for protection of aerial navigation. These drawings shall be submitted to the Bridge Design Engineer for review and transmittal to the FAA for approval. Operations in connection with the work for protection of aerial navigation shall be in accordance with the approved drawings and applicable federal regulations. Failure of the contractor to be familiar with applicable rules and regulations of the FAA will not relieve the contractor of responsibility under the contract.

107.17 HAZARD ZONES. If any portion of the work is determined to be within a known hazard zone, the presence of such hazards will be noted in the plans or project specifications to the extent that definite information can be obtained on these situations.

It shall be the responsibility of the contractor to arrange with the agency concerned for any adjustments relative to the work in the area. Any liability or expense of these arrangements shall be borne by the contractor.

The contractor shall obtain from the Department and submit to the engineer the Department's Standard Release Form signed by the agency involved stating that the contractor has satisfactorily discharged the obligations under terms of the arrangements. This form shall be submitted with the required signatures.

Failure of the Department to determine the presence of all hazards and to so note in the plans or project specifications shall not relieve the contractor of performing the work in accordance with the project requirements at contract unit prices.

107.18 DAMAGE CLAIMS. The contractor shall indemnify the Department, its officers and employees from all suits, actions or claims brought because of injuries or damage sustained by any person or property due to operations of the contractor; due to negligence in safeguarding the work; or use of unacceptable materials in constructing the work; or any negligent act, omission or misconduct of the contractor; or claims or amounts recovered from infringements of patent, trademark or copyright; or from claims or amounts arising or recovered under the Workmen's Compensation Act or other law, ordinance, order or decree; and so much of the money due the contractor under the contract as considered necessary by the Department for such purpose, may be retained for use of the State; or, in case no money is due, the surety bond may be held until such suits,

actions, claims for injuries or damages 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 Public Liability and Property Damage Insurance, including Railroad Protective Liability Insurance in accordance with Subsection 107.08 is in effect.

107.19 OPENING SECTIONS TO TRAFFIC. Opening of sections of the work to traffic prior to completion of the entire contract may be desirable from a traffic service standpoint, or may be necessary due to conditions inherent in the work or by changes in the contractor's work schedule, or may be required due to conditions or events unforeseen at the time of the contract. Such openings shall be made when directed and shall not constitute acceptance of the work nor a part thereof or a waiver of any provisions of the contract.

The plans or project specifications will specify, insofar as possible, which sections shall be opened prior to completion of the contract. On any section opened by order of the engineer, whether specified or not, the contractor will not be required to assume any expense entailed in maintaining the road for traffic. Such expense will be borne by the Department or compensated for in accordance with Subsection 109.04. On portions of the project which are ordered to be opened for traffic, in the case of unforeseen necessity not the fault of the contractor, compensation for additional expense to the contractor and allowance of additional time for completion of other work on the opened portions of the project shall be as set forth in a plan change mutually agreed on by the engineer and the contractor.

When the contractor is dilatory in completing shoulders, drainage structures or other features of the work, the engineer may notify the contractor in writing and establish therein a reasonable period of time in which the work is to be completed. If the contractor fails to make a reasonable effort toward completion in this time period, the engineer may order all or a section of the project opened to traffic. On such sections ordered to be opened, the contractor shall conduct the remainder of construction operations 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.

On any section opened to traffic under the foregoing conditions, whether specified in the contract or opened by necessity of contractor's operations or unforeseen necessity, any damage to the highway not attributable to traffic which occurs on such section (except slides) shall be repaired by the contractor at no direct pay. Removal of slides shall be done by the contractor on a basis agreed to prior to removal of such slide.

107.20 CONTRACTOR'S RESPONSIBILITY FOR WORK. Until final acceptance, the contractor shall have the charge and care thereof and shall take every precaution against damage to any part thereof by action of the elements, vandalism, theft or from other cause, whether arising from execution or non-execution of the work. The contractor shall rebuild, repair, restore or make good damages, including theft and vandalism, to the work before final acceptance and shall bear the expense thereof,

except damage to the work due to unforseeable causes beyond the control of the contractor, including but not restricted to acts of God or governmental authorities.

In case of suspension of work, the contractor shall be responsible for the project. The contractor shall take such precautions as necessary to prevent damage to the project, provide for normal drainage and erect any necessary temporary structures, signs or other facilities at no direct pay. During such period of suspension, the contractor shall acceptably maintain 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 damage.

107.21 UTILITY PROPERTY AND SERVICES. The contractor's operations adjacent to properties of railway and utility companies or adjacent to other property, damage to which might result in considerable expense, loss or inconvenience, shall not commence until after all arrangements necessary for the protection thereof have been made.

The contractor shall cooperate with owners of utility lines in their removal and rearrangement, in order that these operations may progress in a reasonable manner, that duplication of rearrangement work may be minimized and that services rendered by those parties will not be unnecessarily interrupted.

In the event of interruption of utility services due to accidental breakage or being exposed or unsupported, the contractor shall promptly notify the proper authority and shall cooperate with such authority in restoration of service. If utility service is interrupted, continuous cooperation will be required until service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

107.22 FURNISHING RIGHT-OF-WAY. The Department will be responsible for securing all necessary rights-of-way, servitudes and easements in advance of construction.

107.23 PERSONAL LIABILITY OF PUBLIC OFFICIALS. In carrying out the provisions of these specifications, or in exercising any authority granted to them by the contract, there shall be no liability upon the Secretary, Chief Engineer or their authorized representatives, either personally or as officials of the State, it being understood that in all such matters they act solely as representatives of the State.

107.24 NO WAIVER OF LEGAL RIGHTS. Upon completion of the work, the Department will make final inspection and notify the contractor of acceptance. Such final acceptance shall not prevent the Department from correcting any measurement, estimate or certificate made before or after completion of the work, nor shall the Department be prevented from recovering from the contractor or the surety, or both, such overpayment it may sustain by failure of the contractor to fulfill obligations under the contract. A waiver by the Department of any breach of any part of the contract shall not be a waiver of any other breach.

The contractor, without prejudice to the terms of the contract, shall be liable to the Department for latent defects, fraud or such mistakes as amount to fraud, or as regards the Department's rights under any warranty or guaranty.

107.25 THIRD PARTY LIABILITY. It is agreed between the parties executing the contract that it is not intended by any provisions of the contract to create the public nor any member thereof a third party beneficiary hereunder, nor to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the contract.

107.26 ANTITRUST VIOLATIONS. By execution of the contract, the contractor conveys to the Department all rights, title and interest in and to all causes of action it may acquire under Federal and State anti-trust laws, relating to the goods or services purchased by the Department pursuant to the contract.

107.27 CONTRACTOR'S PAYROLLS. On projects not involving Federal funds, all payrolls of the contractor and subcontractors shall be retained in the contractor's field office until final acceptance of the contract. Such payrolls shall be made available for inspection during the life of the contract and during normal working hours. If the contractor does not have a field office on the project, such payrolls shall be made available for inspection on the project upon request. Refusal of the contractor to permit the engineer or authorized representative access to the contractor's or subcontractor's payrolls will be cause for withholding of payments for the work. When predetermined minimum wage rates are included in the contract, the minimum wage determination shall be posted by the contractor in a prominent and easily accessible place at the site of work.

On Federal-Aid Projects, the contractor's payrolls shall be in accordance with the project specifications.

107.28 ARCHAEOLOGICAL AND HISTORICAL FINDINGS. If the contractor encounters cultural artifacts or archaeological or historical sites, operations shall be discontinued. The engineer will contact the proper authorities in order that an appropriate assessment may be made to determine the disposition thereof and necessary actions relative to the site. When directed, the contractor shall excavate the site to preserve the artifacts encountered. Such excavation will be paid for as extra work, including an appropriate adjustment in contract time. Borrow and muck disposal areas furnished by the contractor will be subject to such assessment prior to use.

Section 108
Prosecution and Progress

108.01 SUBLETTING OF CONTRACT. The contractor shall not sublet any portion of the contract without written consent, including work sublet to an authorized Disadvantaged Business Enterprise. If such consent is given, the contractor will be permitted to sublet a portion of the work, but shall perform with the contractor's own organization work amounting to at least 50 percent of the total contract cost. Work as defined in this Subsection will not include materials. Any items designated in the contract as "Specialty Items" may be performed by subcontract and the cost of such may be deducted from the total cost before computing the amount of work required to be performed by the contractor with the contractor's own organization. No subcontract shall relieve the contractor of liability under the contract and bonds.

A subcontractor shall not further subcontract to a third party any portion of this authorized work.

108.02 NOTICE TO PROCEED. The "Notice to Proceed" will stipulate the date on which the contractor shall begin work, which date shall be the beginning of contract time charges.

108.03 CONSTRUCTION PROGRESS SCHEDULE. Prior to beginning the work the contractor shall submit to the project engineer a Construction Progress Schedule giving a satisfactory schedule of operations that provides for completion of the work within the contract time. This schedule shall be on the prescribed bar graph form and shall allocate the entire contract time. The contractor shall have copies of the schedule available at the preconstruction conference.

If the contractor's operations are affected by changes in the plans or amount of work, or if the contractor has failed to comply with the approved schedule, or if requested by the engineer, the contractor shall submit a revised Construction Progress Schedule for approval. This revised schedule shall show how the contractor proposes to prosecute the balance of the work. If a revised schedule has been requested by the engineer, the contractor shall submit the revised schedule within 14 calendar days after the date of request or progress payments may be withheld.

The approved Construction Progress Schedule will be used as the basis of establishing the controlling item of work, charging contract time and as a check on the progress of the work. The Construction Progress Schedule shall show only one controlling item of work for each contract day. If the Construction Progress Schedule has not been approved prior to the issuance of the Notice to Proceed, the engineer will establish the controlling work item and charge contract time accordingly.

108.04 PROSECUTION OF WORK.

(a) General: The contractor shall provide sufficient materials, equipment and labor to complete the project in accordance with the plans

and specifications within the contract time. If the completed work is behind the approved progress schedule, the contractor shall take immediate steps to restore satisfactory progress. Each item of work shall be prosecuted to completion without delay. The contractor shall not transfer equipment or forces from uncompleted work without prior notice to, and approval of, the engineer. If prosecution of the work is discontinued for an extended period of time, the contractor shall give the engineer written notice at least 24 hours before resuming operations.

(b) Disqualification: The contractor's progress will be determined monthly at the time of each partial estimate, and will be based on the total amount earned by the contractor as reflected by the partial estimate. If the contractor's progress is more than 20 percent behind the elapsed contract time, the contractor will be notified that disqualification may occur if progress becomes delinquent by more than the percentages specified. Such additional notification will be made as deemed necessary concerning the progress delinquency of the contractor.

Prior to the elapsing of 55 percent of the contract time, the contractor will be disqualified if progress is more than 40 percent behind the elapsed contract time. After 70 percent of the contract time has elapsed, the contractor will be disqualified if progress is more than 25 percent behind the elapsed contract time. Disqualification will be applied between 55 and 70 percent contract time elapsed on a pro-rata basis; for example, when 60 percent of the contract time has elapsed, the contractor will be disqualified if progress is more than 35 percent behind the elapsed contract time.

During the period of disqualification, the contractor will not be permitted to bid on contracts nor be approved as a subcontractor on contracts. Any proposals submitted by the contractor during the period of disqualification will not be considered and will be returned. The period of disqualification will continue until the completed work on the contract is within the foregoing percentages or until all work on the contract has been satisfactorily completed.

(c) Disqualification Review Board: After disqualification, the contractor may submit a written appeal to the Chief Engineer for review by the Departmental Disqualification Review Board. The written appeal shall be submitted within 14 calendar days after disqualification and may either request a meeting with the review board or that the review board consider a written appeal only. A meeting of the review board will be scheduled within 14 calendar days after receipt of appeal.

The review board will be composed of the Chief Engineer and three other members appointed by the Secretary. The Chief Engineer and two other members will constitute a quorum.

After all pertinent information has been considered, the contractor will be notified of the decision of the review board in writing within 14 calendar days. The decision of the review board will not operate as a waiver by the Department of its rights concerning the assessment of stipulated damages as specified under Subsection 108.08.

108.05 LIMITATION OF OPERATIONS. The contractor shall conduct the work in such manner and sequence to assure the least interference with traffic. The contractor shall have due regard to the location of detours and provisions for handling traffic. The contractor shall not begin new work to the prejudice of work already started. The engineer may require the contractor to finish a section on which work is in progress before

starting on additional sections if the finishing of such section is essential to public convenience and safety.

108.06 LABOR, METHODS AND EQUIPMENT. The contractor shall employ sufficient labor and equipment to prosecute the work to completion in accordance with the contract.

Workers shall have sufficient skill and experience to properly perform the work.

Any representative of the contractor or subcontractor who, in the opinion of the engineer, does not perform in a skillful manner or is disorderly shall be, upon written request, immediately removed by the contractor or subcontractor. A person removed shall not return to the work without written approval. If the contractor fails to remove such a person or fails to furnish suitable and sufficient personnel to properly prosecute the work, the engineer may suspend the work by written notice.

Equipment proposed for use in the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and produce a satisfactory quality of work. No damage to the roadway, adjacent property or other highways shall result from the use of equipment.

When methods and equipment are not specified, the contractor may use any methods or equipment that will accomplish the work in conformity with the contract.

The contractor may request permission to use a method or type of equipment other than specified in the contract. The request shall be in writing and shall include a description of the methods and equipment proposed and the reasons for requesting the change. If approval is given, it will be on the condition that the contractor will be 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 use of the substituted method or equipment and shall complete the work with the specified methods and equipment. The contractor shall remove the deficient work and replace it with work of specified quality or take other corrective action as directed. No change will be made in payment for contract items involved nor in contract time as a result of authorizing a change in methods or equipment.

108.07 DETERMINATION AND EXTENSION OF CONTRACT TIME. The number of days allowed for completion of the work will be stated in the contract.

On working day contracts, a working day will be charged when construction operations proceed for at least 5 continuous hours of the day or 65 percent of the normal work day, whichever is greater, with the normal working force engaged in performing the controlling item of work.

Should the contractor prepare to begin work on any day in which inclement weather, or the conditions resulting from the weather, prevent 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 work.

No working days will be charged for the following days:

(1) Saturdays and Sundays when no work is performed.

(2) State recognized holidays that are defined as regular legal holidays or special holidays that are proclaimed by the Governor or fixed by the Legislature on which no work is performed.

(3) Days on which delays, attributable solely to the Department or other governmental agencies, prevent contractor from proceeding with the controlling item of work at time of delay.

(4) Days on which delays are attributable to the direct effect of strikes, riots or civil commotions.

When the contract time is on a working day basis, the engineer will furnish the contractor a monthly statement showing the number of days charged to the contract for the preceding month and the number of days specified for completion of the contract. The contractor will be allowed 14 calendar days in which to file a written protest setting forth in what respect said monthly statement is incorrect; otherwise, the statement shall be considered accepted by the contractor as correct.

If a protest is filed by the contractor, the Department will conduct such reviews and investigations as required to rule on the protest within 30 calendar days from the date the statement is furnished the contractor. The number of days charged as listed, or revised within the allotted time, shall become final at the end of this 30-day period, subject to change only through legal action.

When the contract time is on a calendar day basis, it shall consist of the number of calendar days stated in the contract beginning with the date stipulated in the Notice to Proceed, including Saturdays, Sundays, holidays and non-work days. All calendar days elapsing between the effective dates of written orders to suspend work and to resume work for suspensions not the fault of the contractor will be excluded.

When the contract time is a fixed calendar date, it shall be the date on which all work on the project shall be completed.

The contract time for the work as awarded is based on the original quantities as defined in Subsection 102.05 and includes time to procure material, equipment and an adequate labor force to complete the work. If satisfactory fulfillment of the contract requires performance of work in greater quantities than those specified, or requires performance of extra work, the contract time will be increased on a basis commensurate with the following:

(a) Mathematical Increase: Upon acceptance of the project, the original contract time will be adjusted proportionally to the amount of the final estimate divided by the original contract amount, except that, in the case of total project cost underrun, the original contract time will not be decreased.

(b) Increase for Difficulty: When the contract is altered in accordance with Subsection 104.02 and the contractor requests additional contract time, the document authorizing or ordering alterations will show the number of additional days justified, the number of days added by anticipated overrun in costs (if any) due to alterations, and the difference between these two numbers. The difference between the two numbers will be added to the contract time.

If the contractor finds it impossible, for reasons beyond the contractor's control, to complete the work within the contract time as specified or as extended in accordance with the provisions of this Subsection, the contractor may, at any time prior to the expiration of the contract time as extended, make written request to the engineer for an extension of time setting forth therein the reasons which justify granting the request. The contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the engineer finds that the work was delayed because of conditions beyond the control and

without the fault of the contractor, the engineer may extend the contract time in such amount as conditions justify.

When final acceptance has been made, daily time charges will cease.

108.08 FAILURE TO COMPLETE ON TIME. For each calendar day or working day, as specified, that the work remains uncompleted after expiration of the contract time, the sum specified in Table 1 will be deducted from payments for the work, not as a penalty but as stipulated damages.

Permitting the contractor to continue work after expiration of the contract time will not operate as a waiver of the Department of its rights under the contract.

The contractor may request a waiver of such portions of the stipulated damages that accrue after the work can be safely and conveniently used for its intended purpose. The written request may be submitted to the engineer at any time after expiration of the contract time, but shall be submitted within 14 calendar days after final inspection, and shall set forth the reasons which the contractor believes justify the waiver and the effective date thereof. The Department will be the sole judge of damages suffered and will waive damages accordingly.

Based on the amount of the original contract, the charges given in Table 1 will be made for each contract day after expiration of the contract time.

TABLE 1
STIPULATED DAMAGES

Original Contract Amount (Dollars)		Daily Charge (Dollars)	
From More Than	To and Including	Calendar Day or Fixed Date	Working Day
0	25,000	$ 80	$ 150
25,000	50,000	210	375
50,000	100,000	240	425
100,000	500,000	270	500
500,000	1,000,000	330	600
1,000,000	2,000,000	400	725
2,000,000	5,000,000	480	875
5,000,000	10,000,000	600	1,100
10,000,000	-----	630	1,150

The amount of stipulated damages will be deducted from payments for the work under the contract or any other contract the contractor has with the Department. The contractor and the surety shall be liable for stipulated damages in excess of amounts due the contractor under the contract.

108.09 DEFAULT AND TERMINATION OF CONTRACT.

(a) The contractor will be in default if the contractor:

(1) Fails to complete the project within the contract time.

(2) Becomes insolvent or a petition is filed in the Bankruptcy Courts of the United States under Chapters 7 or 13 of the Bankruptcy Code naming the contractor as debtor or conversion of a proceeding or petition from Chapter 11 to Chapter 7 or 13 of the Bankruptcy Code or seeks a forced respite under the laws of this State or similar debtor protection by courts of other states.

(3) Allows any final judgment to stand unsatisfied for a period of 14 calendar days,

(4) Makes an assignment for the benefit of creditors,

(5) Discontinues prosecution of the work,

(6) Fails to begin work within 10 calendar days of the "Notice to Proceed."

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

(8) Performs the work unsuitably or neglects or refuses to remove materials, or replace or repair rejected work,

(9) Fails to resume work which has been discontinued after notice to do so,

(10) Fails to perform the work in an acceptable manner or violates any provision in the contract or to follow any federal, state or local laws pertaining to performance, or

(11) Fails to follow federal, state or local laws, rules and regulations concerning construction safety and health standards or permits conditions upon the site of the work which are unsanitary, hazardous or dangerous to the health or safety of the contractor's workmen or the public.

(b) Except as provided in Heading (f), the Department will give written notice to the contractor of the Department's determination that the contractor is in default for any cause specified in this subsection. The Department may give notice to the contractor of its intent to put the contractor in default under this subsection and specify a period of time in which the contractor shall cure the deficiency or a notice of default will issue. Upon notice of default, the Department will have authority, without violating the contract, to take prosecution of the work out of the hands of the contractor as provided in heading (c).

(c) Upon the notice of contractor's default, the Department may notify contractor's surety that it shall undertake completion of the project within 10 calendar days of receipt of notice of the Department's request that it procure prosecution of the work by another contractor until the contract is completed in an acceptable manner. At the end of the 10 calendar day period, or at any time if immediate action must be taken to protect the public interest or the safety of the public or workers, the Department may take prosecution of the work out of the hands of the contractor or surety, may appropriate or use the materials and equipment on the project, or may enter into an agreement for completion of the contract or use other methods as required for completion of the contract in an acceptable manner.

(d) Nothing herein shall be construed to require or obligate the Department to suspend contract time or to release the obligation of the contractor and surety for stipulated damages in accordance with Subsection 108.08.

(e) The costs incurred by the Department due to the contractor's default including attorney's fees, or for completing the work under contract, will be deducted from any monies due or which may become due the contractor. When this expense exceeds the sum which would have been payable under the contract, the contractor and surety shall be liable and shall pay the Department the amount of such excess.

(f) The contractor will automatically be in default by the expiration of contract time on the project and the contractor hereby waives any requirement of written notice of default for failure to attain final

completion of the project within the contract time. If prosecution of the work is to be taken out of the contractor's hands for failure to complete the project within contract time, notice will be given to the contractor and surety of the taking of the prosecution of the work out of the contractor's hands in accordance with Heading (c).

108.10 TERMINATION OF CONTRACTOR'S RESPONSIBILITY. The contract will be considered complete when all work has been satisfactorily completed, the final inspection made, and the work accepted by the DOTD Chief Engineer. The contractor will then be released from further obligation except as set forth in the contractor's payment/performance/retainage bond and Subsection 107.24.

108.11 TERMINATION OF CONTRACT. The Department may, by written notice, terminate the contract or any portion thereof when, for reasons beyond either the Department's or contractor's control, the contractor is prevented from proceeding or completing the work as originally contracted, or when termination would be in the public interest. Such reasons for termination may include, but will not be limited to, executive orders of the President relating to prosecution of war or national defense, national emergency which 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 a contract, or a portion thereof, is terminated before completion of all items of work in the contract, payment will be made for the 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, and other overhead expenses (when not otherwise included in the contract), and moving equipment and materials to and from the project will be considered.

Acceptable materials obtained or ordered by the contractor for the work that are not incorporated in the work shall, at the option of the contractor, be purchased by the Department at actual cost as shown by receipted bills and actual cost records at such points of delivery as designated.

Termination of a contract or a portion thereof, shall not relieve the contractor of responsibility for the completed work, nor shall it relieve the surety of obligation for any just claim arising from the work performed.

Section 109
Measurement and Payment

109.01 MEASUREMENT OF QUANTITIES. All work completed under the contract will be measured according to United States standard measure.

The engineer shall be the judge of the accuracy of measurements, or approximations made in lieu of accurate determinations and these decisions shall be binding upon both parties.

When project specifications or plans indicate that quantities for certain pay items have been computed with sufficient accuracy for payment, the pay quantities for those items will be the design quantities subject to the following adjustments. Design quantities will be adjusted if the engineer makes changes to fit field conditions, if plan errors are proven, or if design changes are necessary.

When measurement of excavation and embankment is based on cubic yard (net section), the design quantities will be verified or revised in accordance with Departmental policy.

Longitudinal measurements for area computations will be made horizontally. Transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing.

A station will be 100 linear feet.

Structures will be measured according to neat lines shown on the plans or as directed.

Items measured by the linear foot, such as pipe culverts, underdrains, etc., will be measured parallel to the foundation upon which such structures are placed.

In computing volumes of excavation, the average end area method or other acceptable methods will be used.

Thickness of plates and galvanized sheet metal used in the manufacture of corrugated metal pipe and metal plate pipe culverts and arches will be measured in decimal fractions of inches.

The term "ton" will mean the short ton of 2,000 pounds avoirdupois. Materials measured or proportioned by weight shall be weighed on approved scales by qualified personnel at designated locations. If material is shipped by rail, the car weight may be accepted provided the weight of material only will be paid for; however, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid by measured weight shall be weighed empty at such times as directed; and each truck shall bear a plainly legible identification mark.

Materials specified to be measured by volume in hauling vehicles shall be hauled in approved vehicles and will be measured therein at the point of delivery on the project. Vehicles may be of any acceptable size or type, provided the body is of such shape that the volume can be readily and accurately determined. Vehicles shall be loaded to at least a predetermined permanently fixed Vehicles will be measured in increments of 0.5 cubic yard, except that when tailgate spreaderboxes are used to place aggregate materials for asphaltic surface treatment, the volume of

the spreaderbox will be added to the volume of the vehicle. When materials are measured by weight and converted to volume for payment, conversion will be made to the nearest 0.1 cubic yard.

Asphaltic materials will be measured by the gallon or by the ton. When specified, volumes of liquid asphaltic materials will be converted to the gallonage at 60°F in accordance with DOTD TR 321.

Net certified scale weights or weights based on certified volumes (in the case of shipments by rail, truck or other transport) will be used as a basis of measurement, subject to correction when material has been lost in transit, wasted or otherwise not incorporated in the work.

When asphaltic materials are shipped by truck or transport, net certified weights or volume, subject to correction for loss or foaming, may be used for computing quantities.

Portland cement will be measured by the hundredweight (CWT).

Timber will be measured by the thousand feet board measure (MFBM) incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The terms "lump sum" and "each" 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 is specified as the unit of measurement, the unit of measurement will include the necessary fittings and accessories. Incidental work will not be measured for payment.

Rental of equipment will be measured by the hour, as described in the Department's Engineering Directives and Standards Manual, EDSM III.1.1.27, entitled Equipment Rental Rates.

When standard manufactured items are specified, 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.

When conversion is necessary from United States standard units to International System of Units (SI units) or from SI units to U. S. Standard units the guidelines, terminology, conversion factors, and rules for rounding in the Standard Metric Practice Guide, AASHTO R1 will be used.

109.02 SCOPE OF PAYMENT. The contractor shall receive and accept compensation as provided in the contract as full payment for furnishing materials and for performing work in an acceptable manner and for all risk, loss, damage or expense arising out of prosecution of the work subject to the provisions of Subsection 107.24.

When the "Payment" clause in the specifications relating to any unit price in the bid schedule requires that the said unit price be considered compensation for certain work, such work will not be measured nor payment made under any other pay item.

109.03 COMPENSATION FOR ALTERED QUANTITIES. When contract quantities are altered in accordance with Subsection 104.02, or when final quantities vary for other reason from the quantities in the bid schedule, the contractor shall accept as payment in full, payment at the contract unit prices for the accepted quantities of work done. No allowance, except as provided hereinafter, will be made for any increased expense, loss of expected reimbursement or loss of anticipated profits claimed by the

contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense of the contractor and subsequent loss of expected reimbursements therefor or for other cause.

When alterations of quantities are caused by alteration in the plans, and such alterations affect the methods or sequence of construction, an allowance will be made, either for or against the contractor, in such amount and basis as agreed to in advance of the performance of the work. The plan change authorizing or ordering the work shall show how the allowance was derived. Except when otherwise authorized by the Chief Engineer, such derivation shall show, as a minimum, breakdowns of costs as detailed in Subsection 109.04, Headings (a) through (g), except that projected costs rather than actual costs will be used.

When alterations in quantities result in an increase or decrease of more than 25 percent in the contract quantity as awarded on any major item of the contract, a supplemental agreement to the contract may be executed between the Department and the contractor at the request of either party, prior to performance of any work in excess of 25 percent of the contract quantity. When the supplemental agreement is executed, the consent of the contractor's surety shall be obtained and furnished to the engineer.

A "Major Item" is an item included in the contract as awarded with a total cost equal to or greater than 10 percent of the original total contract amount.

Any adjustment in unit price will be made on only that portion of the major item exceeding 25 percent increase or decrease. Such adjustment will be made based on the actual cost to perform that portion of the work in excess of the 25 percent increase or decrease. The actual costs shall be itemized in accordance with Subsection 109.04, Headings (a) through (g), except that projected costs will be used in case of an increase in quantity.

A "Minor Item" is an item included in the contract as awarded with a total cost of less than 10 percent of the original total contract amount. A minor item shall become a major item if it is increased by such an amount that its total cost is equal to or greater than 10 percent of the original total contract amount. If a minor item is increased to the extent that it becomes a major item, only that part of the item that exceeds 12.5 percent of the original total contract amount will be considered on any supplemental agreement. The supplemental agreement shall be executed prior to performance of any work in excess of 12.5 percent of the contract quantity. The requirements of the supplemental agreement shall be as described above for increases in major items. If a minor item is decreased, no adjustment will be made in the unit price.

109.04 COMPENSATION FOR ALTERATIONS OF THE CONTRACT. Payment for work performed in accordance with Subsection 104.02 will be made at the unit prices or agreed prices stipulated in the plan change authorizing the work. The Department may require the contractor to do such work on a force account basis, except that compensation for altered quantities shall be in accordance with Subsection 109.03.

When the method of payment for such work is unit prices or agreed prices, the plan change authorizing the work shall show how the unit prices or agreed prices were derived. Except when otherwise authorized by the Chief Engineer, the derivation of costs shall show, as a minimum,

breakdowns for labor, bond, insurance and tax, materials, and equipment as detailed below in Headings (a) through (g), except that projected costs rather than actual costs will be used. The contractor's representative and the engineer shall compare records of the cost of work done as ordered on a force account basis. Such comparison shall be made daily.

When the method of payment for such work is force account, the contractor will be compensated as follows, which shall be full compensation for the work performed.

(a) Labor: For labor and working foremen in direct charge of operations, the contractor shall receive the wage rates agreed on in writing before beginning work for each hour that said labor and foremen are engaged in such work.

The contractor shall receive the actual costs paid to, or in behalf of, workers for subsistence and travel allowances, health and welfare benefits, pension fund benefits or other benefits when such amounts are required by collective bargaining agreement or other employment contract applicable to the classes of labor employed on the work, but limited to a maximum daily rate for subsistence and travel allowances. This maximum shall be agreed upon prior to the contractor incurring such charges.

An amount equal to 20 percent of the sum of the above items will also be paid the contractor.

(b) Bond, Insurance and Tax: For property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions and social security taxes on force account work, the contractor shall receive the actual cost thereof, to which 6 percent will be added. The contractor shall furnish satisfactory evidence of the rates paid for such bond, insurance and tax.

(c) Materials: For materials accepted by the engineer and used, the contractor shall receive the actual cost of such materials delivered to the work including transportation charges paid by the contractor (exclusive of machinery rentals), to which 15 percent will be added.

(d) Equipment: For machinery or special equipment the use of which has been authorized, the contractor shall receive the rental rates agreed on in writing before such work is begun. The Department's Engineering Directives and Standards Manual, EDSM III.1.1.27, entitled Equipment Rental Rates, shall be used to establish rental rates.

(e) Miscellaneous: No additional allowance will be made for general superintendence, the use of small tools or other costs for which no specific allowance is herein provided.

(f) Subcontracting: When the Department authorizes the work to be performed by an approved subcontractor, the contractor will be paid the actual and reasonable cost of such subcontracted work computed as outlined above, plus an additional allowance of 10 percent.

(g) Statements: No payment will be made for force account work until the contractor has furnished the engineer with duplicate itemized statements of the cost of such work detailed as follows:

(1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

(2) Designations, dates, daily hours, total hours, rental rate and extension for each unit of machinery and equipment.

(3) Quantities of materials, prices and extensions.

(4) Transportation of materials.

(5) Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions and social security tax.

Statements shall be accompanied by invoices for materials used and transportation charges. If materials used on force account work are not purchased for such work, but are taken from the contractor's stock, in lieu of invoices, the contractor shall furnish an itemized list of such materials showing that the quantity claimed was actually used, and that the price and transportation costs claimed represent the actual cost to the contractor. Invoices shall be accompanied by the contractor's notarized statement that payment in full has been made for the materials.

109.05 ELIMINATED ITEMS. Should any items contained in the contract be found unnecessary for proper completion of the work, the engineer may, upon written order to the contractor, eliminate such items from the contract. Such action shall not invalidate the contract.

When an item is eliminated, the contractor will be reimbursed for authorized work done towards completion of the item. No allowance, except as provided herein, will be made for any increased expense, loss of expected reimbursement or loss of anticipated profits claimed by the contractor resulting either directly from such elimination or indirectly from unbalanced allocation among the contract items of overhead expense by the contractor and subsequent loss of expected reimbursements therefor or for other reasons.

The plan change authorizing reimbursements shall show how the reimbursements were derived. Except when otherwise authorized by the Chief Engineer, such derivation shall show breakdowns of costs as detailed in Subsection 109.04, Headings (a) through (g).

109.06 PARTIAL PAYMENTS. Provided the work is prosecuted in accordance with the provisions of the contract and with satisfactory progress, the engineer will make the first progress estimate within 2 months from the date indicated to begin work in the Notice to Proceed. The Department will determine the progress estimate date. Each successive progress estimate will be made on this same date of each month thereafter until completion of the contract. Each progress estimate will be an approximation of the value of work performed up to the date the estimate is made.

Monthly estimates will be approximate and subject to correction in subsequent estimates.

Should defective work or material be discovered or reasonable doubt arise as to the integrity of any part of the work prior to final acceptance and payment, an amount will be deducted from subsequent estimates equal in value to the defective or questioned work. Payment for this work will not be included in subsequent estimates until defects have been remedied or causes for doubt removed.

If the contractor is not a corporation, the contractor's Federal Identification Number (if a firm) or Social Security Number (if an individual) shall be furnished to the Department before payments will be made to the contractor for work under the contract.

Payment of the monthly estimate shall not be taken as an admission that the work is done or that its quality is satisfactory, nor as a release of the contractor from the responsibility for any portion thereof, but the whole work and all particulars relating thereto shall be

subject to revision and adjustment by the engineer at the time of final acceptance and payment of the final estimate.

109.07 PAYMENT FOR STOCKPILED OR STORED MATERIAL.

(a) General: When approved, advance payments may be made for fabricated or natural materials that are to be incorporated in the pro ject when stockpiled materials are stored on the project or in a dedicated stockpile at an approved site outside the limits of the project within the State of Louisiana. Payments shall be limited to durable materials described herein and shall represent a significant portion of the project cost. Perishable articles and small warehouse items are not included. These materials shall meet the requirements of the specifications. Payment for stockpiled or stored materials will not constitute acceptance. It shall be the contractor's responsibility to protect the material from damage while in storage.

Payment may be made for the invoice price for the materials. For fabricated materials purchased from commercial sources and delivered to approved storage, partial payment may be the invoice price plus freight and taxes. The quantity of material for payment will not exceed the total estimated quantity required to complete the project. The invoice values will not exceed the appropriate portion of the contract items in which such materials are to be incorporated.

The amounts advanced on stockpiled or stored materials will be recovered by the Department through deductions made on payments as the materials are incorporated in the work.

Partial payment shall be requested by the contractor in writing and the following documents shall be furnished:

(1) Written consent from the contractor's surety.

(2) A copy of the invoices from supplier or manufacturer verifying the cost and quantity of material.

(3) If storage is on private property, a copy of the lease or agreement granting the Department right of entry to property.

Payment for materials stored outside the State of Louisiana will be considered, subject to approval of the Chief Engineer. This will generally be limited to adjacent states, except in cases where it will be in the best interest of the Department to pay for these materials. If payment for stockpiled materials outside the State will affect the bid price for an item, the contractor shall submit a written request to the Chief Engineer prior to bidding.

Within 30 calendar days after payment by the Department, the contractor shall submit a certified copy of invoices from the supplier for each item for which payment has been made. All such invoices submitted shall state the amount received by the supplier as payment in full for the materials. If this certification of payment is not presented within the 30-day period, the advanced payment will be deducted from future progress payments.

Title and ownership of materials for which advancements have been made by the Department shall not vest in the Department until such materials are incorporated in the work and the work accepted by the Department. The making of advancements by the Department shall not release the contractor from the responsibility for any portion thereof.

(b) Fabricated or Manufactured Materials: Fabricated or manufactured materials may include but is not limited to the following:

Structural steel, fabricated structural steel items, steel piling; reinforcing steel; electrical equipment; mechanical equipment; precast concrete items; structural timber; timber piling; fencing and guard rail materials; fabricated sign structures and sign panels.

(c) Other Material: These materials will normally be large quantities of natural or manufactured aggregate. The contractor's request for payment of stockpiled natural material shall give a detailed description of the material, its intended use and location of the site. This material will be inspected and approved after placement in stockpiles on the project. Approval of the stockpiled material will be in writing.

109.08 ADJUSTMENT FOR CHANGES IN COMMON CARRIER RATES. It is agreed that the accepted proposal for the work is based on common carrier rates on file with the Interstate Commerce Commission or with a corresponding intrastate commission or body in effect on the date of opening of bids. Payments to the contractor will be adjusted upon request to compensate for increases in cost due to changes in common carrier rates becoming effective after the date of opening of bids and before expiration of the contract time. The adjustment shall be limited to an amount determined as follows.

The adjustment shall be the product of the increase in common carrier rates multiplied by the net quantity of material shipped at the new rates to the work and incorporated therein, all as shown by receipted common carrier bills.

If the freight cost by common carrier to the job site is included in the quotation by the supplier to the contractor, in addition to receipted freight bills, the supplier shall furnish on each invoice a breakdown showing the freight rate, quantity of material and total freight cost. The contractor shall furnish the supplier's written quotation made prior to the date of bid opening and a notarized statement that the increased freight rate has been paid.

The contractor's request for payment adjustment due to increased common carrier rates shall be submitted as soon as possible after shipments to the project have been completed. Only one request for such payment adjustment shall be made for each project, and any payment adjustment due the contractor for increased common carrier rates will be included in the final estimate for the project. No request for such payment adjustment will be considered unless submitted to the Department, with the required receipted bills and forms, within 30 calendar days after final acceptance.

109.09 ACCEPTANCE AND FINAL PAYMENT. Upon acceptance of the work, the Chief Engineer will execute a certificate that the work provided for in the contract has been completed and accepted under the terms of the contract. The Certificate of Acceptance will be recorded in the office of the Recorder of Mortgages of the parish in which the work has been done. The entire balance due the contractor will be paid to the contractor after the Department has determined that quantities shown on the final estimate are correct; however, before payment of the final estimate, the contractor shall submit to the Department a certificate from the Recorder of Mortgages of the parish in which the work has been done to the effect

that there are no claims or liens recorded against the contract. The date of the certificate shall not be prior to the expiration of 45 calendar days, but shall be prior to the expiration of 90 calendar days, after the Certificate of Acceptance was recorded in the Mortgage Office.

Prior to payment of the final estimate, all releases or waivers on buildings, wells, utilities and railroads shall be furnished as well as any maintenance bonds, certificates from Health Department, tracings, brochures or other items required by the contract.

Payment of the final estimate shall not release the contractor or sureties from liability for any fraud in construction, or in obtaining progress payments, or in payment for materials, labor or other supplies or services for the work, or for any claims for damages, loss or injury sustained by any person through the fault, negligence or conduct of the contractor or any employees, agents, subcontractors, suppliers or representatives.

PART II -- EARTHWORK

Section 201
Clearing and Grubbing

201.01 DESCRIPTION. This work consists of required clearing, grubbing, removing and disposing of vegetation and debris within the limits of the right-of-way and easement areas, except such items that are designated to remain or to be removed under other items.

This work consists of cutting trees, logs, brush, stumps and debris; excavating and removing stumps, roots, submerged logs, snags, and other vegetative or objectionable material; disposing of removed material in accordance with Subsection 202.02; and cleaning the area. When fencing or utility relocation is required, an area 10 feet wide, adjacent to and inside the right-of-way line, shall be cleared and grubbed.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

Erosion control shall be in accordance with Section 204.

201.02 GENERAL CONSTRUCTION REQUIREMENTS. The engineer will designate trees, shrubs, plants and other items to remain. The contractor shall preserve the items designated to remain. Equipment, materials and supplies shall not be stored in proximity of items designated to remain. Trees shall be removed without damaging items marked to remain. In case of damage to bark, trunks, limbs or roots of vegetation marked to remain, the contractor shall repair such damage at no direct pay by horticultural and tree surgery practices published by AAN. Trees shall not be felled outside of the right-of-way. Damage outside the right-of-way caused by the contractor's operations shall be the contractor's responsibility.

201.03 CLEARING AND GRUBBING. Clearing and grubbing shall be done within the construction limits and to a point in fills 15 feet beyond the toes of foreslopes and in cuts 15 feet beyond the tops of backslopes, when width of right of way permits, or to the limits shown on the plans; also from areas required for outfall ditches and channel changes. Trees, stumps, roots and other protruding vegetative obstructions not designated to remain shall be cleared and grubbed (including mowing when required). Undisturbed stumps, roots and nonperishable solid objects which will be a minimum of 2 feet below the subgrade or slope of embankments will be permitted to remain provided they do not extend more than 6 inches above the original ground line or low water level.

Explosives shall be used in accordance with Subsection 107.11.

Except in areas to be excavated, stump holes and other holes left from clearing and grubbing shall be backfilled with usable soil conforming to Subsection 203.06(a) and compacted to at least the density of the surrounding soils.

Burning of material shall be under the constant care of watchmen. Burning of materials shall not jeopardize anything designated to remain on the right-of-way, the surrounding forest cover, or other adjacent

property. Burning shall be in accordance with laws and ordinances and in particular, the current regulations of the Louisiana Department of Environmental Quality and Subsection 107.13.

Materials and debris which cannot be burned and materials which are not burned shall be removed from the right-of-way and disposed of in accordance with Subsection 202.02

Merchantable timber in the area to be cleared which has not been removed from the right-of-way prior to the beginning date stipulated in the Notice to Proceed shall become the property of the contractor.

Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed at no direct pay. Branches of trees extending over the roadbed shall be trimmed to a height of 20 feet above the pavement. Trimming shall be done in accordance with accepted horticultural and tree surgery practices published by AAN.

201.04 MEASUREMENT. No measurement of area will be made for payment.

201.05 PAYMENT. When a pay item is included in the contract, payment for clearing and grubbing will be made at the contract lump sum price. Partial payment will be limited to 10 percent of the original total contract amount until the contractor has earned 40 percent of the original total contract amount. When clearing and grubbing consists of more than 50 percent of the contract amount, payment will be made for the work completed.

When the contract does not contain an item for clearing and grubbing, the work will be at no direct pay.

Payment will be made under:

Item No.	Pay Item	Pay Unit
201(01)	Clearing and Grubbing	Lump Sum

Section 202
Removal of Structures and Obstructions

202.01 DESCRIPTION. This work consists of removal and satisfactory disposal of buildings, floor slabs, foundations, septic tanks, fences, culverts, structures, pavements, abandoned pipelines and other obstructions not designated or permitted to remain, except obstructions to be removed under other contract items. It shall also include salvaging of designated materials and backfilling resulting trenches, holes and pits. If structures or obstructions are encountered which differ materially from those ordinarily encountered, the provisions of Subsection 105.18 shall apply. Removal of contaminated soils, underground tanks or structures containing hazardous materials shall be in accordance with Section 710.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

Erosion control shall be in accordance with Section 204.

202.02 GENERAL CONSTRUCTION REQUIREMENTS. The contractor shall remove and dispose of all portions of buildings, floor slabs, foundations, fences and other obstructions on the right-of-way, except utilities and those items for which other provisions have been made for removal. When specified, the contractor shall remove building foundations, slabs and appurtenances that extend beyond the right-of-way or that are entirely on private property. Designated salvageable material shall be removed, without unnecessary damage, in sections which may be readily transported. Salvageable material shall be stacked at specified storage areas by the contractor. When no storage sites are specified, salvaged materials shall be delivered to the nearest DOTD maintenance unit. Materials not designated to be salvaged shall be disposed of off the project outside the view of the traveling public with written permission of the property owner on whose property the material is placed. Copies of agreements with property owners shall be furnished the engineer prior to beginning of work. Holes left by structure removal, except in areas to be excavated, shall be filled to the level of the surrounding ground with usable soil conforming to Subsection 203.06(a) and shall be compacted as directed to at least the density of the surrounding soils.

202.03 BRIDGES AND DRAINAGE STRUCTURES. Bridges, including approach slabs, and drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Unless otherwise directed, substructures shall be removed to natural stream bottom and those parts outside the stream shall be removed to 1 foot below natural ground surface. Existing structures within the limits of a new structure shall be removed as necessary to accommodate construction of the new structure.

Steel or wood bridges to be salvaged shall be dismantled without unnecessary damage. Dismantling shall include stripping hardware and

removing nails. Steel members shall be match-marked before dismantling. Salvaged material shall be stored or removed in accordance with Subsection 202.02.

Explosives shall be used in accordance with Subsection 107.11. Blasting or other operations necessary for removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work.

202.04 PIPE. Pipe to be salvaged shall be removed without damage to the pipe. Pipe to be relaid shall be removed and stored so that there will be no loss or damage before relaying. The contractor shall replace sections lost from storage or damaged at no direct pay. Pipe not to be relaid and considered usable shall be salvaged, cleaned of soils or other materials, stored or removed and stacked in accordance with Subsection 202.02.

202.05 PAVEMENT, WALKS, CURBS, ETC. Concrete pavement, walks, curbs, gutters, etc., designated for removal, shall be disposed of in accordance with Subsection 202.02.

202.06 MEASUREMENT. When the contract stipulates that payment will be made for removal of structures and obstructions on a lump sum basis, the pay item will include all required removal of structures and obstructions. Where the contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the contract.

If the contract does not include pay items for removal of structures and obstructions, the removal work will not be measured for payment.

Hauling salvaged materials to specified storage sites will not be measured for payment.

202.07 PAYMENT. Payment for removal of structures and obstructions will be made at the contract lump sum price.

Payment for specific obstruction items stipulated for removal and disposal under unit price or lump sum pay items will be made at the contract price per unit or lump sum as specified. This will include removal and disposal of such items and the excavation and backfill incidental to their removal when required. When the removal is in an area to be excavated and payment is made under other items, no deduction will be made for those items. The price shall also include salvage of materials, their custody, preservation, storage on the right-of-way and disposal.

When payment of a specific obstruction item is on a lump sum basis and the quantities vary from the plan quantities, payment will be increased or decreased accordingly. The amount of this increase or decrease will be derived by dividing the contract lump sum price by the plan quantity and multiplying this value by the change in quantity.

Payment will be made under:

Item No.	Pay Item	Pay Unit
202(01)	Removal of Structures and Obstructions	Lump Sum
202(02)	Removal of _____	Each, Linear Foot, Lump Sum, Square Yard

Section 203
Excavation and Embankment

203.01 DESCRIPTION. This work consists of excavation, disposal, placement and compaction of materials for which provisions have not been made under other Sections of these specifications. This work shall include excavation and embankment construction for roadways and other structures, excavation for ditches and channels, and other grading operations necessary for the work in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical sections shown on the plans or established. When contaminated soils or underground tanks are encountered, handling shall be in accordance with Section 710.

Disposal of material shall be in accordance with Subsection 202.02.

The plans may include data regarding the boring and classification of existing materials. The Department does not guarantee the accuracy of such information and bidders may make, at no direct pay, such additional investigations as they consider necessary.

The contractor shall comply with Subsection 107.09 for work in, over or adjacent to navigable waters and wetlands, and shall comply with Subsection 107.28 when cultural artifacts, historical sites or archaeological sites are encountered.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

Excavated material may be used in accordance with Subsection 203.06.

Erosion control shall be in accordance with Section 204.

203.02 GENERAL EXCAVATION. General excavation consists of the excavation of materials within the right-of-way, except drainage or muck excavation.

203.03 DRAINAGE EXCAVATION. Drainage excavation includes the excavation for drainage beyond the limits of the roadway section except for wing ditches at cuts. Drainage excavation also includes inlet and outlet ditches to structures or roadways; changes in or deepening of channels of streams, berm ditches, ditches parallel or adjacent to the roadway beyond the limits of the roadway section; and material excavated from areas under bridges.

203.04 MUCK EXCAVATION. Muck excavation consists of the removal of water saturated soils, organic matter or other material not usable for foundation material. Materials which will decay or produce subsidence in the embankment, or materials containing decaying stumps, roots, logs, humus or other material are not satisfactory for use in the embankment. The engineer will determine the material to be removed. Material which cannot be used shall be removed and disposed of in accordance with Subsection 202.02.

203.05 BORROW. Borrow is defined as soils required for construction of embankments or other portions of the work in excess of soils obtained

from excavation. Borrow shall be obtained from an approved source and shall be used in accordance with Subsection 203.06. The contractor shall make arrangements for obtaining borrow at no direct pay.

Securing of exclusive option by a contractor on borrow areas or materials for the work will be considered a violation of Louisiana law and will be a basis for rejection of bids or such other action the Department deems advisable.

The contractor shall notify the engineer in writing a minimum of 30 calendar days in advance of borrow operations so that samples may be taken and soil tests completed prior to beginning borrow operations. The borrow pit and access shall be cleared to allow access for DOTD boring equipment. The borrow area shall be surveyed with a base line staked. Both the engineer and laboratory shall be furnished with a location plat and borrow pit plat. The contractor will not be permitted to begin borrow operations until materials are approved for use.

203.06 SOIL USAGE.

The laboratory will test and classify soil in accordance with DOTD TR 423 from samples taken in the original location. Soil shall be classified and approved prior to its being placed in embankments or other final positions on the project.

Soil properties will be determined as follows:

Property	Test Method
PI	DOTD TR 428
LL	DOTD TR 428
% Organic	DOTD TR 413
% Silt	DOTD TR 407
pH	DOTD TR 430

(a) Usable Soils: Usable soils shall have a PI of 20 or less, an organic content of less than 5 percent and a maximum silt content of 60 percent.

(b) Selected Soils: Selected soils are natural soils with a maximum PI of 15, maximum Liquid Limit of 35, a maximum organic content of 2 percent, and a maximum silt content of 60 percent.

(c) Nonplastic Embankment: Nonplastic embankment shall be as specified in Subsection 203.09.

(d) Headers: Headers are that portion of the embankment within 1000 feet of a bridge end. Headers shall be constructed for their full height with usable soils having a minimum PI of 10 and a maximum PI of 20. No lime treatment to the soil to meet the PI requirements will be permitted.

(e) Embankments other than Headers:

(1) When embankments are 8 feet or less in height, they shall be constructed with usable soils, except soil with a PI greater than 20 and less than 35 will be permitted when treated with a minimum of 6 percent lime, by volume, provided the organic content and silt requirements given in Heading (a) are met. If the contractor uses lime treatment, it will be at no direct pay. Lime treatment shall be Type E Treatment conforming to Section 304.

(2) When embankments exceed 8 feet in height, the soils below 8 feet shall be usable soils, except that soils with a PI greater than 20 and less than 35 will be permitted without lime treatment provided the

organic content and silt requirements given in Heading (a) are met. The soils above 8 feet shall meet the requirements of Heading (e)(1).

Soils with a PI of 35 to 45 inclusive may be used in embankments in the portion below 8 feet provided they are treated with a minimum of 10 percent lime, by volume, and provided the organic content and silt requirements given in Heading (a) are met. Lime treatment shall be Type E conforming to Section 304. When the contractor uses lime treatment, it will be at no direct pay.

(f) Plastic Soil for Slopes:

(1) PI less than 10: When soils having a PI less than 10 exist on cut slopes or fill slopes, a plastic soil blanket conforming to Subsection 203.10 will be required. Sampling to determine the need for a plastic soil blanket shall be performed in-place. On cut slopes, the contractor shall undercut 12 inches before placement of the plastic soil blanket.

(2) PI 10 or greater: When soils having a PI of 10 or greater and a pH less than 5.5 or greater than 8.5 exist on cut slopes or are used on fill slopes, a plastic soil blanket conforming to Subsection 203.10 will be required. In lieu of furnishing a plastic soil blanket, the contractor may modify the soil pH to conform to the requirements of Subsection 203.10 at no direct pay. Sampling to determine the need for a plastic soil blanket or modification shall be performed in-place. On cut slopes, the contractor shall undercut 12 inches before placement of the plastic soil blanket.

203.07 GENERAL REQUIREMENTS. Excavation and embankment construction consists of constructing roadway embankments, including preparation of areas on which they are to be placed; constructing drainage excavation; backslope construction; constructing dikes, when required; placing and compacting approved material in areas where unusable material has been removed; placing and compacting embankment material in holes, pits and other depressions; and placing and compacting embankment materials for backfilling structures. Prior to beginning excavation, grading or embankment operations in an area, all necessary clearing and grubbing in that area shall have been completed. Embankment materials shall not be placed or spread on portland cement concrete or asphaltic concrete pavements. Pavement surfaces, edges and joints shall not be damaged during embankment operations.

Embankment material shall be used in accordance with Subsection 203.06 and shall be placed in uniform layers not exceeding 12 inches of uncompacted thickness. Each layer shall be placed for the full width of embankment, brought to a uniform moisture content, and compacted by approved methods to a minimum of 95.0 percent of maximum dry weight density before the next layer is placed. Maximum dry weight density will be determined in accordance with DOTD TR 415 or TR 418 and percent in-place density in accordance with DOTD TR 401. The density of the embankment shall be such that the density of the type of base course being constructed as given in the table in Subsection 301.16(a) shall be met. The moisture content at the time of compaction, tested in accordance with DOTD TR 403, shall be within a range of -2.0 percent and +4.0 percent of optimum established in accordance with DOTD TR 418 or the lifts shall be reprocessed and recompacted until these requirements are met. Operations shall be conducted to prevent lamination between lifts. Laminations between lifts shall be corrected prior to placing additional lifts.

Surfaces of excavated areas and embankments shall be smooth and uniform. Material outside construction limits shall not be disturbed.

Excavated material shall become the property of the contractor. Soils from excavation areas may be used when approved in embankments or other finished sections. Surplus or unusable excavated material shall be disposed of by the contractor in accordance with Subsection 202.02 or as provided in this Subsection.

Drainage excavation and rough grading shall be performed simultaneously, unless otherwise directed or permitted. Roots, stumps or other vegetative obstructions in sides and bottom of ditches and channel changes shall be cut to conform to required cross section and grade. Excavated material shall be placed sufficient to protect the integrity of the slope but in no case closer than 3 feet from the edge of ditch.

When obliteration of old roadways is required, it shall include grading operations necessary to satisfactorily incorporate the old roadway into the new roadway and surroundings in order to provide a pleasing appearance from the new roadway.

When preparing surface layers on which the embankment, base or subbase is to be placed, the contractor shall attempt all normal earthwork construction methods before undercutting or modifying the soil with additives will be considered by the Department. Such construction methods shall include, but are not limited to, the following and will be at no direct pay:

(a) Draining and drying of the surface until the material is within the limits of optimum moisture before compaction is attempted.

(b) Using lighter construction equipment for manipulating, disking, drying and compacting the material.

(c) Dumping successive loads of material in a uniformly distributed layer of a thickness necessary to support equipment while placing subsequent layers.

(d) Rerouting heavy construction equipment around the area until the embankment can support the equipment without damage to foundation soils.

Unstable materials shall be removed by undercutting, unless otherwise directed, and backfilled to required section with usable soils as directed.

When undercutting is required, the contractor shall conduct the operations in such manner that the engineer can make necessary measurements before backfill is placed.

When excavation and embankment construction results in surface soils having a PI less than 10 or pH less than 5.5 or greater than 8.5, the contractor shall place a plastic soil blanket conforming to Subsection 203.10.

The contractor shall be responsible for the stability of embankments until final acceptance. Construction activities which may lead to subsequent embankment damage will not be permitted.

When embankments are constructed on a surface sloping more than 6:1 from the horizontal, the slope of the ground on which the embankment is to be placed shall be cut into steps, as directed, before fill is placed.

When a new roadway is to be constructed on an existing roadbed, and the surface of the existing roadbed is within 1 foot of finished subgrade, the existing roadbed shall be scarified full width to a depth of not less than 9 inches and recompacted in accordance with this Subsection.

When an embankment is to be constructed to a height of less than 3 feet, heavy sod and objectionable vegetation shall be removed from the area on which the embankment is to be placed. The area shall be scarified to a depth of approximately 9 inches. This area shall be recompacted to at least 95.0 percent of maximum dry weight density. Maximum dry weight density will be determined in accordance with DOTD TR 415 or TR 418 and percent in-place density in accordance with DOTD TR 401. When height of fill is 3 feet or more, removal of sod will not be required but the area on which embankment is to be placed shall be thoroughly disked and satisfactorily recompacted before construction of embankment.

When embankment material is to be deposited only on one side of abutments, wing walls, piers, or culvert headwalls, the area immediately adjacent to the structure shall not be compacted to the extent that it will cause excessive pressure against the structure. Fill adjacent to the end bent of a bridge shall not be placed higher than the top of the substructure until the superstructure is in place. When the embankment is to be deposited on both sides of a concrete wall or similar structure, operations shall be conducted so that the embankment is always at approximately the same elevation on both sides of the structure. Backfilling of structures shall be performed in accordance with Section 802.

When embankments are constructed in lakes, streams, swamps or other unstable areas and unstable material cannot be removed or the area drained, the requirement for placing material in layers as outlined above may be waived. When this requirement is waived, the embankment shall be placed by end dump or other approved methods to an elevation where normal construction methods can begin. Embankments placed above this elevation shall be constructed in layers as specified above.

203.08 CUT AREA PREPARATION. When a base course, subbase or embankment is to be constructed on the surface of a cut section, the top layer of the cut area shall be a usable soil conforming to Subsection 203.06(a) for the full width of the roadbed. In-place soils which do not meet these requirements shall be removed and replaced with usable soils conforming to Subsection 203.06.

The soil materials used to replace unusable soils in the cut section will be sampled in their original position by the Laboratory and tested and classified. Soils shall be classified in accordance with DOTD TR 423.

(a) When a subbase or base course is to be constructed directly on the surface of a cut area, the top 36 inches shall conform to the requirements for usable soil of Subsection 203.06(a). The top 12 inches shall be scarified and compacted to such density that the compaction requirements of the type base course being constructed given in the table in Subsection 301.16(a) shall be met. Construction, compaction, and testing requirements shall be in accordance with Subsection 203.07.

(b) When an embankment 3 feet or less in thickness is to be constructed on the surface of a cut area, a minimum of the top 36 inches of the cut area and embankment shall be usable soil conforming to Subsection 203.06(a). The top 9 inches of the cut area shall be scarified, compacted and tested in accordance with Subsection 203.07.

(c) When an embankment greater than 3 feet is to be constructed directly on the surface of a cut area, embankment materials shall be placed in maximum lifts 12 inches loose thickness directly on the cut section and compacted and tested in accordance with Subsection 203.07.

When unstable soils are encountered, the area shall be undercut to a stable foundation and the embankment constructed and tested in accordance with Subsection 203.07 to existing grade. Undercut shall be constructed and tested in accordance with Subsection 203.07.

When a stable foundation cannot be reached, the embankment materials shall be "bridged-in" and the remaining embankment constructed in accordance with Subsection 203.07 to existing grade.

203.09 NONPLASTIC EMBANKMENT.

(a) Materials: Nonplastic embankment materials shall conform to Subsection 1003.09.

(b) General Requirements: Material defined in Subsection 203.04 shall not be entrapped in the embankment. The contractor shall remove any such material at no direct pay.

Surcharge materials shall remain on the embankment for at least the specified number of days after approval of the increment. Damage to embankment increments due to the contractor's operations shall be satisfactorily repaired by the contractor at no direct pay. The contractor will be permitted to remove excess surcharge materials after the surcharge period. Verification cross sections of the final embankment will be taken within 90 days after removal of the surcharge. The Department will assume liability for subsidence after these cross sections are taken. After all embankment increments have been surcharged, excess surcharge material shall be satisfactorily disposed of in accordance with Section 202.02 at no direct pay.

Except for shell embankments, the contractor shall furnish and place a plastic soil blanket conforming to Subsection 203.10.

(c) Nonplastic Embankment Construction: Nonplastic embankments shall be constructed by mechanical methods.

Material shall be placed in lifts not exceeding 15 inches uncompacted thickness after establishing a working table as directed. Each lift shall be compacted and tested in accordance with Subsection 203.07.

203.10 PLASTIC SOIL BLANKET: Plastic soil blanket shall consist of soils having a minimum PI of 12 and maximum PI of 35 and a pH not less than 5.5 or greater than 8.5 that will support adequate vegetation. The minimum thickness of the soil blanket will be 12 inches. Areas requiring a plastic soil blanket shall be approved prior to placement of the plastic soil blanket. After materials are placed and spread, lumps, stones, roots and other foreign matter shall be removed from the area. Soil blanket material shall be rolled with a cultipacker or by other approved methods.

Plastic soil blanket shall be placed in a timely manner to prevent erosion. When any increment of embankment reaches 3 feet or finish grade, plastic soil blanket shall be placed.

203.11 EMBANKMENT STABILIZATION WITH GEOTEXTILE FABRICS:

(a) General: This work consists of furnishing and placing geotextile fabric in accordance with these specifications and in conformance with the details shown on the plans.

(b) Materials: The geotextile fabric shall conform to Section 1019.

(c) Construction Requirements: Rolls of geotextile fabric shall be kept covered at all times until use. Geotextile fabric that has been installed shall be covered with embankment within 7 calendar days. When

ultraviolet damage occurs, the geotextile fabric shall be removed and replaced. The geotextile fabric shall be placed at the locations shown on the plans or as directed. Adjacent rolls of geotextile fabric will be overlapped or sewn. When rolls are overlapped, the overlap shall be a minimum of 6.0 feet, including the ends of the rolls. The top layer of the geotextile fabric shall be parallel with adjacent rolls and in the direction of embankment placement. When rolls are sewn, the contractor shall join adjacent rolls by sewing with polyester or kevlar thread. Field sewing shall employ the "J" seam or "Butterfly" seam with the two pieces of geotextile fabric mated together, turned in in order to sew through 4 layers of fabric and sewn with 2 rows of Type 401, two-thread chain stitch. Factory seams other than specified may be submitted to the Materials and Testing Section for approval. Where the ground is covered with water or soil is saturated, sewing of the geotextile fabric will be required.

The geotextile fabric shall be placed as smooth as possible with no wrinkles or folds, except in curved road sections. For curved road sections, the geotextile fabric shall be folded to accommodate the curve. The fold shall be in the direction of construction and pinned or stapled. Ruts that occur during construction shall be filled and compacted prior to placement of geotextile fabric.

Damaged geotextile fabric shall be either removed and replaced with new geotextile fabric or covered with a second layer of geotextile fabric extending 6 feet in each direction from the damaged area.

203.12 QUALITY CONTROL: The contractor shall locate, select, and place material conforming to specification requirements. The contractor shall control the work to ensure compliance with specification requirements. Tests for in-place moisture content shall be performed in accordance with DOTD TR 403, at a frequency that will ensure that the material is within the tolerances of optimum moisture. Tests for in-place density shall be performed in accordance with DOTD TR 401 at a frequency that will ensure that the compactive effort is producing a uniform product that conforms to specification requirements. The contractor shall control placement and finishing to ensure conformance with the lines, grades, thickness, and typical cross-sections shown on the plans or established.

Sections will be inspected prior to acceptance testing. Obviously deficient areas shall be corrected prior to acceptance testing.

203.13 ACCEPTANCE: The Department will perform inspection, sampling, and testing for acceptance. Any area that is deficient will require correction whether identified by inspection or testing.

The embankment (with surcharge, if required) will be approved in increments of 1,000 linear feet, except terminal increments which may be less than 1,000 feet.

Maximum density for earthwork will be determined in accordance with DOTD TR 415 or DOTD TR 418; in-place density will be determined in accordance with DOTD TR 401. The frequency of in-place density testing for acceptance will be a minimum of one test per lift per 1,000 linear feet of roadway.

203.14 MEASUREMENT.

(a) General:

No measurement will be made of material temporarily removed and replaced to facilitate compaction of the material.

Measurement of undercut will be from subgrade or original ground, whichever is lower.

(b) General Excavation, Drainage Excavation, Muck Excavation, Embankment and Nonplastic Embankment: Measurement will be made per cubic yard, computed by the average end area method. The end area will be bounded by the original ground line established by field cross sections taken after completion of required clearing and grubbing and the final theoretical pay line shown on the plans or established by the engineer.

(1) Verification of Final Theoretical Pay Lines:

a. Embankments and Excavations: After completion of excavation and embankment operations, except muck excavation, final excavation and embankment lines will be verified by the engineer in accordance with Department policies.

Final excavation and embankment slope lines shall be uniform in appearance. Measurements shall be taken a minimum of every 10 feet of elevation between the theoretical top of embankment and toe of slope or at slope changes. When the slope varies by more than -0.03 foot to +0.15 foot per linear foot, the slopes shall be reworked by the contractor until these criteria have been met. The top of embankment shall not vary from the established grade by more than ±0.1 foot.

Pay lines for surcharged embankments will be the theoretical surcharge lines shown on the plans. No measurement will be made for removing and disposing of excess surcharge materials.

When payment is made for embankment in its final position, no additional quantity will be measured due to settlement, compaction, erosion or other cause.

Excavation and embankment for crossovers, turnouts, driveway approaches or other minor installations will not be included in the measurement.

b. Muck Excavation: After completion of all muck excavation operations, final theoretical excavation lines will be verified by the engineer. Elevations for underwater mucking will be determined in accordance with DOTD TR 426.

A depth tolerance of ±0.5 foot in mucked areas will be permitted, with a corresponding allowable width variation. Overdepth and overwidth will be waived at no direct pay; however, no measurement for payment will be made for additional embankment material required to backfill areas beyond theoretical muck lines.

(2) Final Field Cross Sections: When payment lines are not shown on the plans and cannot be established, in lieu of final theoretical pay lines, final field cross sections will be used to determine pay quantities for excavation and embankment.

If deficient excavation and embankment areas are permitted to remain without correction, the Department reserves the right to determine pay quantities based on final field cross sections in lieu of theoretical pay lines.

(c) Excavation and Embankment:

(1) Linear Measurement: When excavation or embankment is to be measured on a linear basis, the length will be measured in stations of 100 linear feet, which includes performing the excavation, embankment and grading work necessary for construction of the project. It is the contractor's responsibility to determine quantities of earthwork necessary to complete this item.

When an item for borrow material is not included in the contract, payment for necessary borrow material will be made under this item.

(2) Lump Sum Measurement: When excavation and embankment is to be measured by the lump sum, this item includes performing the excavation, embankment, and grading work necessary for construction of the project. It is the contractor's responsibility to determine the correct quantities of earthwork required to complete this item. No adjustment in contract price will be made due to errors in any estimated earthwork quantities shown on the plans. Payment for the required borrow material will be included in the contract price for this item.

(d) Borrow (Vehicular Measurement): The material will be measured by the cubic yard in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01.

(e) Geotextile Fabric: Geotextile fabric will be measured by the square yard of covered area in place.

No measurement will be made for excavation for culverts or culvert headwalls.

When the grade line of a pipe or box culvert is raised or lowered more than 2 feet from the grade line shown on the plans or is relocated to a site requiring an equivalent change in excavation, payment will be increased or decreased accordingly at the rate of three times the contract unit price for General Excavation (or Embankment if General Excavation is not a contract pay item). The volume to be used in the increase or decrease will be a rectangular solid the length of the pipe or box culvert, the outside width of the pipe or box culvert plus 3 feet, and the average change in invert elevation minus 2 feet.

203.15 PAYMENT. Payment for the accepted quantities will be made at the contract unit prices which includes furnishing the equipment, labor and materials necessary to complete the items.

Payment for roadway obliteration will be made as general excavation.

Payment for undercut will be as general excavation, and payment for required usable soil for backfilling will be made as embankment.

Plastic soil blanket will be included in the pay volume for the embankment.

No direct payment will be made for acquisition of borrow materials outside the right-of-way; acquisition of right-of-way and constructing haul roads; stockpiling and rehandling of materials; precautionary measures to protect private property and utilities; or furnishing necessary water and watering equipment.

Plastic soil blanket in cut sections, when required, will be made as general excavation and payment for the required plastic soil blanket will be made as embankment.

Payment will be made under:

Item No.	Pay Item	Pay Unit
203(01)	General Excavation	Cubic Yard
203(02)	Drainage Excavation	Cubic Yard
203(03)	Muck Excavation	Cubic Yard
203(04)	Embankment	Cubic Yard
203(05)	Nonplastic Embankment	Cubic Yard
203(06)	Excavation and Embankment	Lump Sum
203(07)	Excavation and Embankment	Station
203(08)	Borrow (Vehicular Measurement)	Cubic Yard
203(09)	Geotextile Fabric	Square Yard

Section 204
Temporary Erosion Control

204.01 DESCRIPTION. This work consists of providing temporary erosion control on the project and in areas outside the right-of-way where work is accomplished in conjunction with the project; to prevent pollution of water, detrimental effects to property adjacent to the right-of-way, and damage to work on the project. These measures shall consist of construction and maintenance of temporary erosion control features shown on the plans or as directed.

Installation of temporary erosion control features shall be coordinated with construction of permanent erosion control features to the extent necessary to ensure economical, effective and continuous control of erosion and water pollution throughout the life of the contract.

The use of erosion control features or methods other than those in the contract shall be as directed.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

204.02 CONTROL OF ERODIBLE SOIL:

(a) General: The contractor shall prevent the transmission of soil particles into streams, canals, lakes, reservoirs or other waterways.

Except as necessary for construction, excavated material shall not be deposited into streams or impoundments, or in a position close enough to be washed in waterways by high water or runoff.

The contractor shall not disturb lands or waters outside the limits of construction, except as authorized.

(b) Adjacent to Waterways: Stream banks shall be kept in their natural state. The contractor shall not unnecessarily strip protective vegetation in the vicinity of stream banks and shall conduct operations without damage to banks. No bank shall be excavated except as shown on the plans. No work roads shall be constructed upstream when it is necessary to cut the banks unless approved in writing. Banks cut for work roads shall be located downstream and replaced by the contractor to their original shape and density. Unnecessary stripping of vegetation along banks in the construction area will not be permitted.

(c) Adjacent to Property: The location of, and method of operation in, borrow pits, material pits and disposal areas furnished by the contractor for waste material from the project (other than commercially operated sources) shall meet the approval of the engineer as being such that erosion during and after completion of the work will not result in detrimental siltation or water pollution.

204.03 MATERIALS. Materials not covered by project specifications shall meet commercial grade standards and shall be approved before being incorporated into the project. No testing of materials used in temporary

erosion control features will be required. Acceptance of temporary erosion control materials will be by visual inspection.

When temporary erosion control features become permanent erosion control, sampling and testing will be required in accordance with the appropriate Subsection.

(a) Mulches: Vegetative mulch shall conform to Subsection 1018.19 and emulsified asphalt shall conform to Section 1002.

(b) Seeding: Grass shall be an approved quick-growing species suitable to the area, providing a temporary cover which will not compete with permanent grasses. Rye grass is the only acceptable grass for winter cover.

(c) Slope Drains: Slope drains may be constructed of pipe, fiber mats, rubble, portland cement concrete, asphaltic concrete, plastic sheets or other acceptable material.

(d) Fertilizer: Fertilizer shall conform to Subsection 1018.16.

(e) Silt Fencing: Silt fencing shall be wire-supported or self-supported systems. Other silt fencing systems may be used when approved.

(1) Wire-Supported: Wire-supported silt fencing shall consist of standard woven livestock wire, and minimum of 14-gage wire, a minimum of 36 inches in height with a maximum spacing of 6 inches. Posts shall be either wood or steel installed a minimum of 2 feet in the ground. Filter material shall be burlap weighing approximately 7 1/2 ounces per square yard, approved jute fabric or approved geotextile fabric. Geotextile fabric shall conform to Section 1019, Type F.

(2) Self-Supported: Self-supported silt fencing shall consist of an approved geotextile fabric suitably attached to posts of either wood or steel installed a minimum of 2 feet in the ground. Geotextile fabric shall conform to Section 1019, Type G.

(f) Lime: Agricultural lime shall conform to Subsection 1018.17.

204.04 PRECONSTRUCTION CONFERENCE. At the preconstruction conference or prior to the start of the applicable construction, the contractor shall present the proposed schedule for construction of the project in accordance with requirements of this Section. The schedule shall be in written form. This schedule shall indicate the sequence of clearing and grubbing, earthwork operations, construction of permanent erosion control features, and proposed use of temporary erosion control features. It shall also include proposed methods to prevent pollution of streams, lakes, tidal waters, reservoirs, canals and other impoundments as the result of construction operations. The contractor shall also outline the proposed methods of controlling erosion and preventing pollution on haul roads and in borrow pits, material pits and areas used for disposal of waste materials from the project.

204.05 EXPOSURE OF ERODIBLE EARTH. The engineer may limit the surface areas of unprotected erodible earth exposed by clearing and grubbing, excavation or embankment operations. The engineer may direct the contractor to provide immediate permanent or temporary erosion or pollution control measures to prevent contamination of streams, lakes, tidal waters, reservoirs, canals or other impoundments or prevent detrimental effects on property outside the right-of-way and damage to the project. Limitations of areas in which excavation and embankment operations are

underway shall be commensurate with the contractor's capability and progress in keeping finish grading and permanent erosion control measures in accordance with the accepted schedule.

204.06 INCORPORATION OF EROSION CONTROL FEATURES. Use of temporary erosion control features will be authorized to correct unforeseen conditions that develop during construction; to control erosion prior to the time it is practical to construct permanent control features; or to provide immediate temporary control of erosion that develops during normal construction operations but is not associated with permanent erosion control features. Permanent erosion control features shall be incorporated into the project at the earliest practical time.

Temporary erosion control features will be used as directed in areas where stage construction or other conditions not under control of the contractor preclude completion of a section of roadway in a continuous manner, or where subsequent construction operations will cause damage to permanent erosion control features.

204.07 CONSTRUCTION REQUIREMENTS. Temporary erosion control features shall consist of, but not be limited to, temporary seeding, temporary mulching, sandbagging, slope drains, sediment basins, sediment check dams, erosion checks, artificial coverings and berms. The engineer may direct use of temporary erosion control features or methods other than those included in the original contract. Soil deposits outside the right-of-way shall be immediately removed and the surface repaired at no direct pay. Operations shall be discontinued until erosion deposits have been cleared and the area restored.

(a) Temporary Seeding: Seeding shall be done in accordance with Section 717, except that ground preparation will be limited to blading the area. Lime or fertilizer shall be applied in accordance with Section 718; however, lime or fertilizer may be omitted or the application rate reduced as directed.

(b) Temporary Mulching: Vegetative mulch and emulsified asphalt shall be furnished and applied in accordance with Section 716. Mulch may be omitted or the application rate reduced as ordered. When permanent seeding operations begin, temporary mulch materials shall be plowed under during ground preparation.

(c) Sandbagging: Sandbags shall be placed as directed.

(d) Baled Straw or Hay: Baled straw or hay shall be placed as directed to form checks or dams to control erosion and siltation. Bales shall be properly staked or otherwise secured as directed as shown on the plans. The bale shall be buried 4-6 inches. Two 2-inch by 2-inch by 3-foot stakes shall be driven through each bale, flush to the top of the bale.

(e) Slope Drains: Slope drains shall be constructed with acceptable materials in accordance with plan details or as directed. The discharge area shall be stabilized or protected by temporary riprap as directed. Cost of discharge area protection will be included under the slope drain item.

(f) Sediment Basins: Sediment basins shall be constructed in accordance with plan details or as directed.

(g) Sediment Check Dams: Check dams shall be constructed at locations shown on the plans or as directed. Check dams shall be constructed

before clearing and grubbing or grading in the area is begun unless otherwise directed.

(h) Silt Fencing: Silt fencing shall be furnished and constructed at designated locations.

(i) Berms: Earth berms shall be constructed as directed to divert the flow of water from erodible surfaces.

(j) Unforeseen Conditions: When unforeseen conditions are encountered, the engineer may direct the contractor to construct such temporary devices as required to control erosion during construction. Details may be developed jointly by the engineer and the contractor.

(k) Maintenance of Erosion Control Features: Temporary erosion control devices shall be replaced as directed at no direct pay. Sediment shall be removed in a timely manner to prevent blow out or overtopping at no direct pay.

(l) Removal of Temporary Erosion Control Features: Temporary erosion control features existing at the time of construction of permanent erosion control features shall be removed or incorporated into the soil in such manner that no detrimental effect will result. The engineer may direct that temporary features be left in place. Sediment in sediment basins, silt fences, check dams, and other catchment areas shall be removed, replaced with acceptable soils in accordance with Subsection 203.06, and compacted as directed at no direct pay.

204.08 PROTECTION DURING SUSPENSION OF CONTRACT TIME. Prior to the suspension of operations, the contractor shall shape the top of the earthwork in such manner as to permit runoff of rainwater and shall construct earth berms along the top edges of embankments to intercept runoff water. Temporary slope drains shall be provided in the earth berm to carry runoff. When such preventive measures fail, the contractor shall immediately take other action as necessary to prevent erosion and siltation. The engineer may direct the contractor to perform other erosion control work during suspensions of contract time.

204.09 MEASUREMENT. When temporary erosion and pollution control measures are required due to the contractor's negligence or failure to install permanent controls, such work shall be performed by the contractor at no direct pay.

Required temporary erosion and pollution control work which is not due to the contractor's negligence will be measured as follows:

(a) Temporary Erosion Control Devices: When separate items for temporary erosion control devices are included in the contract, and the work is ordered, the quantities to be paid for will be the weight in pounds of Temporary Seeding and in tons of Temporary Mulching; the volume in cubic yards of Sandbagging with the measurement of sand being made in a batch box or other satisfactory means; the dry weight in tons of Hay or Straw Bales; the length in feet of Temporary Slope Drains measured along the ground surface, and Silt Fencing measured along ground surface between end posts; the number of Sediment Basins and Sediment Check Dams acceptably constructed; and the number of gallons of emulsified asphalt.

Temporary erosion control items may be eliminated when conditions do not justify their use.

(b) When temporary erosion control work is ordered and is not covered by contract items, the work shall be performed as extra work in accordance with Subsection 109.04 except that no extra work order will be required prior to starting work.

Erosion control work for protection of construction areas outside the right-of-way, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured for payment.

The construction of temporary earth berms along edges of the roadway to prevent erosion during grading and subsequent operations will not be measured for payment.

In case of failure of the contractor to control erosion, or siltation, the engineer may employ outside assistance or use his own forces to provide the necessary corrective measures, and the cost thereof will be deducted from payments for the work. Partial payments will be withheld until satisfactory temporary erosion control is established.

204.10 PAYMENT. Payment for temporary erosion control items that are included as contract items will be made at the contract unit prices. Payment for temporary mulching, emulsified asphalt and seeding will be made under Sections 716 or 717. Temporary erosion control work not covered by contract items that is ordered will be paid for in accordance with Subsection 109.04.

Temporary Sandbagging and Baled Hay or Straw will be paid for directly when used other than in construction of Temporary Slope Drains, Temporary Sediment Basins and Temporary Sediment Check Dams. When sandbags and baled hay or straw are used in construction of slope drains, sediment basins and sediment check dams, payment will be made under these items.

Payment for devices used to correct unforeseen conditions will be made at the contract unit price for similar devices shown on the plans, or as extra work if plan details are not applicable.

Payment will be made under:

Item No.	Pay Item	Pay Unit
204(01)	Temporary Sandbagging	Cubic Yard
204(02)	Temporary Baled Hay or Straw	Ton
204(03)	Temporary Slope Drains	Linear Foot
204(04)	Temporary Sediment Basins	Each
204(05)	Temporary Sediment Check Dams	Each
204(06)	Temporary Silt Fencing	Linear Foot

PART III -- BASE AND SUBBASE COURSES

Section 301
Class I Base Course

301.01 DESCRIPTION. This work consists of furnishing and placing Class I Roadway and Shoulder Base Courses on a subgrade layer conforming to Section 305 in accordance with these specifications and in conformance with the lines, grades, thicknesses and typical cross sections shown on the plans or established.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankments and Base Course."

When not specified, any of the following types may be used.

(1) Soil Cement
(2) Stone or Crushed Slag
(3) Cement Stabilized Sand-Shell
(4) Cement Stabilized Sand Clay Gravel
(5) 4 1/2 inches Asphaltic Concrete (Type 5A) on Treated Layer
(6) Recycled Portland Cement Concrete

Unless approved in writing, the same type of Class I Base Course shall be used throughout the project.

With approval, concrete conforming to Section 901 may be used in lieu of the specified base course material in areas inaccessible to compaction equipment in turnouts and crossovers, and in other isolated or irregular areas. Concrete shall be placed, consolidated, finished and cured as directed in accordance with Section 706.

301.02 MATERIALS. Materials shall conform to the following Sections and Subsections and requirements.

Asphaltic Concrete	501
Portland Cement Concrete	901
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Emulsified Asphalt	1002
Cutback Asphalt	1002
Sand Clay Gravel	1003.01 & 1003.03(a)
Sand-Shell	1003.01 & 1003.03(c)
Stone	1003.01 & 1003.03(d)
Recycled Portland Cement Concrete	1003.01 & 1003.03(e)
Crushed Slag	1003.01 & 1003.03(f)
Water	1018.01

(a) Soils for Soil Cement: Soils for soil cement base course shall consist of materials that will stabilize with cement in accordance with DOTD TR 432. Such materials are those soils classified as A-1-a, A-1-b, A-2-4, A-2-6, A-3, A-4 and A-6 in accordance with DOTD TR 423. Soil with

a Liquid Limit greater than 35, a Plasticity Index greater than 12, or an organic content greater than 2 percent shall not be used. Liquid Limit and Plasticity Index will be determined in accordance with DOTD TR 428. Organic content will be determined in accordance with DOTD TR 413. Soil with over 79 percent sand or 60 percent silt when tested in accordance with DOTD TR 407, shall not be used. Soils which do not meet any of these requirements shall not be blended or treated. Topsoil shall not be used. The contractor shall obtain the material to be stabilized from outside right-of-way limits except as provided in Subsection 106.02(c).

(b) Portland Cement: Portland cement shall be Type I, I(B), or II. The quantity of cement used shall be supported by certificate of delivery.

(c) Portland-Pozzolan Cement: The cement shall be Type IP. The quantity of cement used shall be supported by certificate of delivery.

(d) Asphaltic Concrete Base Course: The material requirements for asphaltic concrete base course shall be as described in Section 501.

(e) Treated Layer Under Asphaltic Concrete Base Course: The treated layer under asphaltic concrete shall consist of the same material and treatment as the top layer of embankment. No raw, untreated material shall be placed between a treated embankment and the asphaltic concrete.

301.03 EQUIPMENT. Equipment shall be approved prior to use.

(a) Soil Cement, Cement Stabilized Sand-Shell, and Cement Stabilized Sand Clay Gravel:

(1) General: Central mix plants shall be certified in accordance with current Department procedures. Central mix plants may be either batch or continuous mix process and shall proportion aggregates, soils, and additives in a manner that will meet specification requirements. Safe, convenient facilities shall be provided for sampling mixture components prior to their introduction into the weigh hopper or pugmill. Mixing units shall have no dead areas which allow materials to remain unmixed or which permit improperly mixed materials to be discharged into hauling or storage units. The minimum capacity shall be 150 cubic yards per hour.

A control system shall be provided that will automatically stop plant operations when the material in any storage facility or working bin becomes empty or the flow of material is interrupted. The plant will not be permitted to operate unless this automatic control system is in good working order. When this control system malfunctions during production, operations shall be immediately discontinued.

The soil or aggregate feeder system shall be interlocked with the feeder system for cement, additives, and water such that the proportions of the components of the approved mix design are continuously maintained.

The complete process, including the plant with necessary auxiliary equipment and controls, operating procedures, and sampling and testing methods shall be approved by the Department prior to use. Any modifications to plant equipment or operations shall be approved prior to use.

The contractor shall provide plant site and project site laboratories conforming to Section 722 at no direct pay.

Measuring devices shall be subject to approval and shall be tested, inspected and certified by an approved independent scale service or the Weights and Measures Division, Louisiana Department of Agriculture and Forestry, at no direct pay, every 90 days or as often as deemed necessary to ensure their accuracy.

Scales shall be accurate to ±0.5 percent throughout the range of use. Maximum graduation on scales shall be 0.1 percent of the rated scale capacity.

The cement, soil and aggregate feeders, and water measuring devices shall be equipped with devices by which the rate of feed can be determined while the plant is in operation.

Water measuring devices shall be accurate to 1 percent of the metered quantity. Water meters shall have a maximum graduation of 1 gallon.

Methods and equipment for adding liquid additives shall be approved. Equipment for metering additives shall be capable of measuring the component to an accuracy of 3 percent of the required weight.

(2) Batch Process: When a batch mixing process is used, the mixer shall be equipped with a timing device which will indicate by an obvious signal the completion of the mixing period. The time of mixing a batch shall begin after all components are in the mixer and shall continue until the mixture is uniformly blended. The mixing time shall be approved. Cement for each batch shall be weighed on scales separate from those weighing other components and shall meet the requirements of this Subsection.

(3) Continuous Mix Process: When a continuous mix operation is controlled by weight, the contractor shall provide belt scales for conveyor systems for all components except water.

(4) Hauling Equipment: The mixture shall be hauled from the plant in approved covered trucks that will maintain the moisture content and prevent segregation and the loss of fine material. The cover shall be waterproof, shall completely cover the bed of the truck, shall be equipped with tie downs, and shall not have any rips, tears or holes.

(5) Compaction Equipment: Compaction equipment shall be a conventional sheepsfoot roller for initial compaction. The spikes shall be a minimum of 6 inches long, sufficient in size and number to provide uniform compaction for the full width and depth of the base course.

Finish rolling shall be with static smooth-drum or pneumatic tire rollers. Pneumatic tires shall have smooth tread, shall be the same size and ply rating, and shall be inflated to a uniform pressure not varying more than ±5 psi between tires. Wheels shall not wobble and shall be aligned such that gaps between tires on one axle are covered by tires of the other axle.

(b) Asphaltic Concrete: Equipment for asphaltic concrete shall conform to Section 503.

(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete: Equipment used to mix stone, crushed slag or recycled portland cement concrete shall produce a uniform blend conforming to the requirements elsewhere herein. When a central mix plant is used, it shall conform to Heading (a).

(1) Hauling Equipment: Stone, crushed slag and recycled portland cement concrete shall be hauled in trucks with tight, smooth beds of sufficient size and condition to prevent segregation and the loss of material.

(2) Compaction Equipment: Stone and recycled portland cement concrete compaction equipment shall be designed for the compaction of these materials and may be static or vibratory. Finish rolling shall be with static, smooth steel-wheel or pneumatic tire rollers. Pneumatic tires shall have smooth tread, shall be the same size and ply rating,

shall be inflated to a uniform pressure not varying more than ±5 psi between tires. Wheels shall not wobble and shall be aligned such that gaps between tires on one axle are covered by tires of the other axle.

(d) Automatic Finishing Machine: For all Class I base courses except asphaltic concrete an approved automatic finishing machine shall be used. The approved automatic finishing machine shall be capable of operating from an erected stringline capable of automatically controlling grade and cross-slope conforming to Subsection 501.07(b)(2).

301.04 STORAGE AND HANDLING OF MATERIALS PRIOR TO MIXING:

Stockpiles of materials shall be uniform; separation into separate sizes may be required. Equipment and methods for stockpiling shall be such that no segregation will result. Foreign material shall not be incorporated into the materials. Materials which have become contaminated shall not be used. Stockpiles shall be of uniform moisture content and well drained.

Soils and aggregates shall be stockpiled in dedicated stockpiles and shall be approved prior to mixing with cement. The moisture content of the stockpiles shall be controlled so that the blended mixture when tested in accordance with DOTD TR 403 shall be within ±2.0 percent of the optimum moisture content at the time of compaction. Storage facilities containing soil or fine aggregate shall be equipped with vibrators which will effectively vibrate the side walls of the feeder, prevent any accumulation of material and ensure a constant, uniform supply of material to the mixing unit.

(a) Storage of Cement: Cement shall be transported in watertight conveyances and stored in watertight buildings, silos or other approved facilities to protect the cement from dampness or water intrusion. Cement which has become contaminated, partially set, or which contains lumps of caked cement will be rejected.

Cement shall be certified by the manufacturer in accordance with the Department's current procedure. The contractor shall keep accurate records of cement deliveries and its use. Copies of these records shall be supplied to the engineer as required.

(b) Soils for Soil Cement: Soils for soil cement shall be one or more components, each meeting the requirements of Subsection 301.02(a).

(c) Sand Clay Gravel: Sand clay gravel for cement stabilized sand clay gravel shall be a single component which meets the requirements of Subsection 1003.03(a) or multiple components which, when combined, meet the requirements of Subsection 1003.03(a). The single component material or each separate component of a composited material shall be sampled, tested and approved prior to mixing with cement.

(d) Sand-Shell: Sand-shell for cement stabilized sand-shell shall be separate components sampled, tested, and approved in the stockpile. Individual components and the composited material shall meet the requirements of Subsection 1003.03(c).

(e) Asphaltic Concrete: Asphaltic concrete shall be stored and handled in accordance with Section 501.

(f) Stone, Crushed Slag, and Recycled Portland Cement Concrete: Stone, crushed slag, and recycled portland cement concrete shall be sampled, tested, and approved from dedicated stockpiles prior to placement on the subgrade.

301.05 GENERAL CONSTRUCTION REQUIREMENTS. Class I Base Courses shall be placed on a Subgrade Layer prepared in accordance with Section 305.

(a) Cement Stabilized Base Course: All cement stabilized base courses shall be mixed in a central mix plant conforming to Subsection 301.03. The percentage of cement for soil cement will be determined in accordance with DOTD TR 432 (Method A or B for portland cement; Method B for portland-pozzolan cement) prior to mixing. Samples for determination of the percent cement will be obtained from material in stock piles. For cement stabilized sand-shell and cement stabilized sand clay gravel, the minimum cement content shall be 6.0 percent by volume. Depending on the type of cement and soil or soil-aggregate to be used, normal testing time to determine required cement content may require 21 calendar days.

(b) Asphaltic Concrete: Asphaltic concrete base course shall be constructed in accordance with Section 501. The treated layer under asphaltic concrete base course shall be constructed in accordance with the top layer of embankment.

(c) Stone, Crushed Slag, and Recycled Portland Cement Concrete: Stone, crushed slag and recycled portland cement concrete base courses shall not segregate during construction and shall not cause moisture damage to the subgrade layer.

301.06 MIXING OF SOIL CEMENT, CEMENT STABILIZED SAND-SHELL, AND CEMENT STABILIZED SAND CLAY GRAVEL. Soil cement, cement stabilized sand-shell, and cement stabilized sand clay gravel materials shall be mixed in a central mix plant by either batch or continuous mixing process. Soils, aggregates, additives, and water may be proportioned by either weight or volume. The plant shall be calibrated by weight and equipped with a means to readily verify the quantity of each component. The time and points at which each component is introduced into the mixing process will be approved. The components shall be combined and mixed to produce a uniform, well-blended mixture. The total quantity of materials introduced into the mixing unit shall not exceed the approved capacity of the mixer.

When a continuous mix process is used, soils and aggregates shall be drawn from the storage area by a feeder or feeders which will continuously supply the correct amount of soil or aggregate in proportion to the cement. Soil and aggregate storage areas or feed bins shall be arranged so that the proportion of each size can be separately adjusted if more than one size is used.

Individual aggregates and soils shall be blended within 2 percent of the individual weight of that component and the total weight of aggregate and soils shall be within 1 percent of the required weight of the total material.

Optimum moisture of the mixture will be determined by the Laboratory in accordance with DOTD TR 418. The percentage of moisture in the mixture, by dry weight, shall not vary from optimum moisture within ±2.0 percent at the time of compaction. Moisture content at the time of mixing shall be controlled so that these tolerances are met. When these tolerances are not met and satisfactory control adjustments are not being made, operations shall be discontinued until proper adjustments and uniform operations are established.

Cement shall be incorporated within 1.0 percent of the required weight of cement.

301.07 QUALITY CONTROL OF PLANT OPERATIONS.

The contractor shall have a Certified Soil and Base Course Technician at the plant at all times when the plant is producing material for the Department.

The Certified Soil and Base Course Technician shall be capable of conducting any test or analysis necessary to put the plant into operation and producing cement stabilized mixtures conforming to the specifications. Daily plant operations shall not begin unless the Certified Soil and Base Course Technician is at the plant. The Soil and Base Course Technician certification will be awarded by the Department upon satisfactory completion of the Department's requirements.

(a) Soil Cement, Cement Stabilized Sand-Shell, and Cement Stabilized Sand Clay Gravel: The contractor shall be responsible for quality control of materials during handling, storing, blending, mixing, and transport. The contractor shall be responsible for adjusting equipment to provide the approved percent of each component in the mixture at optimum moisture content. The contractor shall provide suitable equipment for the determination of moisture content, gradation, proper pulverization, and proper combination of components as required.

The contractor shall be responsible for building and maintaining stockpiles of soils and aggregates which meet Department requirements and shall perform testing as necessary to ensure that materials delivered to the plant site meet the Department's specifications prior to requesting acceptance sampling and testing. The contractor shall be responsible for ensuring the quality of materials placed in dedicated stockpiles which have been approved for use. When inspection by the Department indicates contamination or segregation of dedicated stockpiles, the affected materials will be rejected and shall be removed from the dedicated stockpile. Materials shall be sampled, tested and approved by the Department prior to inclusion in an approved dedicated stockpile.

Water shall be incorporated into the mixing chamber through a multi-nozzle spray bar capable of spraying water uniformly, leaving no wet or dry areas. Water shall be added after mixing soils, soil aggregates, and cement.

The contractor's Certified Soil and Base Course Technician shall continually monitor plant operations to ensure that systems are functioning properly and that the proportions of materials are correct. At the beginning of each day's operation, whenever plant operations have been discontinued, and at least four times daily during continuous operation, the contractor shall check the percent cement being incorporated into the mixture. The contractor's Certified Soil and Base Course Technician shall test for moisture content of the soil or aggregate components in accordance with DOTD TR 403 at the beginning of each day's operations, whenever plant operations have been discontinued and at least twice per day during continuous operation. The contractor's Certified Soil and Base Course Technician shall test the moisture content of the mixture including the cement, as needed, to control the finished product within specification requirements. When a composite gradation is specified for the soil or aggregate material, gradation shall be checked at least twice per day in accordance with DOTD TR 112 and TR 113. Tests shall be documented in accordance with the Department's current procedures.

The contractor's Certified Soil and Base Course Technician shall check the percent pulverization in accordance with DOTD TR 431 at least twice per day. At least 80 percent shall pass the No. 4 sieve.

When any quality control test does not meet the applicable specifications, the contractor shall make immediate corrections or the operations shall be discontinued.

(b) Asphaltic Concrete: Asphaltic concrete plant operations shall conform to Section 501.

(c) Stone, Crushed Slag and Recycled Portland Cement Concrete: When stone, crushed slag or recycled portland cement concrete are mixed in a central mixing plant, the requirements of Heading (a) shall be met.

301.08 LOADING, TRANSPORTING AND PLACING ON SUBGRADE. The base course materials shall not segregate during loading. Soil cement, cement stabilized sand-shell or cement stabilized sand clay gravel mixtures shall be covered immediately with an approved waterproof cover that will prevent loss of moisture or fines or exposure to the elements. The cover shall be tied securely in place and shall not be removed until placement of the mixture.

Transportation, placing and spreading methods shall not damage the subgrade. The contractor shall place and spread sufficient material to obtain required width and compacted thickness within the tolerances set forth in Subsection 301.16. Soil cement, cement stabilized sand-shell, and cement stabilized sand clay gravel shall be placed and spread within 1 hour of mixing cement with the soils or soil-aggregates. Base course materials shall not be contaminated with subgrade layer. Any contamination will require retesting and correction of deficiencies. Base course material shall not be placed or spread on portland cement concrete or asphaltic concrete pavements. Pavement surfaces, edges and joints shall not be damaged during construction.

301.09 GRADE AND CROSS SLOPE CONTROL. Unless otherwise specified, Class I Base Courses (except asphaltic concrete) shall be constructed using an automatic finishing machine controlled from an erected stringline conforming to Subsection 501.07(b)(2). Asphaltic concrete base course shall be constructed with an erected stringline in accordance with Section 501.

301.10 COMPACTING AND FINISHING.

(a) Soil Cement, Cement Stabilized Sand-Shell, and Cement Stabilized Sand Clay Gravel: The mixture shall be compacted immediately after placement. Initial compaction shall be completed with an approved sheepsfoot roller so that no internal laminations occur in the completed base course. Compaction shall be with either a pneumatic-tire or smooth steel-wheel roller operated so that no surface laminations occur. The surface shall be kept uniformly moist during compaction and shaping.

During the compaction and finishing, areas which are low or have surface imperfections which need correction shall be corrected using fresh material. The surface shall be thoroughly scarified before placing and blending new base material. Final compaction of the corrected surface shall be completed within the same time limit applied to the initial placement of base materials as outlined in this Subsection.

Compaction shall be completed within 2 hours after initial mixing of cement with base course materials. Each lift of base course shall meet the requirements of Subsection 301.16. After the base has been compacted, water shall be uniformly applied as needed to maintain the proper moisture content for finishing. The surface shall be thoroughly rolled and finished to grade; loosened material shall be removed from the

section. The cross-slope shall not vary by more than ±0.001 ft/ft when tested with an approved 10-foot metal static straightedge.

The surface shall be finish rolled with either a pneumatic-tire or static steel-wheel roller to provide a smooth, tightly knit surface conforming to grade and the typical section shown on the plans. Final finishing with an automatic finishing machine shall result in a surface free of cracks, ridges, waves, surface laminations, or loose material. Final finishing shall be completed within 24 hours after the initial mixing of cement with base course materials. The automatic finishing machine shall produce a base course which conforms to grade and cross-slope. When final finishing cannot be done with an automatic finishing machine, it shall be done in accordance with Subsection 302.07.

At places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain the specified density without damage to adjacent structures.

Transport vehicles and heavy construction equipment shall not operate on compacted base course for a period of 72 hours after placement.

(b) Asphaltic Concrete Base: Compaction and finishing requirements shall be as follows.

(1) The asphaltic concrete layer shall be compacted and finished in accordance with Section 501. Vibratory rollers will not be allowed when it is detrimental to the underlying layers or areas with high water table.

(2) The treated layer under asphaltic concrete shall meet the requirements of the subgrade layer.

(c) Stone, Crushed Slag and Recycled Portland Cement Concrete: Compaction and finishing requirements shall be the same as specified in Heading (a), except that the 2-hour time limit will not apply. Water added to facilitate compaction shall not damage underlying materials. Vibratory rollers will not be allowed when it is detrimental to the underlying layers or in areas with high water table.

301.11 QUALITY CONTROL ROADWAY OPERATIONS: The contractor shall control the selection, placement, compaction, moisture content, density, thickness, width, surface finish, and grade so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The base course shall be constructed so that contamination, segregation, soft spots, wet spots, laminations, and other deficiencies are prevented. The contractor shall perform tests to control moisture content, thickness, width and density.

301.12 PROTECTION AND CURING.

(a) Soil Cement, Cement Stabilized Sand Clay Gravel, Cement Stabilized Sand-Shell, and Treated Layer Under Asphaltic Concrete: Upon completion of final finishing, the base course shall immediately be protected against drying by applying an asphaltic curing membrane in accordance with Section 506. Asphaltic curing membrane shall be placed on the same day as treatment. Complete coverage of curing membrane shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

(b) Stone, Crushed Slag, and Recycled Portland Cement Concrete: The completed base course shall be covered with asphaltic prime coat in

accordance with Section 505. Complete coverage of asphaltic prime coat shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

301.13 CONSTRUCTION JOINTS: Each day's construction shall be tied into the completed work of the previous day by a straight transverse construction joint formed by cutting back into the total width of the base to form a true vertical face free of loose and broken material at a point where the base conforms to the typical section shown on the plans.

Longitudinal joints constructed between parallel lanes or similar joints between lanes and ramps, etc., shall be reasonably vertical and free of loose and/or broken material.

The base at all joints is to be constructed so that the materials at and adjacent to the joint are stable, uniformly compacted and are tightly knit.

301.14 MAINTENANCE OF BASE COURSE. The contractor shall protect the completed base course from damage from public traffic or the contractor's operations, and shall satisfactorily maintain the completed base course including the asphaltic curing membrane or prime coat. Damaged base course shall be repaired by the contractor at no direct pay. When patching of the base course is required, in addition to removing damaged or unsound base course, the contractor shall remove a sufficient width and depth of base course to ensure satisfactory placement of patching material. The engineer will approve the type of patching material before use. Patching or other base course repair shall restore a uniform surface, shall conform to the requirements of the material being used, and shall be completed at least 24 hours prior to surfacing operations.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed base course during the 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed base course onto shoulders or other suitable areas during the 72-hour curing period, when conditions permit.

When traffic is permitted to use the completed base course subsequent to the 72-hour curing period and prior to construction of the surface course, the base shall be further protected by additional applications of asphaltic curing membrane or prime coat as directed in accordance with Subsection 301.12 at no direct pay.

Prior to surface course construction, the contractor shall correct deficiencies, clean the base course surface, repair any damages caused by traffic, and apply additional asphaltic curing membrane or prime coat as directed at no direct pay. This work shall be completed at least 24 hours prior to construction of the next layer.

Any weak spots that develop shall be satisfactorily corrected and the base kept free from deficiencies and true to grade and cross section at no direct pay.

When the surfacing is asphaltic concrete and traffic, including construction equipment, is allowed on the base, the first lift of surfacing shall be placed within 30 calendar days.

301.15 WEATHER LIMITATIONS. Placement of a Class I Base Course will not be permitted when the subgrade or stockpiles are frozen, when the ambient air temperature is below 35°F, or in the rain.

301.16 ACCEPTANCE REQUIREMENTS. Soils and aggregates will be tested for acceptance by the Department prior to placement in dedicated stockpiles.

Plant operations will be checked for uniformity and the proportioning of the components. The percent cement will be checked at least twice per day in accordance with DOTD TR 436. The percent cement being incorporated into the mixture shall not vary more than -0.1 percent by volume of the total material from the approved percent or operations shall be discontinued until corrections have been made.

The moisture content of the soil cement or cement stabilized mixtures will be tested for conformance to optimum moisture content in accordance with DOTD TR 403 at placement at least twice per day. When the moisture content is not within specification limits, the contractor shall take immediate corrective actions or operations shall be discontinued. When the moisture content is not within specification limits the in-place material may be required to be removed.

Pulverization of the soil cement or cement stabilized mixtures will be tested in accordance with DOTD TR 431 at the plant at least twice per day. At least 80 percent shall pass the No. 4 sieve.

Base courses, except asphaltic concrete, will be checked for determining acceptance in increments of 1,000 linear feet per roadway or 2,000 linear feet per shoulder constructed separately. Asphaltic concrete base course will be accepted in accordance with Section 501.

(a) Density Requirements: Upon completion of compaction operations, base course density, except asphaltic concrete, will be determined in accordance with DOTD TR 401. Density requirements of Asphaltic Concrete Base Course shall be in accordance with Section 501.

The density requirements will be as follows:

Base Course Type	Maximum Density Test Method	% of Maximum Density (Min.)
Soil Cement	DOTD TR 418	95.0
Cement Stabilized Sand-Shell	DOTD TR 418	95.0
Cement Stabilized Sand Clay Gravel	DOTD TR 418	95.0
Stone, Crushed Slag or Recycled Portland Cement Concrete	DOTD TR 418	98.0
Treated Layer Under Asphaltic Concrete	DOTD TR 418	95.0
Asphaltic Concrete	DOTD TR 304	95.0

(1) Soil Cement, Cement Stabilized Sand-Shell, Cement Stabilized Sand Clay Gravel, and Treated Layer Under Asphaltic Concrete: When the density test value for the section is below 95.0 percent, a payment adjustment will be applied as follows.

Density Test Value	% of Contract Unit Price
95.0 & Above	100
94.0 to 94.9	90
93.0 to 93.9	75
Below 93.0	50 or Remove[1]

[1]At the option of the Department after investigation.

(2) Asphaltic Concrete: The density requirements for asphaltic concrete base course shall be as specified in Section 501.

(3) Stone, Crushed Slag, and Recycled Portland Cement Concrete: When any test value is less than that required in the preceding table, compaction shall continue until the specified density is obtained.

(b) Thickness Requirements: The thickness of the completed base course will be determined in accordance with DOTD TR 602. The underthickness requirements for asphaltic concrete base course shall be in accordance with Section 501.

Underthickness of base courses, except asphaltic concrete, shall not vary from plan thickness in excess of 1/2 inch. Base course thickness deficiencies in excess of this tolerance shall be corrected as specified herein at no direct pay. When reconstruction is used as a method of correction, this tolerance shall apply.

Overthickness may be waived at no direct pay when grade requirements are met. When grade requirements are not met and no grade adjustments are permitted, correction will be required at no direct pay.

Failing areas will be isolated longitudinally for purposes of correction for the entire width.

(1) Soil Cement, Cement Stabilized Sand-Shell, Cement Stabilized Sand Clay Gravel and Treated Layer Under Asphaltic Concrete: When no grade adjustments are permitted, underthickness deficiencies shall be corrected by removing and replacing the full depth of base course in deficient areas with one of the following materials:

a. The same type of base course.
b. Asphaltic concrete conforming to Section 501.
c. Concrete conforming to Section 901.

When grade adjustments are permitted, the contractor shall have the option of correcting underthickness deficiencies by furnishing and placing a supplemental layer of asphaltic concrete conforming to Section 501 for the full width of base course in lieu of removing and replacing deficient base course. Thickness of the supplemental layer of asphaltic concrete shall be as follows:

Underthickness (Inches)	Minimum Thickness of Supplemental Asphaltic Concrete (Inches)
3/4 to 1 1/4	1 1/4[1]
1 1/2 to 1 3/4	1 1/2
2 to 2 1/2	2
Over 2 1/2	Remove and Replace

[1]May be included in the subsequent lift.

(2) Asphaltic Concrete Base Course: When grade adjustments are not permitted, underthickness in excess of the tolerances given in Subsection 501.11 shall be corrected to plan thickness by removing and replacing the full depth of base course. When grade adjustments are permitted, underthickness shall be corrected by placing and compacting a 1 1/4-inch thick supplemental layer of asphaltic concrete conforming to Section 501 at no direct pay.

(3) Stone, Crushed Slag and Recycled Portland Cement Concrete: When grade adjustments are permitted, underthickness in excess of 1/2

inch shall be corrected to plan thickness by furnishing, placing, mixing, reworking, shaping, and compacting an additional thickness of the same type of base course material. When grade adjustments are not permitted, the base course shall be removed and replaced.

(c) Width Requirements: The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of ±3 inches on each side of centerline. Shoulder base course width shall not vary from plan width in excess of 3 inches. When the base course for both roadway and shoulders is built at the same time, the ±3-inch tolerance on each side of centerline will be applied. Base course width deficiencies in excess of the above tolerances shall be corrected as follows at the contractor's expense:

(1) Overwidth: Overwidths on all base courses may be waived at no direct pay.

(2) Underwidth: Underwidths of all base courses in excess of the tolerances given above shall be corrected to plan width by furnishing and placing additional materials; however, the width of widening materials shall be not less than 12 inches. The thickness of the widening shall be plan thickness. Materials for widening deficient base course shall be one of the following:

1. The same type of base course.
2. Asphaltic concrete conforming to Section 501.
3. Concrete conforming to Section 901.

(d) Correction of Other Deficiencies: The contractor shall correct deficiencies in surface finish, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. These deficiencies shall be corrected by removing and replacing or as directed.

301.17 MEASUREMENT. The quantities of Class I base course for payment will be the design volumes or areas specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions and compacted thickness of the completed base course shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

301.18 PAYMENT. Payment for Class I Base Course will be made at the contract unit price, adjusted as specified in Subsection 301.16 and the following provisions, which includes furnishing and placing required base course materials, portland cement, portland-pozzolan cement, water, erected stringline, asphaltic curing membrane and prime coat.

Adjustments for variations in Class I Base Course thickness based on different structural coefficients shall be made by placing additional subgrade layer. This additional subgrade layer shall be paid for as base course.

Payment adjustments will be applied for specification deviations of asphaltic materials in accordance with Section 1002. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

Asphaltic concrete base course will be further subject to payment adjustments for deficiencies in Marshall Stability, pavement density,

aggregate gradation, or additives as specified in Table 2 of Section 501. Any payment adjustment in asphaltic concrete shall apply to the cubic yard total quantity of base course when payment is by cubic yard.

Failure to add the specified amount of cement in soil cement, cement stabilized sand-shell and cement stabilized sand clay gravel will result in a payment adjustment in accordance with Table 1.

When payment adjustments are made for more than one deficiency, they shall be cumulative.

Payment will be made under:

Item No.	Pay Item	Pay Unit
301(01)	Class I Base Course	Cubic Yard
301(02)	Class I Base Course (" Thick)	Square Yard
301(03)	Class I Base Course for Shoulders	Cubic Yard
301(04)	Class I Base Course for Shoulders (__" Thick)	Square Yard

TABLE 1
PAYMENT ADJUSTMENT SCHEDULE

	% of the Contract Unit Price			
	100	90	80	50 Remove or Replace[1]
% Cement in Cement Stabilized Bases less than required amount	0.0-0.1	0.2-0.4	0.5-1.0	more than 1.0

[1]At the option of the Department after investigation.

Section 302
Class II Base Course

302.01 DESCRIPTION. This work consists of furnishing and placing Class II roadway and shoulder base course on a prepared surface in accordance with these specifications, in conformity with the lines, grades, thickness, and typical sections shown on the plans or established. The contractor shall control the selection, placement, mixing and compaction of materials so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements. The contractor shall perform tests to control gradation (when required), moisture content, pulverization, thickness, width and density.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

When not specified, any of the following types may be used.

Soil Cement
Cement Treated Sand Clay Gravel
Cement Treated Sand-Shell
Sand Clay Gravel
Shell
Sand-Shell
Stone or Crushed Slag
Asphaltic Concrete on Embankment Layer
Recycled Portland Cement Concrete

Unless approved in writing, the same base course material shall be used throughout the project.

With approval, concrete conforming to Section 901 may be used in lieu of the specified Class II Base Course material in areas inaccessible to mixing and compacting, in turnouts and crossovers, and in other isolated or irregular areas. Concrete shall be placed, consolidated, finished and cured as directed in accordance with Section 706.

In order to meet air quality standards, the contractor may be required to use central plant mixing of cement treated mixtures in dust sensitive areas at no direct pay. The contractor may use other types of Class II Base Course in dust sensitive areas at no direct pay. The Department will identify the dust sensitive areas before cement treatment begins.

302.02 MATERIALS. Materials shall conform to the following Sections or Subsections and requirements.

Asphaltic Concrete	501
Portland Cement Concrete	901
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02

Cutback Asphalt	1002
Sand Clay Gravel	1003.01 & 1003.03(a)
Shell	1003.01 & 1003.03(b)
Sand-Shell	1003.01 & 1003.03(c)
Stone	1003.01 & 1003.03(d)
Recycled Portland Cement Concrete	1003.01 & 1003.03(e)
Crushed Slag	1003.01 & 1003.03(f)
Water	1018.01

(a) Soils for Soil Cement: Soils for soil cement base course shall consist of materials that will stabilize with cement in accordance with DOTD TR 432. Such materials are those soils classified as A-1-a, A-1-b, A-2-4, A-2-6, A-3, A-4 and A-6 in accordance with DOTD TR 423. Soil with a Liquid Limit greater than 35, a PI greater than 12, or an organic content greater than 2 percent shall not be used. Liquid Limit and PI will be determined in accordance with DOTD TR 428. Organic content will be determined in accordance with DOTD TR 413. Soil with over 79 percent sand or 60 percent silt when tested in accordance with DOTD TR 407 shall not be used. Soils which do not meet any of these requirements shall not be blended or treated. Topsoil shall not be used. The contractor shall obtain the material to be stabilized from outside right-of-way limits except as provided in Subsection 106.02(c).

(b) Portland Cement: Portland cement shall be Type I, I(B), or II. The quantity of cement used shall be supported by Certificate of Delivery.

(c) Portland-Pozzolan Cement: The cement shall be Type IP. The quantity of cement used shall be supported by Certificate of Delivery.

(d) Asphaltic Concrete Base Course: The material requirements for asphaltic concrete base course shall be as described in Section 501. The top half of the base thickness shall be asphaltic concrete and the remaining thickness shall be the same type and construction as the top layer of embankment.

302.03 EQUIPMENT. Equipment shall be subject to approval prior to use. When in-place mixing is used, the equipment shall conform to Subsection 303.03. When central mixing is used, the equipment shall conform to Subsection 301.03(a). Compaction equipment shall conform to Subsection 301.03(a)(5).

302.04 GENERAL CONSTRUCTION REQUIREMENTS. Base course material shall be placed on a subgrade prepared in accordance with Sections 203, 304, 305 or 306 as specified. Asphaltic concrete base course shall be constructed in accordance with Section 501.

302.05 MIXING.

(a) Soil Cement: Soil shall be combined with cement and water by in-place mixing or in a central plant and shaped on the subgrade.

A minimum of 70 percent of the pulverized soil, as determined by DOTD TR 431, shall pass the No. 4 sieve after mixing. The optimum moisture of the mixture will be determined in accordance with DOTD TR 418. The percentage of moisture in the mixture, by dry weight, shall not vary from the optimum moisture by more than ±2.0 percent at the time of compaction when tested in accordance with DOTD TR 403.

(1) In-Place Mixing: After placement of soil and prior to mixing with cement, the soil shall be shaped to required section and compacted to at least 93.0 percent of maximum dry weight density at the required grade. Samples to determine optimum moisture, percent cement, and maximum dry weight density will be taken after the roadbed is blended, shaped, and compacted to the minimum of 93.0 percent density and before the addition of cement. Maximum dry weight density will be determined in accordance with DOTD TR 418 and in place density will be determined in accordance with DOTD TR 401.

The percentage of cement will be determined in accordance with DOTD TR 432 prior to mixing, from materials sampled in-place on the project after compaction to 93.0 percent of maximum density. Water needed to bring the moisture content of the mixture within the tolerance shall be added and uniformly mixed with the materials. During the mixing process, water shall be added only through the spray bar of the in-place mixer which is adjusted to provide uniform coverage across the completed width of the roadway for the full depth of the base. Wet streaks or spots will not be allowed. Depending on the type of cement and soil to be used, normal testing time to determine required cement content may require 15 calendar days. The method of cement distribution shall be such that the amount of cement used can be readily determined. The spread rate of cement shall be determined in accordance with DOTD TR 436.

When the moisture content is not within ±2.0 percent of optimum, operations shall be discontinued and will not be allowed to resume until the contractor demonstrates that moisture content is controlled within this tolerance. No more than one transport shall be placed and pulverized until moisture content is within ±2.0 percent of optimum.

(2) Central Plant Mixing: Mixing in a central mix plant shall conform to Section 301. When central plant mixing is used, a reduction of 1.0 percent in the volume of cement required will be permitted.

(b) Cement Treated Sand Clay Gravel: Sand clay gravel shall be combined with cement and water by in-place mixing or in a central plant and shaped on the subgrade.

Optimum moisture of the mixture will be determined by the Laboratory in accordance with DOTD TR 418. The percentage of moisture in the mixture, by dry weight, shall not vary from optimum moisture by more than ±2.0 percent at the time of compaction when tested in accordance with DOTD TR 403.

(1) In-Place Mixing: In-place mixing shall conform to Heading (a)(1) except that the percentage of portland cement required will be 6 percent by volume.

When the moisture content is not within ±2.0 percent of optimum, operations will be discontinued and will not be allowed to resume until the contractor demonstrates that moisture content is controlled within this tolerance. No more than one cement transport shall be placed and pulverized until moisture content is within ±2.0 percent of optimum.

(2) Central Plant Mixing: Central plant mixing shall conform to Section 301 except that a reduction of 0.5 percent in the required volume of cement will be permitted.

(c) Cement Treated Sand-Shell: Sand-shell shall be combined with cement and water by in-place mixing or in a central plant and shaped on the subgrade.

Optimum moisture of the mixture will be determined by the Laboratory in accordance with DOTD TR 418. The percentage of moisture in the

mixture, by dry weight, shall not vary from optimum moisture by more than ±2.0 percent at the time of compaction when tested in accordance with DOTD TR 401.

(1) In-Place Mixing: Sand-shell for cement treated sand-shell shall be separate components sampled, tested and approved in dedicated stockpiles. Individual components and the composite material shall conform to the requirements of Subsection 1003.03(c).

In-place mixing shall conform to Heading (a)(1) except the percentage of portland cement required will be 5 percent by volume and the percentage of portland-pozzolan cement required will be determined in accordance with DOTD TR 432, Method B.

When the moisture content is not within ±2.0 percent of optimum, operations shall be discontinued and will not be allowed to resume until the contractor can demonstrate that moisture content can be controlled. No more than one transport shall be placed and pulverized until moisture content is within ±2.0 percent of optimum.

(2) Central Plant Mixing: Central plant mixing shall conform to Section 301 except a reduction of 0.5 percent in the required volume of cement will be permitted.

(d) Stone, Crushed Slag or Recycled Portland Cement Concrete: Stone, crushed slag or recycled portland cement concrete shall be a uniform blend prior to placement on the subgrade. Materials will be sampled and approved in dedicated stockpiles after mixing, prior to placement on the subgrade. When mixing is necessary, water shall be added to the material for proper blending.

(e) Sand Clay Gravel: Sand clay gravel shall be uniformly mixed. When mixed prior to placement, it shall be mixed in an approved pugmill or on a mixing table. When necessary for proper blending, water shall be added to the materials during mixing operations. Materials will be sampled and approved in dedicated stockpiles after materials have been mixed prior to placement.

(f) Shell or Sand-Shell: Shell and sand-shell shall be uniformly mixed. When mixed prior to placement, they shall be mixed in an approved pugmill or on a mixing table. When necessary for proper blending, water shall be added to the materials during mixing operations. Sand and shell will be sampled and approved in dedicated stockpiles prior to mixing.

302.06 TRANSPORTING AND PLACING ON SUBGRADE. Transportation and spreading methods shall not damage the subgrade. The contractor shall place and spread sufficient base course material to obtain required width and compacted thickness within the tolerances set forth in Subsection 302.12. Subgrade material shall not contaminate the base course. Any contamination will require retesting and correction of deficiencies. Base course material shall not be placed, spread or mixed on portland cement concrete or asphaltic concrete pavements. Base course construction operations shall not damage adjacent pavement surfaces, edges and joints.

302.07 COMPACTING AND FINISHING.

(a) General: The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations or loose material. The surface shall be thoroughly rolled and finished to grade. The cross-slope shall not vary by more than ±0.001 ft/ft when checked with an approved 10-foot metal static straightedge. Density requirement shall be in accordance with Subsection 302.12.

(b) Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Sand-Shell, Stone, and Recycled Portland Cement Concrete: When central plant mixing is used, these materials shall be compacted and finished in accordance with Subsection 301.10, except that the automatic grade machine will not be required. When in-place mixing is used, these materials shall be compacted and finished in accordance with Subsection 303.06 except for cross-slope. Cross slope shall be in accordance with Subsection 302.12. Compaction of the mixture shall be performed immediately upon completion.

Compaction and finishing operations shall be completed within 3 hours after initial placement of cement on base course materials. Upon expiration of the 3-hour period after initial placement, only tight blading of the base course surface will be allowed. Bladed material shall not be drifted along the base, but shall be wasted. Stabilized material shall be utilized in the base course except that small amount necessary for tight blading. Excessive blading to achieve plan depth will not be allowed. The contractor shall complete operations, including tight blading before beginning the next day's operations. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations, or loose materials.

(c) Shell, Sand-Shell, and Sand Clay Gravel: These materials shall be compacted using an approved sheepsfoot roller and finished with an approved pneumatic tire roller. The surface shall be kept uniformly moist during compaction and final finishing.

(d) Asphaltic Concrete: Asphaltic concrete shall be compacted and finished in accordance with Section 501. The soil layer shall be compacted and finished in accordance with the top layer of embankment.

302.08 QUALITY CONTROL ROADWAY OPERATIONS: The contractor shall control the selection, placement, compaction, cement spread, mixing, moisture content, density, thickness, width, surface finish, cross-slope and grade to produce a completed base course that is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The base course shall be constructed to prevent contamination, segregation, soft spots, wet spots, laminations and other deficiencies. The contractor shall be responsible for taking tests necessary to adequately control the work.

302.09 PROTECTION AND CURING:

(a) Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Sand-Shell, Treated Soil Layer Under Asphaltic Concrete, Stone and Recycled Portland Cement Concrete: Protection and curing shall conform to Subsection 301.12.

(b) Shell, Sand-Shell, Sand Clay Gravel and Soil Layer Under Asphaltic Concrete: The surface shall be kept moist as directed to avoid loosening of surface material. The base course, shall be primed in accordance with Section 505.

302.10 MAINTENANCE OF BASE COURSE. The contractor shall protect the completed base course from damage from public traffic or the contractor's operations, and shall satisfactorily maintain the completed base course including the asphaltic curing membrane or prime coat. Damaged base course shall be repaired by the contractor at no direct pay. When patching of the base course is required, in addition to removing damaged or

unsound base course, the contractor shall remove a sufficient width and depth of base course to ensure satisfactory placement of patching material. The engineer will approve the type of patching material before use. Patching or other base course repair shall restore a uniform surface, shall conform to the requirements of the material being used, and shall be completed at least 24 hours prior to surfacing operations.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed base course during the 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed base course onto shoulders or other suitable areas during the 72-hour curing period, when conditions permit.

When traffic is permitted to use the completed base course subsequent to the 72-hour curing period and prior to construction of the surface course, the base shall be further protected by additional applications of asphaltic curing membrane or prime coat as directed in accordance with Subsection 301.12 at no direct pay.

Prior to surface course construction, the contractor shall correct deficiencies, clean the base course surface, repair any damages caused by traffic, and apply additional asphaltic curing membrane or prime coat as directed at no direct pay. This work shall be completed at least 24 hours prior to construction of the next layer.

Any weak spots that develop shall be satisfactorily corrected and the base kept free from deficiencies and true to grade and cross section at no direct pay.

When the surfacing is asphaltic concrete and traffic including construction equipment, is allowed on the base, the first lift of surfacing shall be placed within 30 calendar days.

302.11 WEATHER LIMITATIONS. Construction of base course will not be permitted when base course material is frozen, when the ambient air temperature is below 35°F, or in the rain.

302.12 ACCEPTANCE REQUIREMENTS:

Soils and aggregates will be sampled for acceptance by the Department in accordance with the Materials Sampling Manual.

For central plant mixing, the cement content will be determined in accordance with Subsection 301.16. For in-place mixing, the cement content will be determined in accordance with Subsection 303.11.

The moisture content of the soil cement or cement treated mixtures will be tested for conformance to optimum moisture content in accordance with DOTD TR 403.

The pulverization of the soil cement or cement treated mixtures will be tested in accordance with DOTD TR 431 and shall be at least 70 percent.

Base course, except asphaltic concrete, will be checked for determining acceptance in increments of 1,000 linear feet per roadway or 2,000 linear feet per shoulder constructed separately. Asphaltic concrete will be accepted in accordance with Section 501.

(a) Density Requirements: Upon completion of compaction operations, base course density, except asphaltic concrete, will be determined in accordance with DOTD TR 401. The density requirements for asphaltic concrete base course will be determined in accordance with Section 501.

The density requirements shall be as follows:

Base Course Type	Maximum Density Test Method	% of Maximum Density (Min.)
Soil Cement	DOTD TR 418	94.0
Cement Treated Sand Clay Gravel	DOTD TR 418	95.0
Cement Treated Sand-Shell	DOTD TR 418	95.0
Sand Clay Gravel	DOTD TR 418	100.0
Shell or Sand-Shell	DOTD TR 418	100.0
Stone, Crushed Slag or Recycled Portland Cement Concrete	DOTD TR 418	95.0
Treated Layer under Asphaltic Concrete	DOTD TR 418	95.0
Soil Layer under Asphaltic Concrete	DOTD TR 418	95.0
Asphaltic Concrete	DOTD TR 304	95.0

(1) Soil Cement: When the density test value for the section is below 94.0 percent, a payment adjustment will be applied as follows.

Density Test Value	% of Contract Unit Price
94.0 & Above	100
93.0 to 93.9	90
92.0 to 92.9	75
Below 92.0	50 or Remove[1]

[1]At the option of the Department, after investigation.

(2) Cement Treated Sand Clay Gravel, Cement Treated Sand-Shell and Treated Layer Under Asphaltic Concrete: When the density test value for the section is below 95.0 percent, a payment adjustment will be applied as follows.

Density Test Value	% of Contract Unit Price
95.0 & Above	100
94.0 to 94.9	90
93.0 to 93.9	75
Below 93.0	50 or Remove[1]

[1]At the option of the Department, after investigation.

(3) Shell, Sand-Shell, Sand Clay Gravel, Stone, Crushed Slag, Recycled Portland Cement Concrete and Soil Layer under Asphaltic Concrete Base Course: When any test value is less than the required density, compaction shall continue until the specified density is obtained.

(b) Thickness Requirements: The thickness of the completed base course will be determined in accordance with DOTD TR 602.

The completed base course shall not vary from plan thickness in excess of the following tolerances. Base course thickness deficiencies in excess of these tolerances shall be corrected as specified herein at no direct pay.

(All Bases Except Asph. Conc.) Underthickness	(Stab. & Treat. Bases) Overthickness
3/4 inch	1 1/2 inches

Any failing area will be isolated for purposes of correction.

Asphaltic concrete base thickness will be determined in accordance with Section 501.

When central plant mixing is used, overthickness may be waived at no direct pay.

(1) Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Sand-Shell, and Treated Layer Under Asphaltic Concrete: When no grade adjustments are permitted, underthickness deficiencies in excess of tolerance shall be corrected by removing and replacing the full depth of base course in deficient areas with one of the following materials:

a. The same type of base course.
b. Asphaltic concrete conforming to Section 501.
c. Concrete conforming to Section 901.

When grade adjustments are permitted, the contractor shall have the option of correcting thickness deficiencies by furnishing and placing a supplemental layer of asphaltic concrete conforming to Section 501 for the full width of base course in lieu of removing and replacing deficient base course. When approved, corrections may be made by restabilizing the existing material in accordance with this Section. Thickness of the supplemental layer of asphaltic concrete shall be as follows:

Underthickness (Inches)	In-Place Mixing Overthickness (Inches)	Minimum Thickness of Supplemental Asphaltic Concrete (Inches)
3/4 to 1 1/4	1 3/4 to 2	1 1/4
1 1/2 to 1 3/4	2 1/4 to 2 1/2	1 1/2
2 to 2 1/2	2 3/4 to 3	2
Over 2 1/2	Over 3	Remove and Replace[1]

[1]At the option of the Department after investigation.

When reconstruction is the method of correction, the above tolerances shall apply.

(2) Shell, Sand-Shell, Sand Clay Gravel, Stone, Crushed Slag and Recycled Portland Cement Concrete: When grade adjustments are allowed, underthickness in excess of 3/4 inch shall be corrected to plan thickness by furnishing, placing, reworking, shaping and compacting additional base course material as required. When no grade adjustments are allowed the material shall be removed and replaced at no direct pay.

(3) Asphaltic Concrete Base Course: When no grade adjustments are allowed, underthickness in excess of the tolerances given in Subsection 501.11 shall be corrected to plan thickness by removing and replacing the full depth of base course. When grade adjustments are allowed, underthickness in excess of the tolerances given in Subsection 501.11 shall be corrected to plan thickness by placing and compacting a 1 1/4-inch thick supplemental layer of asphaltic concrete conforming to Section 501 at no direct pay.

(c) Width Requirements: The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of 6 inches. Shoulder base course width shall not vary from plan width in excess of 3 inches. When the base course for both roadway and shoulders is built at the same time, the 6-inch width tolerance will be applied. Base course width deficiencies in excess of the foregoing tolerances shall be corrected as follows at no direct pay.

(1) Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Sand-Shell and Asphaltic Concrete Base Course:

a. Overwidth: Overwidths of asphaltic concrete and treated base courses mixed in a central plant may be waived at no additional cost to the Department. When no grade adjustments are allowed, the full depth and width of base course in areas having overwidths in excess of the foregoing tolerances shall be removed and replaced to the plan width with one of the following materials:

1. The same type of base course.
2. Asphaltic concrete conforming to Section 501.
3. Concrete conforming to Section 901.

In lieu of removing and replacing the overwidth areas of base course, at the Department's option, any base course less than 12 inches overwidth will be allowed to remain in place at an adjusted payment of 90 percent of the contract unit price for the complete section. Overwidth in excess of 12 inches shall be removed and replaced as indicated above. When approved, corrections may be made by restabilizing the existing material in accordance with this Section.

When grade adjustments are permitted, the contractor shall correct base course width deficiencies by removing and replacing as specified above, or by furnishing and placing a 1 1/4-inch thick supplemental layer of asphaltic concrete conforming to Section 501 on the 1,000-foot section for the full width of the base course.

b. Underwidth: Underwidths of base course in excess of the foregoing tolerances shall be corrected to plan width and thickness by furnishing and placing additional materials; however, the width of widening materials shall be not less than 12 inches. When approved, corrections may be made by restabilizing the existing material in accordance with this Section. Materials for widening deficient base course shall be one of the following:

1. The same type of base course.
2. Asphaltic concrete conforming to Section 501.
3. Concrete conforming to Section 901.

(2) Shell, Sand-Shell, Sand Clay Gravel, Stone, Crushed Slag and Recycled Portland Cement Concrete Base Course: Overwidths will be waived at no additional cost to the Department. Underwidths in excess of the foregoing tolerances shall be corrected to plan widths by furnishing, placing, reworking, shaping and compacting additional base course material as required.

(d) Grade and Cross-slope: The finished grade shall be within ±1/2 inch of the established grade. The cross-slope shall not vary by more than ±0.001 ft/ft when tested with an approved 10-foot metal static straight-edge.

(e) Correction of Deficiencies: The contractor shall correct deficiencies in surface finish, cross-slope, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. Deficiencies shall be corrected by removing and replacing or as directed.

302.13 SHOULDER CONSTRUCTION WITH BASE COURSE: Base course for shoulders shall be constructed to the dimensions shown on the plans and shall be one of the base courses listed in Subsection 302.01. Base course for shoulders shall meet the requirements for the course used.

302.14 MEASUREMENT. The quantities of base course for payment will be the design volumes or areas specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions and compacted thickness of the completed base course shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

302.15 PAYMENT. Payment for base course will be made at the contract unit price, adjusted as specified in Subsection 302.12 and the following provisions, which includes furnishing and placing required base course materials, portland cement, portland-pozzolan cement, water, asphaltic curing membrane and prime coat.

Payment adjustments will be applied for specification deviations of asphaltic materials in accordance with Section 1002. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

Asphaltic concrete base course will be further subject to payment adjustments for deficiencies in Marshall Stability, roadway density, aggregate gradation or additives as specified in Table 2 of Section 501. Any payment adjustment in asphaltic concrete shall apply to the cubic yard total quantity of base course when payment is by cubic yard.

When payment adjustments are made for more than one deficiency, they shall be cumulative.

Payment will be made under:

Item No.	Pay Item	Pay Unit
302(01)	Class II Base Course	Cubic Yard
302(02)	Class II Base Course (" Thick)	Square Yard

Section 303
In-Place Cement Stabilized Base Course

303.01 DESCRIPTION. This work consists of cold planing, scarifying, pulverizing, blending, shaping and stabilizing roadbed material with portland cement or portland-pozzolan cement in accordance with the lines, grades, thickness and sections established or shown on the plans.

This cement stabilization is primarily for existing roadbed materials; however, it shall include materials furnished and placed by the contractor at no direct pay. When specified, the contractor shall furnish and place materials under different pay items to be stabilized in accordance with this Section.

For bid purposes, the estimated rate of portland cement or portland-pozzolan cement required for stabilization is 10 percent by volume; however, the actual rate of cement to be used for stabilization will be determined by the Laboratory. When the actual rate of cement differs from the estimated rate, an adjustment will be made as specified in Subsection 303.13(a).

With approval, concrete conforming to Section 901 may be used in lieu of the specified base course material in areas that are inaccessible to mixing and compacting equipment, in turnouts and crossovers, and in other isolated or irregular areas. The concrete shall be placed, consolidated, finished, and cured in accordance with the requirements of Section 706. The contractor shall remove and satisfactorily dispose of existing materials as required to accommodate placement of the concrete at no direct pay. Excess material shall be disposed of in accordance with Subsection 202.02.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

In order to meet air quality standards, the contractor may be required to use central plant mixing of cement stabilized mixtures in dust sensitive areas at no direct pay. The contractor may use other types of Class II Base Course in dust sensitive areas at no direct pay. The Department will identify the dust sensitive areas.

303.02 MATERIALS. Materials shall conform to the following Sections or Subsections:

Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Emulsified Asphalt	1002
Water	1018.01

Portland cement shall be Type I, I(B), or II. Portland-pozzolan cement shall be Type IP. The quantity of cement used shall be supported by proof of delivery.

Soils or soil-aggregate combinations furnished by the contractor for stabilization in accordance with this Section shall conform to the requirements of Subsection 301.02(a).

303.03 EQUIPMENT. Equipment necessary to produce a finished base course which meets specification requirements shall be furnished and maintained by the contractor. Equipment shall be approved prior to use. Pulverization shall be accomplished using an approved in-place mixer.

The in-place mixer shall be equipped with a spray bar which has the capability of applying water across the full width of the cut and shall be adjustable to prevent overlap of water distribution on adjacent paths.

Cement spreaders shall be equipped with a calibrated spreader-box mechanically adjustable for various widths. The contractor shall have a back-up cement spreader equipped with a calibrated spreader-box on the project.

Compaction equipment for cement stabilized base courses shall be conventional sheepsfoot rollers for initial compaction. The spikes shall be a minimum of 6 inches long, sufficient in size and number to provide uniform compaction for the full width and depth of the base course. Finish rolling shall be with static smooth-drum or pneumatic-tire rollers.

303.04 PREPARATION OF ROADBED. Unless otherwise specified, the contractor has the option of removing all or a portion of the existing asphaltic concrete surfacing in accordance with Section 509 prior to cement stabilization. Removed materials shall become the property of the contractor. When directed, the contractor shall replace the removed materials with an equal compacted thickness of soil or soil-aggregate combinations conforming to Subsection 301.02(a). To determine the quantity of material to be added, a compaction factor of 1.30 shall be used. During these removal and replacement operations, the contractor shall maintain the areas being used by public traffic in a safe condition. Surface removal operations shall not be conducted more than 2 miles in advance of base course stabilization. Sufficient quantities of removed material or approved other surfacing material shall be available for traffic maintenance at no direct pay. The contractor shall scarify and pulverize materials to be stabilized for the full width and depth of the base course. Existing asphaltic surfacing which is not removed shall be pulverized and uniformly mixed with materials below the surfacing. When this material is to be used as shoulder aggregate, the operation shall be controlled to produce shoulder material meeting the requirements of Subsection 1003.04(e).

Preparation of roadbed shall not be performed in excess of 2 miles in advance of base course stabilization.

The scarified and pulverized material shall be blended from edge of base to edge of base to achieve uniform blending. When existing material is not uniform across the full width to be stabilized, the material shall be blended to form a uniform blend for the full width and depth of the base course.

The roadbed shall be scarified and pulverized to at least 60 percent passing the No. 4 sieve in accordance with DOTD TR 431 prior to mixing with cement. Materials which cannot be satisfactorily pulverized shall be removed and disposed of as directed at no direct pay in accordance with Subsection 202.02.

After the roadbed has been prepared as specified above, the contractor shall shape the roadbed to the required section and uniformly compact the roadbed material to at least 93.0 percent of maximum dry weight density prior to mixing with cement. Maximum dry weight density will be determined in accordance with DOTD TR 415 or TR 418 and in-place density will be determined in accordance with DOTD TR 401. Areas which cannot be compacted to 93.0 percent of maximum dry weight density shall be corrected at no direct pay.

303.05 MIXING. After preparation of materials to be stabilized, the percent of cement to be used will be determined by the Laboratory in accordance with DOTD TR 432 from materials sampled in-place on the project after compaction to 93.0 percent of maximum dry weight density. Depending on the type of cement to be used and materials to be stabilized, normal testing time to determine the required cement content may require 15 calendar days. Samples to determine optimum moisture, percent cement, and maximum dry weight density will be taken after the roadbed is blended, shaped, and compacted to the minimum of 93.0 percent of maximum dry weight density and before the addition of cement. Cement shall be spread through an approved spreader box, adjusted for proper spread, width, and required rate.

The method of mixing shall be such that the amount of cement used can be readily determined when tested in accordance with DOTD TR 436. Cement shall be uniformly spread and mixed with the material. The mixture shall be shaped to the required section.

Water shall be added as needed by means of the mixer and shall be uniformly incorporated in the mixture in amounts required to attain optimum moisture for the mixture. During the mixing process, water shall be added only through the spray bar of the in-place mixer which is adjusted to provide uniform coverage across the completed width of the roadway for the full depth of the base. Wet streaks or spots will not be allowed.

Optimum moisture of the mixture will be determined by the Laboratory in accordance with DOTD TR 415 or TR 418. The percentage of moisture determined in accordance with DOTD TR 403 in the mixture by dry weight shall not vary from optimum moisture by more than ±2 percent at the time of compaction.

303.06 COMPACTING AND FINISHING. The mixture shall be uniformly compacted immediately upon completion of mixing to the specified depth and width with an approved sheepsfoot roller so that no internal laminations occur in the completed base course. The surface shall be kept uniformly moist during compacting and final finishing. Compaction shall continue until each lift of base course has met the requirements of Subsection 303.11.

At places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain the specified density without damage to adjacent structures.

Compaction and finishing operations shall be completed within 3 hours after initial placement of cement on base course materials. Upon expiration of the 3-hour period after initial placement, only tight blading of the base course surface will be allowed. Bladed material shall not be drifted along the base, but shall be wasted. Stabilized material shall be utilized in the base course except that small amount necessary

for tight blading. Excessive blading to achieve plan depth will not be allowed. The contractor shall complete operations, including tight blading before beginning the next day's operations. The cross slope shall not vary by more than ±0.001 ft/ft when checked with an approved 10-foot metal static straight-edge. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations, or loose material.

303.07 QUALITY CONTROL: The contractor shall control the preparation of roadbed, selection, placement, cement spread, mixing, compaction, moisture content, density, thickness, width, surface finish, grade and cross slope so that the completed base course is uniform and conforms to plan dimensions and other acceptance requirements as provided herein. The base course shall be constructed so that contamination, segregation, soft spots, wet spots, laminations and other deficiencies are prevented. The contractor shall be responsible for taking such tests as necessary to adequately control the work.

303.08 PROTECTION AND CURING. Upon completion of final finishing, the base shall be immediately protected against rapid drying for a period of 72 hours by applying an asphaltic curing membrane in accordance with Section 506. Asphaltic curing membrane shall be placed on the same day as stabilizing. Complete coverage of curing membrane shall be maintained from initial application until the placement of the next course. When traffic, including construction equipment, is allowed on the base course, at least the first lift of surfacing shall be placed within 30 calendar days unless otherwise directed.

303.09 MAINTENANCE. The contractor shall protect the completed base course from damage due to either public traffic or the contractor's operations, and shall satisfactorily maintain the completed base course including asphaltic curing membrane. Damaged base course shall be repaired by the contractor at no direct pay. When patching of the base course is required, in addition to removing damaged or unsound base course, the contractor shall remove a sufficient width and depth of base course to ensure satisfactory placement of patching material. The engineer will approve the type of patching materials before use. Patching or other repair of the base course shall be made in such manner as to restore a uniform surface, shall conform to the requirements of the material being used and shall be completed at least 24 hours prior to surfacing operations.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed base course during the 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed base course onto shoulders or other suitable areas during the 72-hour curing period when conditions permit.

When traffic is permitted to use the completed base after the 72-hour curing period and prior to the construction of the surface course, the base shall be further protected by additional applications of asphaltic curing membrane as directed at no direct pay in accordance with Subsection 302.10.

Prior to surface course construction, the contractor shall correct deficiencies, clean the base course, repair damage caused by traffic and

apply additional asphaltic curing membrane as directed at no direct pay. This work shall be completed at least 24 hours prior to construction of the next layer.

Any weak spots that develop shall be satisfactorily corrected and the base kept free from deficiencies and true to grade and cross section at no direct pay. When the surfacing is asphaltic concrete and traffic, including construction equipment, is allowed on the base, the first lift of surfacing shall be placed within 30 calendar days.

303.10 WEATHER LIMITATIONS. Mixing will not be permitted when the base course material is frozen, when the ambient air temperature is below 35°F, or in the rain.

303.11 ACCEPTANCE REQUIREMENTS. Soils and aggregates will be tested by the Department from samples taken after preparation of the roadbed.

Cement spread rate will be tested in accordance with DOTD TR 436.

The moisture content of the cement stabilized mixtures will be tested for conformance to optimum moisture content in accordance with DOTD TR 403 at placement at least twice per day.

The pulverization of the prepared roadbed will be tested in accordance with DOTD TR 431, and shall be at least 60 percent passing the No. 4 sieve.

The completed base course will be checked for determining acceptance in increments of 1,000 linear feet per roadway or 2,000 linear feet per shoulder constructed separately.

(a) Density Requirements: Upon completion of compaction operations, in-place density will be determined in accordance with DOTD TR 401.

The density requirement as based on DOTD TR 415 or TR 418 will be 95.0 percent of maximum density.

When the density test value for the section is below 95.0 percent, a payment adjustment will be applied as follows:

Density Test Value	Percent of Contract Unit Price
95.0 & Above	100
93.0 to 94.9	90
90.0 to 92.9	75
Below 90.0	50 or Remove[1]

[1]At the option of the Department, after investigation.

(b) Thickness Requirements: The thickness of the completed base course will be determined in accordance with DOTD TR 602.

The completed base course shall not vary from plan thickness in excess of the following tolerances. Base course thickness deficiencies in excess of these tolerances shall be corrected as specified herein at no direct pay.

Underthickness	Overthickness
3/4"	1 1/2"

Any failing area will be isolated for purposes of correction. Base course thickness deficiencies in excess of the foregoing tolerances shall be corrected as follows.

When no grade adjustments are permitted, thickness deficiencies shall be corrected by removing and replacing the full depth of base course in deficient areas with one of the following materials.

(1) Cement stabilized base course.
(2) Asphaltic concrete conforming to Section 501.
(3) Concrete conforming to Section 901.
(4) Restabilization with cement.

When grade adjustments are permitted, the contractor shall have the option of correcting deficiencies by furnishing and placing a supplemental layer of asphaltic concrete conforming to Section 501 for the full width of base course in lieu of removing and replacing deficient base course. When approved, corrections may be made by restabilizing the existing material in accordance with this Section. Thickness of the supplemental layer of asphaltic concrete shall be as follows:

Underthickness (Inches)	Overthickness (Inches)	Minimum Thickness of Supplemental Asphaltic Concrete (Inches)
1 to 1 1/2	1 3/4 to 2	1 1/4[1]
1 3/4 to 2	2 1/4 to 2 1/2	1 1/2
2 1/4 to 2 1/2	2 3/4 to 3	2
Over 2 1/2	Over 3	Remove and Replace[2]

[1]May be placed with subsequent lift of asphaltic concrete.
[2]At the option of the Department, after investigation

(c) Width Requirements: The width of the completed base course will be determined in accordance with DOTD TR 602. Roadway base course width shall not vary from plan width in excess of 6 inches. Shoulder base course width shall not vary from plan width in excess of 3 inches. When the base course for roadway and shoulders are constructed at the same time, the 6-inch width tolerance will be applied. Base course width deficiencies in excess of foregoing tolerances shall be corrected as specified herein at no direct pay.

(1) Overwidth: When no grade adjustments are permitted, the full depth and width of base course in isolated areas having overwidths in excess of the foregoing tolerances shall be removed and replaced to the plan width with one of the following materials.

a. Cement stabilized base course.
b. Asphaltic concrete conforming to Section 501.
c. Concrete conforming to Section 901.
d. Restabilization with cement.

In lieu of removing and replacing overwidth base course, areas of the deficient base course will be allowed to remain in place at a payment adjustment of 90 percent of the contract unit price for the entire 1,000-foot section.

When grade adjustments are permitted, the contractor shall correct base course width deficiencies by removing and replacing as specified above, or by furnishing and placing a 1 1/4 inch thick supplemental layer of asphaltic concrete conforming to Section 501 for the full width of the roadway.

(2) Underwidth: Underwidths of base course in excess of the foregoing tolerances shall be corrected to plan width by furnishing and placing additional materials; however, the width and thickness of the widening materials shall be not less than 12 inches. Materials used for widening the deficient base course shall be the same as specified for overwidth correction in Heading (1).

(d) Grade and Cross-slope: The finished grade shall be within ±1/2 inch of the established grade. The cross-slope shall not vary by more than ±0.001 ft/ft when tested with an approved 10-foot metal static straight-edge.

(e) Correction of Deficiencies: The contractor shall correct deficiencies in surface finish, grade, contamination, segregation, soft spots, wet spots, laminations and other deficiencies at no direct pay. Deficiencies shall be corrected by removing and replacing or as directed.

303.12 MEASUREMENT.

(a) Cement: Cement or portland-pozzolan cement will be measured by the hundredweight (CWT). When cement or portland-pozzolan cement is furnished in bulk, the contractor shall furnish certified weights for each transport load or furnish certified scales on the project site to weigh each transport used. When cement or portland-pozzolan cement is furnished in bags the number of bags used and the weight per bag of 94 pounds will be used to calculate the total weight used.

(b) Stabilization: The quantity of in-place cement stabilized base course for payment will be the design areas as specified in the plans and adjustments thereto. The design quantity is based on the horizontal dimensions of the completed base course shown on the plans. The design quantity will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are necessary.

303.13 PAYMENT.

(a) Cement: Payment for cement or portland-pozzolan cement will be made at the contract unit price per hundredweight (CWT). The estimated quantity of cement or portland-pozzolan cement is based on stabilization at a rate of 10 percent by volume. The final pay quantity will be computed on the basis of the design quantity of cement determined in accordance with DOTD TR 432.

(b) Stabilization: Payment for in-place cement stabilized base course will be made at the contract unit price, adjusted as specified in Subsection 303.11 and the following provisions, which includes furnishing required water and asphaltic curing membrane, and performing necessary roadbed preparation. No direct payment will be made for removal and disposal of asphaltic surfacing, replacing the removed surfacing with approved soils, or maintaining the areas in safe condition for traffic.

Payment adjustments will be applied for specification deviations of asphaltic materials in accordance with Section 1002 based on the invoice price per gallon. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

Item No.	Pay Item	Pay Unit
303(01)	In-Place Cement Stabilized Base Course (__" Thick)	Square Yard
303(02)	Cement	Hundredweight (CWT)

Section 304
Lime Treatment

304.01 DESCRIPTION. This work consists of constructing one or more courses of a mixture of lime and soil, or soil-aggregate, and water in accordance with these specifications, in conformity with the lines, grades, thickness and sections shown on the plans.

Lime treatment will be designated as Type B, C, D, or E. Type B shall be used for base or subbase. Type C shall be used for conditioning for cement treatment or stabilization. Type D shall be used for working table treatment under embankments. Type E shall be used for conditioning and drying of embankments. Lime treatment shall be in accordance with these specifications and Table 2.

304.02 MATERIALS. Materials shall conform to the following Sections and Subsections:

Emulsified Asphalt	1002
Water	1018.01
Lime	1018.03

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

In order to meet air quality standards, the contractor may be required to use central plant mixing, lime slurry, or granular lime in dust sensitive areas at no direct pay. The Department will identify dust sensitive areas before lime treatment begins.

304.03 EQUIPMENT. Equipment necessary to produce a finished product meeting specification requirements shall be furnished and maintained by the contractor. An approved in-place mixer meeting the requirements of Subsection 303.03 shall be used for Type B and C treatments. An approved in-place mixer meeting the requirements of Subsection 303.03 or an approved disc shall be used for Type D and E treatments.

303.04 GENERAL CONSTRUCTION REQUIREMENTS. Materials shall be kept moist after lime is applied. Water shall be added as needed during mixing and remixing operations, during the curing period, and to keep the cured material uniformly moist until covered. Lime shall be protected from moisture prior to use.

When granular quicklime is applied in dry form, precautions shall be taken to prevent injury to persons, livestock and plants. Quicklime spilled or deposited outside areas designated for treatment shall be immediately collected and buried or satisfactorily slaked.

Lime shall not be applied on a frozen foundation or when the ambient air temperature is below 35°F.

(a) Type B Treatment: Lime shall be incorporated in the following sequence: Spreading the lime; initial mixing; watering; sealing and

mellowing for at least 48 hours; and mixing until pulverization requirements are met; compacting; finishing; and maintaining in accordance with Subsection 304.10 The percent of lime for Type B treatment will be determined in accordance with DOTD TR 416. After lime treatment, the treated soil shall have a maximum Liquid Limit of 40 and a maximum PI of 10.

(b) Type C Treatment: Lime shall be incorporated in the following sequence: Spreading the lime; initial mixing; watering; sealing and mellowing for a minimum of 48 hours; mixing until pulverization requirements are met; compacting; finishing; and maintaining. Unless specified, the percent lime for Type C treatment will be determined in accordance with DOTD TR 416.

(c) Type D Treatment: One increment of lime shall be spread and mixed with materials to be treated, watered as required and compacted to the satisfaction of the engineer. Unless specified, the percent of lime for Type D treatment will be determined in accordance with DOTD TR 416.

(d) Type E Treatment: One increment of lime shall be spread and mixed with materials to be treated and compacted and finished in accordance with the normal embankment construction procedures of Section 203. Unless specified, the percent of lime for Type E treatment will be determined in accordance with DOTD TR 416.

304.05 SPREADING AND MIXING. The percentage of lime to be incorporated shall be as specified. When not specified, the required percentage of lime will be determined by the Laboratory in accordance with DOTD TR 416.

A unit weight of 35 pounds per cubic foot will be used to compute the required application rate of hydrated lime or granular quicklime regardless of the actual unit weight of the lime used.

Lime may be furnished in bags or bulk and distributed, in powder form, granular or in a slurry, and in the required proportion. Dry lime shall be prevented from blowing by adding water or by other suitable means.

Lime shall be uniformly spread and mixed with the soil to the width and depth shown on the plans or as directed. The Department will determine lime spread rate in accordance with DOTD TR 436. Any procedure which results in excessive loss or displacement of lime shall be discontinued.

Areas to which lime is applied shall be processed on the same day as application is made. Lime exposed to air for more than 6 hours and lime lost or damaged before incorporation due to rain, wind or other cause will be rejected, deducted from measured quantities, and shall be replaced by the contractor at no direct pay.

(a) Type B Mixing: After the 48-hour mellowing period, the lime treated mixture shall be kept moist and be manipulated with an in-place mixer until the pulverization requirements of Subsection 304.06 have been met.

(b) Type C Mixing: Following the 48-hour mellowing period, the lime treated mixture shall be thoroughly manipulated with an in-place mixer to the satisfaction of the engineer. The mixture shall meet the pulverization requirements of Subsection 304.06 prior to subsequent stabilization or treatment with portland cement.

(c) Types D and E: Mixing may be accomplished with an in-place mixer or an approved disc.

304.06 PULVERIZATION. For Types B and C treatment, the pulverized mixture, when tested in accordance with DOTD TR 431, shall meet the following gradation requirements:

U. S. Sieve	Percent Passing (By Weight)
3/4"	95
No. 4	50

Pulverization requirements for Type B and C treatments shall be met prior to final compaction and finishing.

304.07 COMPACTING AND FINISHING.

(a) Type B: After meeting the pulverization requirement, the mixture shall be uniformly compacted to at least 95.0 percent of maximum dry weight density. The maximum dry weight density will be determined in accordance with DOTD TR 418 and in-place density in accordance with DOTD TR 401. Compaction and finishing operations shall be completed within 6 hours after meeting pulverization requirements. One density test will be taken per 1,000 linear feet per roadway or 2,000 linear feet per shoulder constructed separately in accordance with DOTD TR 401. At places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain uniform compaction to required density without damage to adjacent structures. Any section not meeting the required density shall be reconstructed in accordance with these specifications at no direct pay. Reconstruction shall include the addition of the specified amount of lime.

The final finish shall meet grade and cross-slope requirements and shall have a smooth, uniform, closely knit surface, free from ridges, waves, loose material or laitance.

(b) Type C: Type C lime conditioned materials shall be shaped and uniformly compacted to the required sections.

(c) Type D: Type D lime treated materials shall be uniformly compacted and finished to the satisfaction of the engineer.

(d) Type E: Type E lime treated materials shall be compacted and finished in accordance with the normal embankment construction procedures of Section 203.

304.08 QUALITY CONTROL. Construction methods shall prevent contamination, segregation, soft spots, wet spots, laminations and other deficiencies. The contractor shall be responsible for taking such tests as necessary to adequately control the work.

(a) Type B Lime Treatment: The contractor shall control the grade, cross-slope, lime spread, mixing, pulverization, thickness, width, density and curing to construct a completed course that is uniform and conforms to the acceptance requirements.

(b) Type C Lime Treatment: The contractor shall control the lime spread, mixing and pulverization to construct a completed course that is uniform and conforms to the acceptance requirements.

(c) Type D Lime Treatment: The contractor shall control the lime spread and mixing to construct a completed course that is uniform and conforms to the acceptance requirements.

(d) Type E Lime Treatment: The contractor shall control the lime spread, mixing and density to construct a completed layer that is uniform and conforms to the acceptance requirements.

304.09 PROTECTION AND CURING (TYPE B). After finishing operations have been completed, the material shall be protected against rapid drying for 72 hours by applying an asphaltic curing membrane conforming to Section 506. The application shall be placed immediately following smooth rolling and shall be adequately maintained during the 72-hour curing period.

304.10 MAINTENANCE.

(a) Type B Lime Treatment: The contractor shall protect the completed course from damage from public traffic or the contractor's operations, and shall satisfactorily maintain the completed course, including asphaltic curing membrane. Any damaged course shall be repaired by the contractor at no direct pay. When patching of the course is required, in addition to removing damaged or unsound course, the contractor shall remove a sufficient width and depth of course to ensure satisfactory placement of patching material. Patching or other course repair shall restore a uniform surface and shall be completed at least 24 hours prior to surfacing operations.

When maintenance of traffic is not required, neither public traffic nor construction traffic shall be allowed on the completed course during the 72-hour curing period. When maintenance of traffic is required, both public traffic and construction traffic shall be routed off the completed course onto shoulders or other suitable areas during the 72-hour curing period when conditions permit.

When traffic is permitted to use the completed lime treatment subsequent to the 72-hour curing period and prior to construction of the surface course, the course shall be further protected by additional applications of asphaltic curing membrane as directed in accordance with Section 506 at no direct pay.

Prior to surface course construction, the contractor shall correct deficiencies, clean the surface, repair any damage caused by traffic and apply additional asphaltic curing membrane as directed at no direct pay. This work shall be completed at least 24 hours prior to construction of the next layer.

Any weak spots that develop shall be satisfactorily corrected and the course kept free from deficiencies and true to grade and cross section at no direct pay.

When traffic, including construction equipment is allowed on the course, at least the next course shall be placed within 30 calendar days.

(b) Types C, D and E Treatments: These treatments shall be maintained by the contractor to prevent damage to the lime treated layer as directed.

304.11 DIMENSIONAL TOLERANCES (TYPE B TREATMENT).

(a) General: Thickness and width of completed lime treated courses will be checked for acceptance in accordance with DOTD TR 602.

Areas not meeting tolerances specified herein will be delineated and shall be corrected to plan dimensions by scarifying, adding lime, remixing, and recompacting deficient areas at no direct pay.

(b) Thickness Requirements: Underthickness shall not exceed 3/4 inch and overthickness shall not exceed 1 inch.

(c) Width Requirements: When lime treatment for both roadway and shoulders is constructed at the same time, the 6 inches underwidth tolerance shall apply. Overwidth will be waived at no direct pay.

304.12 MEASUREMENT.

(a) Lime: Lime will be measured by the ton. When lime is furnished in bags, the number of bags used and the weight per bag will be used for measurement. When lime is furnished in bulk, the contractor shall furnish certified weights for each transport load.

(b) Treatment: The quantities of Type B, C and D lime treatment for payment will be the design areas as specified on the plans and adjustments thereto. Design quantities are based on the horizontal dimensions of the completed lime treatment shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are necessary.

No measurement for payment will be made for Type E lime treatment other than as specified.

(c) Water and asphaltic curing materials will not be measured for payment.

304.13 PAYMENT.

(a) Lime: Payment for lime will be made at the contract unit price per ton. If quicklime is used in a slurry, payment will be made at the unit price for hydrated lime after converting the quicklime to the equivalent weight of hydrated lime by multiplying the weight of quicklime by 1.32 then multiplying that product by the purity of the lime.

(b) Treatment: Payment for Type B, C and D lime treatment will be made at the contract unit prices per square yard, adjusted as specified in Section 1002 for specification deviations of asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials. Payment for Type E Treatment will be at the contract unit price per ton of lime used.

Payment will be made under:

Item No.	Pay Item	Pay Unit
304(01)	Lime	Ton
304(02)	Lime Treatment (Type B)(___" Thick)	Square Yard
304(03)	Lime Treatment (Type C)(___" Thick)	Square Yard
304(04)	Lime Treatment (Type D)(___" Thick)	Square Yard
304(05)	Lime (Type E Treatment)	Ton

TABLE 2
LIME TREATMENT

Type	Use	Requirements
B	Base or Subbase	1. One application of lime 2. Initial mixing 3. 48-hour mellowing or aging period 4. Pulverization[1] 5. Density control 6. Minimum thickness and width 7. 72-hour cure
C	Conditioning for Cement treatment or Stabilization	1. One application of lime 2. Initial mixing 3. 48-hour mellowing or aging period 4. Pulverization[1] 5. Compact to engineer's satisfaction 6. No cure required
D	Working Table Under Embankment	1. One application of lime 2. Mixing[2] 3. Compact to engineer's satisfaction 4. No cure required
E	Conditioning and Drying	1. One application of lime per embankment lift 2. Mixing[2] 3. Embankment construction requirements including density.

[1]In-place mixer shall be required.
[2]In-place mixer or approved disc shall be required.

Section 305
Subgrade Layer

305.01 DESCRIPTION. This work consists of treating subgrade soil materials with lime, portland cement, portland-pozzolan cement, or constructing a subgrade layer of stone, crushed slag. recycled portland cement concrete, shell, sand-shell, or asphaltic concrete in accordance with plan details or as directed. When not specified, the subgrade layer may be composed of any of the types of materials listed above, at the option of the contractor. Unless approved in writing, the same subgrade layer shall be used throughout the project. The plans may limit the types of subgrade layer allowed.

These specifications set forth the minimum requirements for construction of the subgrade layer; however, the contractor shall construct a subgrade layer that will provide adequate support for construction of the base/pavement structure. Additional treatment required to provide such support shall be performed by the contractor at no direct pay.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Embankment and Base Course."

In order to meet air quality standards, the contractor may be required to use central plant mixing of lime or cement treated mixtures in dust sensitive areas at no direct pay. The Department will identify the dust sensitive areas before lime or cement treatment begins.

305.02 MATERIALS. Materials shall conform to the following Sections and Subsections:

Asphaltic Concrete	501
Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Emulsified Asphalt	1002
Shell	1003.01 & 1003.03(b)
Sand-Shell	1003.01 & 1003.03(c)
Stone	1003.01 & 1003.03(d)
Recycled Portland Cement Concrete	1003.01 & 1003.03(e)
Crushed Slag	1003.03(f)
Water	1018.01
Lime	1018.03

Asphaltic Concrete shall meet the requirements of Type 5B Base Course.

305.03 EQUIPMENT. Equipment necessary to produce a finished product meeting specification requirements shall be furnished and maintained by the contractor. The equipment will be approved prior to use.

305.04 CONSTRUCTION REQUIREMENTS.

(a) Treated Subgrade Layer: Materials to be treated shall be existing materials or materials placed under other pay items.

(1) Subgrade Soils: Subgrade soils to be treated shall be not more than 79 percent sand or 69 percent silt, when tested in accordance with DOTD TR 407, and shall not have a PI exceeding 35 when tested in accordance with DOTD TR 428.

(2) Pulverization: After mixing with cement, or lime and cement, the pulverization of the mixture shall conform to the following gradation requirements when tested in accordance with DOTD TR 431.

U. S. Sieve	% Passing (By Wt.)
3/4"	95
No. 4	50

(3) Treatment: The minimum amount of cement or lime and cement for treatment shall be as follows:

PI	Lime or Cement (By Vol.)
0-10	8% cement
11-20	10% cement
21-35	10% lime and 8% cement

a. Lime Treatment: Treatment shall conform to Section 304 for Type C treatment, except that the quantity of lime shall be as specified above.

b. Cement Treatment: When in-place mixing is used the treatment shall conform to Section 303. The quantity of cement shall be as specified above.

When central mixing is used, it shall conform to Section 301.

(b) Aggregate Subgrade Layer: Stone, shell, sand-shell, crushed slag, and recycled portland cement concrete shall be mixed, placed, compacted and finished in accordance with Section 302.

(c) Asphaltic Concrete Subgrade Layer: Asphaltic concrete shall be constructed in accordance with Section 501.

305.05 MEASUREMENT. The quantities of subgrade layer for payment will be the design areas as specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions of the completed subgrade layer shown on the plans. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

DOTD TR 602 measurements for width and thickness will not be made, but the width and thickness will be checked by the engineer during construction.

When aggregate, asphaltic concrete or central mixing is used, the removal of existing soil materials from the subgrade will not be measured for payment.

305.06 PAYMENT. Payment for subgrade layer will be made at the contract unit price which includes lime, cement, water, stone, shell, sand-shell, recycled portland cement concrete, crushed slag, asphaltic concrete, and asphaltic curing membrane or prime coat, subject to the payment adjustment provisions of Section 1002 for specification deviations of asphaltic

materials and Subsection 303.11(a) for density deficiencies of cement treated materials. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

Payment will be made under:

Item No.	Pay Item	Pay Unit
305(01)	Subgrade Layer (____" Thick)	Square Yard

Section 306
Scarifying and Compacting Roadbed

306.01 DESCRIPTION. This work consists of scarifying, shaping and compacting an existing roadbed to form a subbase or base course in accordance with these specifications, and in conformity with the lines, grades, depth and cross section shown on the plans or established.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application for Quality Assurance Specifications for Embankment and Base Course."

306.02 CONSTRUCTION REQUIREMENTS. Existing materials shall be scarified for the full width of roadbed and a minimum depth of 6 inches, shaped to the required section, and uniformly compacted to at least 95 percent of maximum dry weight density for subbase, and 100 percent for base, as determined in accordance with DOTD TR 401 and TR 418. Any damage to the scarified roadbed prior to compaction shall be corrected at no direct pay. The scarified, shaped and compacted roadbed shall have a smooth, uniform, closely knit surface, free from ridges, waves, depressions or loose material. Scarifying of the roadbed shall not be performed in excess of 1 mile in advance of compacting the roadbed. The recompacted roadbed shall be primed in accordance with Section 505.

306.03 MAINTENANCE OF COMPACTED ROADBED. The contractor shall protect the compacted roadbed from damage due to either public traffic or construction operation and shall maintain the roadbed in satisfactory condition at all times, including the asphaltic prime coat. Any damage shall be immediately repaired by the contractor at no direct pay.

306.04 MEASUREMENT. The quantities of scarifying and compacting roadbed for payment will be the design lengths or areas as specified in the plans and adjustments thereto. Design quantities are based on the horizontal length of the roadbed shown on the plans. Design quantities will be adjusted when the engineer makes changes to adjust to field conditions, if plan errors are proven, or when design changes are necessary.

306.05 PAYMENT. Payment for scarifying and compacting roadbed will be at the contract unit price, which includes prime coat.

Payment adjustments will be applied for specification deviations of asphaltic materials in accordance with Section 1002. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

Payment will be made under:

Item No.	Pay Item	Pay Unit
306(01)	Scarifying and Compacting Roadbed (___" Thick)	Mile
306(02)	Scarifying and Compacting Roadbed (___" Thick)	Square Yard

PART IV — SURFACE COURSES

Section 401
Aggregate Surface Course

401.01 DESCRIPTION. This work consists of furnishing and constructing aggregate surface courses for roadways, shoulders, drives or other facilities in accordance with these specifications, and in conformity with the lines, grades, thicknesses and typical sections shown on the plans or established.

401.02 MATERIALS. The contractor has the option of furnishing any one of the following types of aggregate surface course materials conforming to the indicated Subsections.

Stone	1003.01 & 1003.04(a)
Sand Clay Gravel (Lime Treated)	1003.01 & 1003.04(b)
Shell	1003.01 & 1003.04(c)
Recycled Portland Cement Concrete	1003.01 & 1003.04(d)
Reclaimed Asphaltic Pavement	1003.01 & 1003.04(e)
Crushed Slag	1003.01 & 1003.04(f)
Water	1018.01
Lime	1018.03

Unless otherwise approved in writing, the same type material shall be used throughout the project.

401.03 EQUIPMENT. Equipment necessary to produce a finished product meeting specification requirements shall be furnished and maintained by the contractor. Equipment will be approved prior to use.

401.04 SHOULDER CONSTRUCTION:

(a) General: The subgrade shall be approved before aggregate surface course is placed. Material removed from shoulders shall be uniformly spread adjacent to the shoulder material.

(b) Existing Shoulders: On existing shoulders, where only aggregate surface course is to be placed, vegetation shall be removed and the shoulders shaped and satisfactorily compacted prior to placing aggregate surfacing. For reconstructed shoulders, the top layer under the subgrade shall be a usable soil conforming to Subsection 203.06 and shall be compacted to a minimum of 95.0 percent of maximum dry weight density. Maximum dry weight density will be determined in accordance with DOTD TR 415 or DOTD TR 418 and percent in-place density in accordance with DOTD TR 401.

(c) New Shoulders: For new shoulders, the top layer under the subgrade shall be a usable soil conforming to Subsection 203.06 and shall be compacted to a minimum of 95.0 percent of maximum dry weight density. Maximum dry weight density will be determined in accordance with DOTD TR 415 or DOTD TR 418 and percent in-place density in accordance with DOTD TR 401.

401.05 PLACING MATERIALS. The material shall be placed directly on the prepared and approved subgrade from hauling vehicles or spreading equipment. No surface course shall be placed on damaged subgrade until repairs conforming to Subsection 401.04 have been completed and approved.

Aggregate surfacing materials shall not be placed or spread on adjacent portland cement concrete or asphaltic concrete pavements. Aggregate surfacing operations shall be conducted so that pavement surfaces, edges and joints are not damaged.

401.06 MIXING.

(a) Stone, Crushed Slag, Reclaimed Asphaltic Pavement, Recycled Portland Cement Concrete or Shell: Stone, crushed slag, reclaimed asphaltic pavement, recycled portland cement concrete and shell shall be a uniform blend, sampled in dedicated stockpiles and approved prior to placement.

(b) Sand Clay Gravel: Prior to placement, the approved sand clay gravel shall be uniformly mixed with 6 percent lime by volume. For central plant mixing, a reduction of 1 percent in the required volume of lime will be permitted. Prior to treatment the sand clay gravel shall be mixed, sampled and approved as specified in Heading (a) above. Adequate moisture shall be added to control compaction.

401.07 SHAPING AND COMPACTING AGGREGATE SURFACE COURSE.

(a) General: The material shall be shaped by suitable means and compacted. Shaping and compacting shall continue until the surface conforms to the required sections and is free from ruts and waves.

(b) Aggregate Surfacing: Aggregate surfacing shall be compacted to the satisfaction of the engineer by approved methods. After initial compaction, the surface shall be wetted as necessary and rolled with a pneumatic-tire or steel-wheel roller to a tight, uniform surface.

(c) Reclaimed Asphaltic Pavement: Reclaimed asphaltic material shall be placed to required thickness, shaped to the required section, and compacted with at least three passes by an approved pneumatic-tire roller to a tight, uniform surface.

(d) Lime Treated Materials: Finishing and compaction of lime treated materials shall be completed within 72 hours after initial mixing with lime.

401.08 DIMENSIONAL TOLERANCES. When net section measurement is specified, the thickness and width of completed aggregate surface course will be checked for acceptance in accordance with DOTD TR 602. When vehicular measurement is used, no DOTD TR 602 measurements will be made. The engineer will take measurements to ensure the work's conformance to plan dimensions. Areas with thickness and width deficiencies in excess of the following tolerances shall be corrected to plan dimensions by furnishing, placing, reworking, shaping, and compacting additional materials as required at no direct pay.

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

(b) Width: Underwidth on roadways shall not exceed 6 inches. Underwidth on shoulders shall not exceed 3 inches. When the roadway and shoulder are constructed at the same time the 6-inch width tolerance shall apply. Overwidth may be waived at no additional cost to the Department.

401.09 MEASUREMENT.

Preparation of existing shoulders will not be measured for payment.

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

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

Materials delivered by volume will be measured by the cubic yard in hauling vehicles and divided by the following factor to determine the pay volume:

	Factor
Stone or Crushed Slag	1.30
Lime Treated Sand Clay Gravel	1.30
Shell	1.70
Recycled Portland Cement Concrete	1.30
Reclaimed Asphaltic Pavement	1.50

Materials delivered by weight will be measured by the ton (2000 pounds) in hauling vehicles and divided by the following factor to determine the pay volume:

	Factor
Limestone	1.95
Sandstone	1.82
Porous Limestone	1.76
Lime Treated Sand Clay Gravel	1.89
Shell	1.62
Recycled Portland Cement Concrete	1.82
Reclaimed Asphaltic Pavement	1.80

401.10 PAYMENT. Payment for aggregate surface course will be made at the contract unit price per cubic yard, which includes furnishing and placing and compacting required aggregate materials, water and lime.

Payment will be made under:

Item No.	Pay Item	Pay Unit
401(01)	Aggregate Surface Course (Net Section)	Cubic Yard
401(02)	Aggregate Surface Course (Adjusted Vehicular Measurement)	Cubic Yard

Section 402
Traffic Maintenance Aggregate

402.01 DESCRIPTION. This work consists of furnishing and constructing aggregate surfacing for maintenance of traffic as directed and in accordance with the following requirements.

402.02 MATERIALS. Aggregate for maintenance of traffic shall be satisfactory to the engineer.

402.03 EQUIPMENT. Equipment necessary to produce a finished product meeting specification requirements shall be furnished and maintained by the contractor.

402.04 CONSTRUCTION REQUIREMENTS. The contractor shall satisfactorily place, shape, compact and maintain areas requiring traffic maintenance aggregate. When directed, the aggregate material shall be reused on the project at designated locations for traffic maintenance at no direct pay. When aggregate surfacing is no longer necessary for maintenance of traffic, the contractor shall, unless otherwise directed, remove the aggregate surfacing and dispose of the removed materials in accordance with Section 202.

402.06 MEASUREMENT. Traffic maintenance aggregate will be measured by the cubic yard in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01. No adjustment factor will be used.

When the contract does not include a pay item for "Traffic Maintenance Aggregate (Vehicular Measurement)," this material will be provided and placed at no direct pay.

402.07 PAYMENT. Payment for traffic maintenance aggregate maintained and subsequently removed (when required) will be made at the contract unit price under:

Item No.	Pay Item	Pay Unit
402(01)	Traffic Maintenance Aggregate (Vehicular Measurement)	Cubic Yard

PART V -- ASPHALTIC PAVEMENTS

Section 501
Asphaltic Concrete Mixtures

501.01 DESCRIPTION: These specifications are applicable to asphaltic concrete wearing, binder and base course mixtures of the plant mix type.

This work consists of furnishing and constructing one or more courses of asphaltic concrete mixture applied hot in conformance with these specifications and in conformity with the lines, grades, thicknesses and typical sections shown on the plans or established. The mixture shall consist of aggregates and asphalt with additives combined in proportions which meet the requirements of this Section including Table 1 and the absolute viscosity test of Subsection 503.02. Equipment and processes shall conform to Section 503.

No substitutions will be allowed for Type 7 or Type 8F mixes without an approved plan change. For Type 9 Wearing Course no substitutions will be allowed without an approved plan change with the following exceptions. The same roadway wearing course mix being used for the main roadway may be substituted for Type 9 Wearing Course when shoulders are paved at the same time and through the same paver as the adjacent roadway. Substitutions will be allowed for other mixes without requiring a plan change as follows:

1. Wearing course of the same or higher stability for binder course.
2. Wearing or binder course for base course.
3. Higher stability for lower stability mix of the same course.

When any substitution is made, the plant requirements for the mixture used shall apply. The stability requirements of Table 1 of the mix used shall be equal to or greater than the mix originally specified.

Quality assurance requirements and design procedures shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Asphaltic Concrete Mixtures."

501.02 MATERIALS: The contractor shall keep accurate records, including proof of deliveries of materials for use in asphaltic concrete mixtures. Copies of these records shall be furnished to the engineer upon request. Materials shall conform to the following Subsections:

Asphalt	1002.01
Silicone and Anti-Strip Additives	1002.02
Aggregates	1003.01 & 1003.06
Hydrated Lime	1018.03(a)
Mix Release Agent	1018.26

(a) Asphalt: Asphalt cement Grade AC-30 shall be used, except when mixtures contain 20 percent to 30 percent reclaimed asphaltic pavement, Grade AC-10 shall be used.

The contractor shall reduce the amount of asphalt cement in the plant's storage or working tanks to 20 percent or less before adding another grade of asphalt cement or asphalt cement from another source.

(b) Additives:

(1) Silicone: Silicone additives, when needed, shall be dispersed into the asphalt by methods and in concentrations given in QPL 22.

(2) Anti-Strip (AS): An anti-strip additive shall be added at the minimum rate of 0.5 percent by weight of asphalt and thoroughly mixed with the asphalt cement at the plant. Additional anti-strip additive shall be added up to 1.2 percent by weight of asphalt in accordance with Subsection 501.03(b).

(3) Hydrated Lime: Hydrated lime additive may be incorporated into all asphaltic concrete mixtures at the rate specified in the approved job mix formula. The minimum rate shall not be less than 1.5 percent by weight of the total mixture. Hydrated lime additive shall be added to and thoroughly mixed with aggregates in conformance with Subsection 503.02(e). Hydrated lime may be added as a mineral filler in accordance with Heading (c)(3).

(c) Aggregates: Aggregates shall meet the requirements of Table 1 and Subsection 1003.

(1) Recycled Portland Cement Concrete: Recycled Portland Cement Concrete will be allowed in base courses with a maximum of 70 percent recycled portland cement concrete by weight combined with new aggregates. Recycled concrete shall be crushed and screened into a minimum of two stockpiles composed of different sized aggregates separate from other materials at the plant. Recycled concrete shall be dried as required for new aggregates.

(2) Reclaimed Asphaltic Pavement (RAP): Reclaimed asphaltic pavement shall be stockpiled separate from other materials at the plant and will be subject to approval prior to use. Such stockpiles shall be uniform and free of soil, debris, foreign matter and other contaminants. Reclaimed materials that cannot be broken down during mixing or that adversely affect paving operations shall be screened or crushed to pass a 2-inch sieve prior to use.

(3) Mineral Filler: Mineral filler conforming to the requirements of Subsection 1003.06(a)(11) may be used in all mixtures.

(4) Screenings: Screenings conforming to the requirements of Subsection 1003.06(a)(6) may be used in all mixtures.

(5) Crushed Aggregates: Crushed aggregates are crusher generated materials manufactured by crushing materials which have a maximum of 10 percent passing the No. 4 sieve.

a. Type 8 and Type 8F Mixes: For Type 8 and Type 8F mixes, a minimum of 75 percent by weight of the new aggregates in wearing and binder courses for travel lanes shall be crushed aggregates; the remaining 25 percent may be natural sand and mineral filler.

b. Type 3 Mixes: For Type 3 mixes, a minimum of 65 percent by weight of the new aggregates used in wearing and binder courses for travel lanes shall be crushed aggregates; the remaining 35 percent may be natural sand and mineral filler.

c. Type 7 and Type 9 Mixes: For Type 7 and Type 9 mixes a minimum of 55 percent, by weight, of the new aggregates used in wearing and binder courses shall be crushed aggregates; the remaining 45 percent may be natural sand and mineral filler.

d. Friction Ratings for coarse aggregates shall be determined in accordance with Subsection 1003.06. The allowable usage of coarse aggregates shall be as follows.

Friction Rating	Allowable Usage
I	All mixtures
II	All mixtures
III	All mixtures except Type 8F WC[1]
IV	All mixtures except Type 3WC[2], 8WC or 8F WC

[1]At least 30 percent by weight of the total aggregates by volume for Type 8F WC shall have a Friction Rating of I, or at least 50 percent by weight of the total aggregate shall have a Friction Rating of II, not more than 10 percent of these materials shall pass the No. 10 sieve.

[2]Type 3 WC (with ADT/lane greater than 1000 VPD) may use this aggregate provided a minimum of 50 percent by weight of the coarse aggregates in the mixture have a Friction Rating of I or II. This aggregate may also be used in mixtures for shoulders, drives, curbs, detours, etc.

501.03 DESIGN AND QUALITY CONTROL OF MIXTURES.

(a) General: It is the intent of these specifications that the mixtures produced and placed meet the requirements for 100 percent payment. The contractor shall be responsible for design, production, transportation and laydown of mixtures. Work shall meet the requirements of this Section and be subject to acceptance by the Department.

The contractor shall exercise quality control over materials and their assembly, design, processing, production, hauling, laydown and associated equipment. Quality control is defined as the constant monitoring of equipment, materials and processes to ensure that mixtures produced and laid are uniform, are within control limits, and meet specification requirements. When these specifications are not being met and satisfactory control adjustments are not being made, operations shall be discontinued until proper adjustments and uniform operations are established. Control shall be accomplished by a program independent of, but correlated with, the Department's testing and shall ensure that the requirements of the job mix are being achieved and that necessary adjustments provide specification results.

The contractor shall conduct such tests as necessary, in addition to the required tests, to design, control and place mixtures within specifications.

The quality of mixtures will be evaluated during two phases, mixture produced at the plant, and mixture hauled, laid and compacted. Quality of both phases will be evaluated in series of lots conforming to Subsection 501.12. A lot is a segment of continuous production of asphaltic concrete mixture from the same job mix formula produced for the Department at an individual plant. Plant quality control testing shall be conducted on each lot independent of delivery points. Project site quality control testing shall be conducted on each project for that portion of the lot placed on that project.

When the plant is in operation, the contractor shall have a Certified Asphaltic Concrete Plant Technician at the plant or jobsite who is capable of designing asphaltic concrete mixes, conducting any test or analysis necessary to put the plant into operation and producing a

mixture meeting specifications. Daily plant operations shall not begin unless the Certified Asphaltic Concrete Plant Technician is at the plant. The Asphaltic Concrete Technician certification will be awarded by the Department upon satisfactory completion of the Department's requirements.

(b) Job Mix Formula: The contractor shall design the mixtures for optimum asphalt content and comply with requirements of DOTD TR 303, Method A; however, Method B may be used when approved. The job mix formula shall include the recommended formula and supporting design data. The recommended formula shall be submitted for approval to the District Laboratory Engineer on a properly completed Asphaltic Concrete Job Formula form. No mixture shall be produced until the proposed job mix formula has been approved.

The proposed job mix formula shall indicate a single anti-strip additive rate which is 0.1 percent greater than the percentage which will yield a minimum of 90 percent coating when tested in accordance with DOTD TR 317 or 0.1 percent greater than the percentage which will produce a minimum Tensile Strength Ratio (TSR) of 75 percent when tested in accordance with DOTD TR 322 whichever gives the greatest amount of anti-strip additive. The approved limit shall be 0.2 percent by weight of asphalt, with the lower limit being the quantity determined in accordance with DOTD TR 317 and the maximum limit not to exceed 1.2 percent by weight of asphalt.

The job mix formula shall indicate a single rate of hydrated lime additive when used. The job mix formula rate of hydrated lime additive shall not be less than 1.5 percent by weight of total mixture.

The job mix formula shall produce an asphaltic concrete mixture with a minimum TSR of 75 percent when tested in accordance with DOTD TR 322. The contractor's proposed job mix formula shall indicate a minimum TSR value of 75 percent attained in accordance with DOTD TR 322 on plant-produced mixture or laboratory-produced mixture. Production of this job mix formula will be allowed pending validation by the Department on plant produced mixture. When the Department's validation result is less than 75 percent TSR, no further production for that job mix formula or any proposed job mix formula substituted for that mix type will be accepted on any DOTD project having DOTD TR 322 requirements until a passing plant-produced TSR value is verified by the Department. A previously validated and approved job mix formula may be produced in lieu of the disapproved job mix formula.

The job mix formula shall indicate the optimum mixing temperature which is the midpoint of the range shown on the Optimum Mixing and Compaction Temperatures Chart for the asphalt cement used. This chart shall be furnished by the Materials and Testing Section. The job mix formula limits for mix temperature will be ±25°F from the optimum mixing temperature.

When aggregates with a water absorption value greater than 2.0 percent determined in accordance with AASHTO T 84 for fine aggregate or AASHTO T85 for coarse aggregate are used in the mixture, the contractor shall increase the initial optimum asphalt cement content to compensate for the asphalt cement absorbed by the aggregates. When aggregates with an asphalt absorption value greater than 0.5 percent, determined in accordance with DOTD TR 320, are used in the mixture, the contractor shall increase the initial optimum asphalt cement content to compensate for the asphalt cement absorbed by the aggregates.

The job mix formula will allow the full range of gradation mix tolerances within the mix type specification limits.

The plant shall be operated to produce, on a continuing basis, a mixture uniformly conforming to the approved job mix formula. When this is not the case, the contractor shall make satisfactory adjustments or cease operations. The District Laboratory Engineer may permit the contractor to submit a new Asphaltic Concrete Job Mix Formula form for approval. The contractor shall submit a new job mix formula whenever a plant begins initial operations for the Department in a specific location or whenever a plant experiences a change in materials or source of materials. A new job mix formula will also be required whenever there are significant changes in equipment, such as the introduction of a new crusher, drum mixer, burner, etc.

(c) Control Charts: For control purposes, the contractor shall obtain a minimum of two samples of mixture from each lot. Test results for extracted gradation (DOTD TR 309), percent crushed (DOTD TR 306) and asphalt content (DOTD TR 308) of each lot shall be plotted on control charts. The upper and lower control limits as shown on the approved job mix formula shall be included on the control chart. When the results of two consecutive extracted gradations on any sieve, except the No. 200, fall within 1 percent of the approved job mix formula gradation limit, or fall erratically within the range, the contractor shall immediately make corrections to maintain the mix within specified limits.

When the results of two consecutive extracted gradations on the No. 200 sieve fall within 0.5 percent of the approved job mix formula gradation limit or fall erratically within the range, the contractor shall immediately make corrections.

(d) Reclaimed Asphaltic Pavement (RAP): The quantity of reclaimed asphaltic pavement to be used shall be designated in the job mix formula and meet the requirements of Table 1. The approved quantity shall be established after testing for absolute viscosity in accordance with Subsection 503.02(a). When mixtures contain less than 20 percent reclaimed asphaltic pavement, Grade AC-30 asphalt cement shall be used. Grade AC-10 asphalt cement shall be used in mixtures containing from 20 to 30 percent RAP. The mixture produced shall conform to the requirements for the type mixture specified. The engineer may require the contractor to reduce the percentage of reclaimed asphaltic pavement to meet acceptance criteria.

When RAP is used in the mixture, the new aggregate shall be dried and heated in a dryer to a sufficiently high temperature to produce a mixture with a minimum discharge temperature of 280°F.

501.04 WEATHER LIMITATIONS: Asphaltic concrete mixtures shall not be applied on a wet surface or when the ambient temperature is below 50°F for wearing courses and 40°F for base and binder courses, except that material in transit, or a maximum of 50 tons in a surge bin or silo used as a surge bin at the time plant operation is discontinued may be laid; however, mixture laid shall perform satisfactorily and meet specification requirements. Inclement weather will be sufficient reason to terminate or not begin production.

When base course materials are placed in plan thicknesses of 2 3/4 inches or greater, these temperature limitations shall not apply provided all other specification requirements are met.

501.05 SURFACE PREPARATION: The surface to be covered shall be approved prior to placing mixtures. The contractor shall maintain the surface until it is covered.

(a) Cleaning: The surface to be covered shall be swept clean of dust, dirt, caked clay, caked material and loose material by revolving brooms or other mechanical sweepers supplemented with hand equipment as directed. When mixtures are to be placed on portland cement concrete pavement or overlaid portland cement concrete, the contractor shall remove excess joint filler from the surface by an approved burning method. The contractor shall remove any existing raised pavement markers prior to asphaltic concrete overlay operations.

When brooming does not adequately clean the surface, the contractor shall wash the surface with water in addition to brooming to clean the surface.

When liquid asphalt is exposed to traffic for more than 2 calendar days, becomes contaminated, or degrades due to inclement weather, the liquid asphalt shall be reapplied at the initial recommended rate at no direct pay.

(b) Applying Liquid Asphaltic Materials:

(1) Existing Pavement Surfaces: Before constructing each course, an approved asphaltic tack coat shall be applied in accordance with Section 504. The contractor shall protect the tack coat and spot patch as required.

(2) Raw Aggregate Base Course and Raw Embankment Surfaces: The contractor shall apply an approved asphaltic prime coat to unprimed surfaces, or protect in-place prime coat and spot patch as required with asphaltic prime coat, in accordance with Section 505.

(3) Cement and Lime Stabilized or Treated Embankment and Base Course Surfaces: The contractor shall apply an approved asphaltic curing membrane when none is in place, or protect the in-place curing membrane and spot patch, as required, with asphaltic material in accordance with Section 506.

(4) Other Surfaces: Contact surfaces of curbs, gutters, manholes, edges of longitudinal and transverse joints, and other structures shall be covered with a uniform coating of an approved asphaltic tack coat conforming to Section 504 before placing asphaltic mixtures.

501.06 JOINT CONSTRUCTION.

(a) Longitudinal Joints: Longitudinal joints shall be constructed by setting the screed to allow approximately 25 percent fluff and also overlapping the paver approximately 2 inches onto the adjacent pass. Prior to rolling, the overlapped mix shall be pushed back to the uncompacted side, without scattering loose material over the uncompacted mat, to form a vertical edge above the joint. The vertical edge shall then be compacted by rolling to form a smooth, sealed joint. Longitudinal joints in one layer shall offset those in the layer below by a minimum of 3 inches; however, the joint in the top layer shall be offset 3 inches to 6 inches from the centerline of pavement when the roadway comprises two lanes of width, or offset 3 inches to 6 inches from lane lines when the roadway is more than two lanes. The narrow strip shall be constructed first.

Where adjacent paving strips are to be placed, the longitudinal edge joint of the existing strip shall be tacked.

(b) Transverse Joints: Transverse joints shall be butt joints formed by cutting back on the previously placed mixture to expose the full depth of the lift. An approved 10-foot static straightedge shall be used to identify the location at which the previously placed mixture is to be cut back to maintain no greater than a 1/8-inch deviation in grade. The cut face of the previously placed mat shall be lightly tacked before fresh material is placed. The screed shall rest on shims that are approximately 25 percent of plan thickness placed on the compacted mat or the screed shall be set at a distance that is 25 percent of plan thickness above the mat surface. Transverse joints shall be formed by an adequate crew. Transverse joints shall be checked by the engineer for surface tolerance using a stringline extended from a point 10 feet before the joint to a point approximately 40 feet beyond the joint. Any deviation in grade from the stringline in excess of 3/16 inch for roadway wearing courses and 1/4 inch for other courses shall be immediately corrected prior to the paving operation continuing beyond 100 feet of the transverse joint. Additionally, the transverse joint shall meet the surface tolerance requirements of Table 1. The contractor shall make necessary corrections to the joint before continuing placement operations.

Transverse joints in succeeding lifts shall be offset at least 2 feet.

501.07 HAULING, PAVING AND FINISHING. Mixtures shall be transported from the plant and delivered to the paver at a temperature no cooler than 25°F below the lower limit of the approved job mix formula. The temperature of the mix going through the paver shall not be cooler than 250°F.

No loads shall be sent out so late in the day that completion of spreading and compaction of the mixture cannot be completed during daylight, unless artificial lighting has been approved.

When segregation occurs, haul trucks shall be loaded with a minimum of three drops of mix, the last of which shall be in the middle.

Each lift of asphaltic mixture shall be placed in accordance with the specified lift thickness. When no lift thickness is specified, binder and wearing course mixtures shall be placed in lifts not exceeding 2 inches plan thickness. Base course mixtures shall be placed in lifts of such thickness that all specification requirements are met.

With the engineer's approval, motor patrols may be used to fill isolated depressions in the initial layer, provided this construction does not result in unsatisfactory subsequent lifts.

(a) Coordination of Production: The contractor shall coordinate and manage plant production, transportation of mix and placement operations to achieve a high quality pavement and shall have sufficient hauling vehicles to ensure continuous plant and roadway operations. The engineer will order a halt to operations when sufficient hauling vehicles are not available.

On final wearing course construction under traffic with pavement layers of 2 inches compacted thickness or less, the contractor will be permitted to pave one travel lane for a full day. The contractor shall pave the adjacent travel lane the next work day. When the adjacent travel lane is not paved the next calendar day and the longitudinal joint is exposed to traffic for more than 3 calendar days, the entire length of exposed longitudinal joint shall be cut back to plan thickness to a vertical edge and heavily tacked. When pavement layers are greater than 2 inches compacted thickness, the contractor shall place approximately

1/2 of each day's production in one lane and the remainder in the adjacent lane.

Pavement shall be protected from traffic until it has sufficiently hardened to the extent the surface is not damaged.

(b) Paving Operations:

All mixtures shall flow through the paver hopper. Mixtures dropped in front of the paver shall be either lifted into the hopper or rejected and cast aside. Delivery of material to the paver shall be at a uniform rate and in an amount within the capacity of paving and compacting equipment. The paver speed and number of trucks shall be adjusted to have one truck waiting in addition to the one at the paver in order to maintain continuous paving operations. The height of material in front of the screed shall remain uniform.

Transfer of mixture from haul truck to paver may be made by direct unloading into the paver hopper or by use of approved mechanical transfer devices to transfer mix from a haul truck or windrow. During mixture transfer, the paver shall not be jarred or moved out of alignment. During truck exchanges the level of mix in the paver hopper shall not drop so low as to expose the hopper feed slats.

Pavers shall be designed and operated to place mixtures to required line, grade and surface tolerance without resorting to hand finishing.

Longitudinal joints and edges shall be constructed along lines established. Stringlines or other forms of longitudinal control shall be placed by the contractor for the paver to follow. The paver shall be positioned and operated to closely follow the established line. Irregularities in alignment shall be corrected by trimming or filling directly behind the paver.

After each load of material has been placed, the texture of the unrolled surface shall be checked to determine its uniformity. The adjustment of screed, tamping bars, feed screws, hopper feed, etc., shall be checked frequently and adjusted as required to assure uniform spreading of the mix to proper line and grade and adequate compaction. When segregation of materials or other deficiencies occur, paving operations shall be suspended until the cause is determined and corrected.

Surface irregularities shall be corrected directly behind the paver. Excess material forming high spots shall be removed. Indented areas shall be filled and finished smooth. Hand placement in accordance with Heading (c) for surface repair will be permitted. Material shall not be cast over the surface.

When paving and finishing operations are interrupted so that the mixture remaining in trucks, paver, paver hopper or on the pavement cools to such extent that it cannot be placed, finished or compacted to the same degree of smoothness and with the same texture and density as the uncooled mixture, the cooled mixture shall be removed and replaced at no direct pay.

When additional mix is required to increase superelevation in curves, the use of automatic slope control will be optional with the contractor.

The erected stringline method of construction shall be required for airport runways. Unless the erected stringline is required or directed, the 30-foot (minimum) traveling reference plane method of construction shall be used.

The following requirements shall apply for mechanical pavers:

(1) Minimum 30-foot Traveling Reference Plane: The minimum 30-foot traveling reference plane shall consist of a minimum of 8 sensing

points with wheels or feet mounted on a frame and moving independently so that the grade reference changes to follow the average reading from all wheels or feet. When the reference plane is designed for the grade sensor to rest on a solid (one-piece) rigid beam, a piano wire will not be required. When the beam is not monolithic and rigid, a piano wire shall be stretched from end-to-end, so that there is less than 0.1-inch variance when the grade sensor is in place.

After the initial paving strip of each lift is finished and compacted, adjacent paving strips shall be placed to the grade of the initial paving strip using a traveling reference plane to control grade and a slope control device to control cross slope.

When directed, the shoe device shall be used to control the grade of the initial or adjacent paving strips on any lift. On multilane pavements, the initial paving strip and the sequence of lane construction will be subject to approval.

When both outside edges of the paving strip being placed are flush with previously placed material, the slope control device shall not be used. A grade sensor is required for each side of the paver.

In superelevated curves, the cross slope shall be changed from that specified for tangents to that specified for superelevation in gradual increments while the paver is in motion so a smooth transition in grade is obtained. This change in cross slope shall be accomplished within the transition distance specified.

(2) Erected Stringline: An erected stringline shall consist of a piano wire stretched between stakes set at no greater than 25-foot intervals tensioned between supports so that there is less than 0.1 inch variance between supports when the sensor is in place. The stringline elevation will be verified by the Department using standard surveying practices.

The initial paving strip of the first lift shall be constructed using an erected stringline referenced to established grade. When permitted, mixtures required to level isolated depressions may be placed without automatic screed control. Subsequent lifts may be constructed by use of the traveling reference plane, provided surface and grade tolerances are met on the previous lift.

Only one grade sensor and the slope control device are necessary for roadways with a normal crown on tangent alignment. Superelevated curves will require the use of two grade sensors and two erected stringlines to obtain proper grade and slope; however, when the automatic screed control device is equipped with a dial or other device which can be conveniently used to change the cross slope in small increments, superelevated curves may be constructed using this device and one erected stringline.

After the initial paving strip of the first lift is finished and compacted, adjacent paving strips shall be laid using a minimum 30-foot traveling reference plane.

(3) Without Automatic Screed Control: When permitted, pavers without automatic screed control may be used for pavement patching, pavement widening, paved drives and turnouts.

(c) Hand Placement: When the use of mechanical finishing equipment is not practical, the mix may be placed and finished by hand to the satisfaction of the engineer. No casting will be allowed including casting the mixture from the truck to the grade. During paving operations material shall be thoroughly loosened and uniformly distributed. Material

that has formed into lumps and does not break down readily will be rejected. The surface shall be checked before rolling and irregularities corrected.

501.08 COMPACTION.

(a) General: After placement, mixtures shall be uniformly compacted, by rolling while still hot, to at least the density specified in Table 1. If continuous roller operation is discontinued, rollers shall be removed to cooler areas of the mat, where they will not leave surface indentations. The use of steel wheel rollers which result in excessive crushing of aggregate will not be permitted.

The rolling pattern established by the contractor shall be conducted by experienced operators in consistent sequences and by uniform methods that will obtain specified density and smoothness. Individual roller passes shall uniformly overlap preceding passes to ensure complete coverage of the paving area. The speed and operation of rollers shall not displace, tear or crack the mat. Nonvibrating steel wheel rollers shall be operated with drive wheels toward the paver. Any operations causing displacement, tearing or cracking of the mat shall be immediately corrected.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operations or fails to produce a satisfactory surface shall not be used. Operation of equipment resulting in accumulation of material and subsequent shedding of accumulated material into the mixture or onto the mat will not be permitted.

To prevent adhesion of mixture, wheels of steel wheel rollers shall be kept properly moistened, but excess water will not be permitted.

Pneumatic tire rollers shall be operated so that tires will retain adequate heat to prevent mix from adhering to tires. The pneumatic tire roller shall be operated at a contact pressure which will result in a uniform, tightly-knit surface. The pneumatic tire roller shall be kept approximately 6 inches from unsupported edges of the paving strip; however, when an adjacent paving strip is down, the roller shall overlap the adjacent paving strip approximately 6 inches.

Vibratory rollers may be used provided they do not impair the stability of the pavement structure or underlying layers. Vibratory rollers shall not be used on the first lift of asphaltic concrete placed over the asphalt treated drainage blanket. When mix is placed on newly constructed cement or lime stabilized or treated layers, vibratory rollers shall not be used for at least 7 days after such stabilization or treatment.

The surface of mixtures after compaction shall be smooth and true to cross slope and grade within the tolerances specified. Mixtures that become loose, broken, contaminated or otherwise defective shall be removed and replaced with fresh hot mixture compacted to conform with the surrounding mixture.

Ripples in the mat surface will not be accepted. Lots with rippled areas will be subject to rideability testing by the Department. These areas will be compared with the balance of the lot and adjacent acceptable riding surfaces to determine acceptability. Areas identified by such testing as unacceptable shall be corrected at no direct pay. Damage to the longitudinal joint shall be minimized to conform to Subsection 501.07(a).

(b) Breakdown Rolling: Breakdown or initial rolling shall be accomplished with a static or vibratory steel-wheel roller designed for initial compaction of hot asphaltic concrete mixtures conforming to Subsection 503.06.

(c) Intermediate Rolling: Intermediate rolling shall be accomplished using an approved pneumatic tire roller conforming to Subsection 503.06.

(d) Finish Rolling: Finish rolling shall be accomplished with an approved nonvibrating steel wheel roller conforming to Subsection 503.06 until roller marks have been eliminated.

After finish rolling, newly finished pavements shall have a uniform, tightly-knit surface free of cracks, tears or other deficiencies. Deficiencies shall be corrected at no direct pay and the contractor shall adjust operations to correct the problem. This may require the contractor to adjust the mix or furnish additional or different equipment.

(e) Hand Compaction: Along forms, curbs, headers, walls and at other places inaccessible to rollers, mixture shall be uniformly compacted to the satisfaction of the engineer with approved hand tampers or mechanical tampers, conforming to Subsection 503.07.

501.09 PAVEMENT SAMPLES. Samples shall be cores approximately 4 inches in diameter taken by an approved core drill. The contractor shall furnish samples cut from the completed work. The removed pavement shall be replaced with hot or cold mixture and refinished during the work day coring is performed. No additional compensation will be allowed for furnishing test samples and replacing the areas with new pavement. Samples shall be taken by the contractor in the presence of the engineer's representative from areas selected by the Department in accordance with Subsection 501.12(b)(2)c. When the design thickness is greater than 1 3/8 inches, cores less than 1 3/8 inches thick shall not be used as pavement samples for payment determination.

Cores shall be transported to the plant in approved styrofoam transport containers or one-gallon friction-top cans. Regardless of transport container used, the container will be sealed, signed, and dated by the inspector using an approved method. The individually wrapped core will also be sealed, signed, and dated by the inspector using an approved method. Any evidence of tampering with the core wrappings, sticker, or of opening the container or friction-top can will result in the cores being rejected. Additional pavement samples will be required.

501.10 SURFACE TOLERANCE REQUIREMENTS: Acceptance testing for surface tolerance as outlined herein and in Table 1 of this Section will be the responsibility of the Department. Quality control testing will be the responsibility of the contractor. The contractor shall provide an approved 25-Foot California-Type Ames Profilograph calibrated and operated in accordance with DOTD TR 641 for longitudinal surface tolerance quality control testing. The profilograph used for longitudinal surface tolerance acceptance and to determine surface tolerance payment adjustments will consist of an approved 25-Foot California-Type Ames Profilograph furnished, calibrated and operated by the Department in accordance with DOTD TR 641. An approved 10-foot metal static straightedge shall be furnished by the contractor for transverse and longitudinal surface tolerance acceptance testing.

The operation of the profilograph including evaluation of the profile trace, determination of the Profile Index, calculation of the Average Profile Index and the determination of high points (bumps) in excess of specification limits shall be accomplished by a trained, authorized technician who has successfully completed the Department's training and evaluation program.

Surface tolerance testing will be required on roadway and airport wearing and binder courses, and shoulder and parking area wearing courses. For the purposes of surface tolerance requirements, the wearing course is defined as the last lift placed. The binder course is defined as the last lift placed prior to the wearing course.

Other lifts on which additional asphaltic concrete is to be placed shall be finished so that succeeding courses will meet the requirements in this Section. Base courses on which portland cement concrete pavement is to be placed shall be finished so that the portland cement concrete pavement will meet the requirements of Section 601.

(a) Longitudinal Surface Tolerance: The finished surface will be tested in the longitudinal direction for conformance to the surface tolerance requirements listed in this Section. When testing for roadway and airport wearing and binder courses using the profilograph, one path in each paving strip in a lot will be selected at random in accordance with the Materials Sampling Manual. For shoulders (minimum 10 feet wide) and parking areas, testing of the wearing course in one random path will be required. The entire lot will be tested and shall meet the following requirements:

(1) Quality Control Testing: The contractor shall test the pavement no later than during the first work day following placement but in no case longer than 14 calendar days. Quality Control testing using a profilograph shall be required on roadway and airport wearing and binder courses, shoulders (minimum 10 feet wide) and parking area wearing courses.

When quality control testing establishes that the surface tolerance is deficient, the contractor will immediately suspend paving operations. Paving operations will not be allowed to resume until appropriate corrections have been made and a test section successfully placed with acceptable surface tolerance. This test section shall consist of a maximum of 500 tons of asphaltic concrete which is to be placed in a continuous operation.

The contractor shall control the paving operation and frequently test the surface to maintain the quality of the finished surface. The contractor shall profile, correct and reprofile as many times as necessary to verify that specification requirements have been met before notifying the engineer a lot is being submitted for acceptance.

The contractor shall correct deficiencies, determined during quality control testing in accordance with Heading (e) at no direct pay. Once these corrections have been completed and the surface tolerance requirements listed herein and in Table 1 have been met, the contractor shall provide the engineer the reports required in DOTD TR 641 with notification that the lot is ready for acceptance testing.

a. Roadway and Airport Wearing:

1. Multi-lift New Construction and Overlays More Than Two Lifts: Pavement with high points (bumps) in excess of 0.3 inch in 25 feet or less shall be corrected and the lot retested. The Average Profile Index shall not be more than 3.0 inches per mile per lot.

2. Single-lift Construction Over Cold Planed Surfaces and Two-Lift Overlays: Pavement with high points (bumps) in excess of 0.3 inch in 25 feet or less shall be corrected and the lot retested. The Average Profile Index shall be not more than 5.0 inches per mile per lot.

3. Single-lift Overlays Over Existing Surfaces: Pavement with high points (bumps) in excess of 0.3 inch in 25 feet or less shall be corrected and the lot retested. The Average Profile Index shall be not more than 8.0 inches per mile per lot.

b. Binder courses, shoulders (minimum 10 feet wide) and parking area wearing courses: The Average Profile Index shall be not more than 12.0 inches per mile per lot. Lots with an Average Profile Index more than 12.0 inches per mile and high points (bumps) in excess of 0.3 inch in 25 feet or less shall be corrected in accordance with Heading (e) and the lot retested. Surface requirements shall be met prior to placing the wearing course.

c. Shoulders (less than 10 feet wide), turnouts, crossovers, and roadway sections less than 100 feet in length: For shoulders (less than 10 feet wide), turnouts, crossovers and roadway sections less than 100 feet in length, the wearing course shall be tested with an approved 10-foot metal static straightedge and the surface deviations shall not exceed 1/2 inch. Areas with surface deviations in excess of 1/2 inch shall be isolated and corrected by the contractor in accordance with Heading (e).

(2) Acceptance Testing: After corrective work and quality control testing within a lot has been completed by the contractor in conformance with these specifications and Table 1, the Department will evaluate the profile trace from the contractor's quality control tests for all courses. Longitudinal variations in the final wearing course surface will be subject to provisions of Subsection 501.12(b)(2)d. The entire lot will be tested by the Department no later than 14 calendar days after all corrective work is completed by the contractor with the same type of equipment. Test path for acceptance testing will be randomly selected independent of Quality Control test paths in accordance with the Materials Sampling Manual.

The surface of each shoulder less than 10 feet wide will be tested longitudinally by the engineer at a minimum of one randomly selected location in each 300 linear feet of shoulder using the 10-foot metal static straightedge; areas with surface deviations in excess of 1/2 inch will be isolated by the engineer and shall be corrected by the contractor in accordance with Heading (e).

(b) Transverse Surface Tolerance: The transverse surface finish shall be controlled so that the values shown in Table 1 will not be exceeded. The surface for binder and wearing courses will be tested at selected locations by the engineer in the transverse direction for conformance to surface tolerance requirements of Table 1. Corrections shall be made as directed in accordance with Heading (e).

(c) Cross Slope: When the plans require the section to be constructed to a specified cross slope, tests shall be run at selected locations, using a stringline, slope board or other comparable method. The cross slope shall be so controlled that the values shown in Table 1 will not be exceeded. Cross slope variations allowed in Table 1 shall apply to each lane constructed.

(d) Grade: When the plans require the pavement to be constructed to a grade, tests for conformance shall be run at selected locations, using a stringline or other comparable method. Grade variations shall be controlled so that the tolerance shown in Table 1 will not be exceeded. Grade tolerances shall apply to only one longitudinal line, such as the centerline or outside edge of pavement. Corrections shall be made in accordance with Heading (e) of this Subsection.

(e) Correction of Deficient Areas: Deficiencies to be corrected in the final wearing course shall be corrected by diamond grinding and applying a light tack coat, removing and replacing, or furnishing and placing a supplemental layer of wearing course mixture at least 1 1/4 inches compacted thickness for the full width of the roadway meeting specification requirements at no direct pay. If the supplemental layer does not meet specification requirements, it shall be removed and replaced.

Deficiencies to be corrected in binder and shoulder courses shall be corrected in a manner meeting specification requirements at no direct pay. Corrections shall be made before subsequent courses are constructed.

501.11 DIMENSIONAL REQUIREMENTS: Mixtures that are specified for payment on a cubic yard or square yard basis shall conform to the following dimensional requirements. Overthickness and overwidth will be waived at no direct pay.

(a) Thickness: Thickness of mixtures will be determined in accordance with DOTD TR 602. Underthickness shall not exceed 1/4 inch.

When grade adjustments are permitted for all mixtures except the final wearing course, areas with underthickness in excess of 1/4 inch shall be corrected to plan thickness at no direct pay by furnishing and placing additional mixture in accordance with Subsection 501.10(e). For the final wearing course, areas with underthickness in excess of the 1/4 inch shall be corrected to plan thickness at no direct pay by furnishing and placing a supplemental layer of wearing course mixture meeting specification requirements in accordance with Subsection 501.10(e) over the entire area for the full width of the roadway when grade adjustments are permitted.

When grade adjustments do not permit, the deficient overthickness area shall be removed and replaced at no direct pay.

(b) Width: The width of completed courses will be determined in accordance with DOTD TR 602. Underwidths shall be corrected by furnishing and placing additional mixture a minimum of 1 foot wide and plan thickness at no direct pay.

501.12 ACCEPTANCE REQUIREMENTS. All Department inspection procedures, including sampling and testing, form the basis for acceptance of the asphaltic concrete. Any section of pavement that is obviously deficient shall be satisfactorily corrected or replaced. Sampling and testing shall be accomplished following a stratified sampling plan in accordance with the Materials Sampling Manual and specified test procedures. Times and locations shall be established by the engineer.

A standard lot is 1,000 tons of consecutive production of asphaltic concrete mix from the same job mix formula produced for the Department at an individual plant. Additional adjustments may be made to the standard

lot size as specified in this Subsection. Minor adjustments will be made to the lot size to accommodate hauling unit capacity.

Acceptance testing for Marshall properties, percent anti-strip additive, percent hydrated lime (when used), quality of asphalt cement, aggregate gradation, percent crushed aggregate, percent asphalt cement, and percent moisture in loose mix will be conducted on the total lot quantity. Acceptance testing for pavement density, surface tolerance and dimensional tolerances will be conducted on that portion of the lot placed on each contract.

When historical records indicate acceptable and uniform mix, the standard lot size may be increased when agreed upon by the engineer and contractor. The engineer may decrease the size of an individual lot for any of the following conditions:

(1) The interval between continuous production exceeds 2 days.
(2) A new job mix formula is accepted.
(3) The final lot is less than 1,000 tons.
(4) A payment adjustment will be applied to the portion of the lot already produced, provided plant adjustments have been made to bring the asphaltic concrete into conformance with the requirements of Table 1 and the job mix formula.

In case of a smaller individual lot size, the plant mix will be accepted on the average values of those tests run.

Pavement density and surface tolerance requirements will not be applied for short irregular sections, such as drives, aprons and turnouts; however, mix shall be placed to provide a neat, uniform appearance and shall be compacted by satisfactory methods.

For projects, or separate locations within a project, requiring between 250 and 1000 tons of mixture, one sample will be taken for Marshall properties testing for each 250 tons or portion thereof produced. Sampling and testing for aggregate gradation, asphalt content and percent crushed shall be in accordance with Heading (b)(2)b. Five samples shall be taken for determination of pavement density, with the sampling distribution to be determined by the engineer.

For projects, or separate locations within a project, requiring less than 250 tons, the job mix formula, materials, and plant and paving operations shall be satisfactory to the engineer. Payment adjustments for Marshall properties will be based on "Individual Test Within Lot" values in Table 2. Sampling and testing requirements for aggregate gradation, surface tolerance and pavement density may be modified by the engineer and the payment adjustment for deviations waived.

(a) Inspection: Mix exhibiting deficiencies before placement such as segregation, contamination, lumps, nonuniform coating, excessive temperature variations or other deficiencies, apparent on visual inspection, shall not be placed.

Mix exhibiting deficiencies during placement, such as segregation, contamination, alignment deviations, variations in surface texture and appearance or other deficiencies, apparent on visual inspection, will not be accepted. Poor construction practices such as handwork, improper truck exchanges, improper joint construction, or other deficiencies, apparent on visual inspection, will not be accepted.

Deficiencies revealed by visual inspection after placement and before final acceptance shall be corrected at no direct pay.

When requested by the contractor, the acceptability of mixtures or work rejected by visual inspection will be evaluated by tests and measurements.

(b) Sampling and Testing:

(1) Without Payment Adjustments: The Department will take samples or perform tests as outlined in these specifications to ensure that the asphaltic concrete conforms to Department standards, which include job mix limits, typical sections, material properties, surface deviations and verification of control testing. The Department will perform tests for gradation, percent crushed, percent asphalt cement, and Marshall properties to determine the acceptability of the asphaltic concrete without payment adjustment, except that gradation for the No. 4, No. 40 and No. 200 sieves and Marshall Stability shall be subject to payment adjustments in accordance with Heading (b)(2). Sampling and testing will be in accordance with the requirements of Heading (b)(2). Deviations from specified tolerances will not be accepted. When a sample or test indicates a deviation from a specified tolerance, the contractor shall take immediate corrective action, or operations shall be discontinued.

(2) With Payment Adjustments: When the mix does not meet requirements in the areas listed in this Section, the Payment Adjustment Schedules shown in Table 2 will be applied. Production of mix that is not eligible for 100 percent payment will not be allowed on a continuous basis. When test results demonstrate that payment adjustments are necessary, satisfactory control adjustments shall be made, or production shall be discontinued.

The Department will pay the contractor at an adjusted rate as specified in Table 2 for tests conducted by the Department on samples obtained from each lot of material, in accordance with the following Headings. In addition a payment adjustment will be applied for the use of asphalt cement which does not meet specifications.

a. Marshall Stability: Testing for Marshall Stability will be conducted by the Department. Compacted specimens of mixture shall conform to the properties in Table 1 when tested in accordance with DOTD TR 305 for both an individual and an average of four samples taken from each lot after the mixture is placed in trucks. One sample will be taken from each of four sublots. Temperature at the time of molding specimens shall be within 15°F of mix temperature at the time of sampling. When an individual test or the average of tests representing the lot is outside acceptance limits shown in Table 1, an adjustment in unit price for the lot will be made in accordance with Table 2.

b. Aggregate Gradation, Asphalt Content and Percent Crushed: Sampling and testing for aggregate gradation, asphalt content and percent crushed will be conducted by the Department. Three loose mix samples, randomly spaced throughout the production of each lot, will be taken after placement of the mix in the truck. These samples shall be properly identified and delivered to the District Laboratory for testing in accordance with DOTD TR 309, TR 307 and TR 306, respectively. One of these three samples will be tested and if the test results are within the job mix control limits given in Table 1, no payment adjustment will be made and the remaining two samples will be discarded.

When test results from the one sample are outside the job mix control limits, the remaining two samples for the lot will be tested. Deviations of gradation will be calculated for each test and the

deviations will be averaged for determination of adjustments in unit price in accordance with Table 2. This adjustment in unit price is determined by percent deviation from job mix control limits for the Nos. 4, 40 and 200 sieves, and only the sieve with the greatest adjustment in unit price will be used.

c. Pavement Density: Acceptance testing for pavement density will be conducted by the Department. Upon completion of compaction, five pavement samples per contract shall be obtained in accordance with Subsection 501.09 from each lot within 24 hours after placement of the lot. When this falls on a day the contractor's crews are not working, sampling shall be done within 3 calendar days. The lot will be divided into five sublots of approximately equal length. One sample shall be obtained from each sublot. The number of samples representing a lot will not be less than five. The density requirement for the average of five samples will be as shown in Table 1 determined in accordance with DOTD TR 304. Payment will be made in accordance with Table 2.

When the sampling location determined by random sampling falls within areas that are to be replaced or within 1 foot of the unsupported pavement edge, another random sampling location will be used.

d. Longitudinal Surface Tolerance: Testing for surface tolerance will be required for each lot on the final roadway wearing course lift and airport wearing course lift. The requirements for longitudinal surface tolerance on the final roadway and airport wearing course lift shall be:

1. Multi-lift New Construction and Overlays More Than Two Lifts: Pavements shall not have any high points (bumps) in excess of 0.3 inch in 25 feet or less. The Average Profile Index shall not be more than 3.0 inches per mile per lot, except that Average Profile Indexes up to 6.0 inches per mile per lot will be acceptable with applicable payment adjustments.

2. Single-lift Construction Over Cold Planed Surfaces and Two-Lift Overlays: Pavements shall not have any high points (bumps) in excess of 0.3 inch in 25 feet or less. The Average Profile Index shall not be more than 5.0 inches per mile per lot, except that Average Profile Indexes of up to 10.0 inches per mile per lot will be acceptable with applicable payment adjustments.

3. Single-lift Overlays Over Existing Surfaces: Pavement shall not have any high points (bumps) in excess of 0.3 inch in 25 feet or less. The Average Profile Index shall not be more than 8.0 inches per mile per lot, except that Average Profile Indexes of up to 15.0 inches per mile per lot will be acceptable with payment adjustments.

To determine surface tolerance payment adjustments, the Profile Index will be determined in accordance with DOTD TR 641. The Average Profile Index will be calculated and any high points (bumps) in excess of specification limits will be identified. When high points (bumps) are found in excess of 0.3 inch in 25 feet or less, the contractor shall make corrections in accordance with Subsection 501.10(e). When the Department determines the Average Profile Index exceeds the specification limits for 100 percent payment, the contractor will be allowed to make corrections in accordance with Subsection 501.10(e) for one additional time. The Department will reprofile for acceptance.

When sections of pavement do not meet the requirements for surface tolerance, an adjustment in unit price for the lot will be made in accordance with Table 2.

e. Anti-Strip Additive: Testing for addition of anti-strip additive will be conducted by the Department at a frequency of twice per lot. When anti-strip additive is not added within the range given on the approved job mix formula, an adjustment in unit price will be made in accordance with Table 2. The payment adjustment required will be on the averaged whole percent payment for the lot. The lot will be divided into two approximately equal sublots. The percent pay will be adjusted for each sublot, then averaged to determine the payment adjustment for the lot.

501.13 MEASUREMENT: Asphaltic tack coat, prime coat or curing membrane will not be measured for payment.

(a) Weight Measurement: Asphaltic concrete will be measured by the ton of 2,000 pounds from printed weights as provided in Section 503. Stamped printer tickets will be issued for each truckload of material delivered. Material lost, wasted, rejected or applied contrary to specifications will not be measured for payment.

Estimated quantities of asphaltic concrete shown on the plans are based on 110 lb/sq yd/inch thickness. The measured quantity of asphaltic mixtures will be multiplied by the following adjustment factor to obtain the pay quantity.

Theoretical Gravity	Adjustment Factor
2.340 - 2.369	1.02
2.370 - 2.399	1.01
2.400 - 2.479	1.00
2.480 - 2.509	0.99
2.510 - 2.530	0.98

The adjustment factor for mixtures with theoretical gravities less than 2.340 or more than 2.530 will be determined by the following formulas:

Theoretical gravity less than 2.340:

$$F = \frac{2.400}{S}$$

Theoretical gravity more than 2.530:

$$F = \frac{2.470}{S}$$

where,
F = quantity adjustment factor
S = theoretical gravity of mixture from approved job mix formula

(b) Volume or Area Measurement: The quantities for payment will be the design quantities specified in the plans and adjustments thereto. Design quantities will be adjusted when the engineer makes changes to adjust to field conditions or when design changes are necessary. Design quantities are based on the horizontal dimensions and compacted thickness of the completed course shown on the plans.

501.14 PAYMENT. Payment for asphaltic concrete will be made at the contract unit price on a lot basis. When the mix does not conform to

acceptance requirements, payment will be made at an adjusted price per unit of measurement in accordance with Section 1002 and Table 2. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic materials.

(a) General: Payment for asphaltic concrete will include furnishing all required materials, producing the mixtures, preparing the surfaces on which the mixtures are placed, hauling the mixtures to the work site, and placing and compacting the mixtures.

(b) Wearing Course Mixes: The lowest percentage of contract price will be used for final adjustment in unit price for deficiencies in Marshall Stability, pavement density, surface tolerance, aggregate gradation, anti-strip additive, and asphalt cement properties.

(c) Base, Binder and Shoulder Mixes: The lowest percentage of contract price will be used for final adjustment in unit price for deficiencies in Marshall Stability, pavement density, aggregate gradation, anti-strip additive, and asphalt cement properties.

(d) Substitutions: When substitutions are made in accordance with Subsection 501.01 for Type 9 Wearing Course, payment for shoulder wearing course will be the theoretical measurement for the Wearing Course.

(e) Erected Stringline: When the use of an erected stringline is not specified, but directed by the engineer, an additional payment of $200 per contract plus $0.05 per linear foot will be made for mixtures placed by the erected stringline method. When the use of an erected stringline is specified, no additional payment will be made.

(f) Payment: Payment will be made under:

Item No.	Pay Item	Pay Unit
501(01)	Asphaltic Concrete	Ton
501(02)	Asphaltic Concrete	Cubic Yard
501(03)	Asphaltic Concrete (___" Thick)	Square Yard

TABLE 1
REQUIREMENTS FOR ASPHALTIC CONCRETE MIXTURES

A. Mixture Requirements

U. S. Sieve % Passing	Type 3 Wearing Course	Type 3 Binder Course	Type 5 Base Course A	Type 5 Base Course B	Type 7 Wearing Course	Type 7 Binder Course	Type 8 and 8F Wearing Course[7]	Type 8 and 8F Binder Course	Type 9 Wearing Course	Mix Tolerance
1 1/2"	---	---	100		---	---	---	---	---	---
1"	100	100	80-100		100	100	100	100	100	±6
3/4"	95-100	85-100	---		95-100	85-100	95-100	85-100	98-100	±6
1/2"	85-100	70-100	---		85-100	70-100	85-100	70-100	90-100	±6
3/8"	70-100	60-95	---		70-100	60-95	70-100	60-95	70-100	±6
No. 4	50-75	40-70	35-70		50-75	40-70	50-75	40-70	50-75	±6
No. 10	28-55	28-50	---		28-55	28-50	28-55	28-50	28-55	±6
No. 40	14-30	14-30	16-40		14-30	14-30	14-30	14-30	14-32	±5
No. 80	8-20	8-20	---		8-20	8-20	8-20	8-20	8-20	±4
No. 200[9]	3.0-8.0	3.0-8.0	3.0-8.0		3.0-8.0	3.0-8.0	3.0-8.0	3.0-8.0	3.0-8.0	±2.0
Extracted Asphalt, %	---	---	---		---	---	---	---	---	±0.4
Mix Temperature,	---	---	---		---	---	---	---	---	±25°F
% Crushed, Min.	85	70	As Needed		80	70	90	85	70	---
Aggregates[1]	A,B,C	A,B,C,D, E,F,I	A,B,C,D,E, F,G,H,I		A,B,C	A,B,C, D,E,I	A,B,C	A,B,C, D,E,I	A,B,C,D,E,I	---
Marshall Stability, lb										
No. of Blows	75	75	75	50	50	50	75	75	50	---
Design[2]	1700	1700	1400	1100	1400	1400	2000	2000	1200	---
Minimum	1500	1500	1200	900	1200	1200	1800	1800	1000	---
Individual	1300	1300	1000	800	1000	1000	1500	1500	800	---
Mar. Flow, 1/100 in.	8-15	8-15	15 Max.	15 Max.	8-18	8-15	8-15	8-15	8-18	---
% Voids	3.0-5.0	3.0-5.0	3.0-5.0	3.0-5.0	2.0-4.0	3.0-5.0	3.0-5.0	3.0-5.0	2.0-4.0	---
% VFA	70-80	70-80	70-80	70-80	75-85	70-80	70-80	70-80	75-85	-3
% VMA, Min.[8]	14.5	14.0	13.0	13.0	14.5	14.0	14.5	14.0	15.0	---
% RAP, Max	0.0	30.0	30.0	30.0	0.0	30.0	0.0	30.0	20.0	---

B. Pavement Requirements

Density, %
- Pavement Wearing & Binder Courses - 96.0
- Base Course & Mixes Placed on Shoulders - 95.0

Surface Tolerance Variation, inches[6]	Transverse[3]	Cross Slope[3]	Grade[4]
Roadway Wearing Courses[5]	1/8	3/8	1/2
Binder Courses	1/4	1/2	1/2
Shoulder Wearing Course (10 feet min. width)	3/16	3/4	3/4

[1] A - Gravel, B - Slag, C - Stone approved for wearing surface, D - Stone, E - Clam or reef shell, F - Expanded clay, G - Sand Gravel, H - Recycled portland cement concrete, I - Reclaimed asphaltic pavement. See Subsection 501.02(c).

[2] The contractor shall design a mixture at a stability value based on historical plant performance that will ensure compliance with 100 percent payment requirements for the average of four samples. Values listed may be used as guide.

[3] Based on 10 feet.

[4] Applicable only when grade is specified.

[5] For longitudinal surface tolerance acceptance testing for payment see Subsection 501.12(b)(2)d.

[6] For longitudinal surface tolerance requirements see Subsection 501.10.

[7] At least 30 percent of the total aggregates by weight for Type 8F wearing course shall have a Friction Rating of I or at least 50 percent of total aggregate shall have a Friction Rating of II and not more than 10 percent of these materials shall pass the No. 10 sieve.

[8] For Design Guideline. For mixes with a theoretical gravity greater than 2.47, a tolerance of minus 1.0 percent will be applied to the minimum VMA.

[9] Max of 6.5 percent passing the No. 200 sieve for design of all mixtures.

TABLE 2
PAYMENT ADJUSTMENT SCHEDULES

	Percent of Contract Unit Price/Lot[1]				
	100	98	95	80	50 or Remove[2]
Marshall Stability (lb):					
Type 7 WC & BC, and Type 5A Base					
Lot (Average)	1200 & Above	---	1100 to 1199	1000 to 1099	Below 1000
Individual Test Within Lot	1000 & Above	Below 1000	---	---	---
Type 3 WC & BC					
Lot (Average)	1500 & Above	---	1400 to 1499	1250 to 1399	Below 1250
Individual Test Within Lot	1300 & Above	Below 1300	---	---	---
Type 5B Base					
Lot (Average)	900 & Above	---	850 to 899	800 to 849	Below 800
Individual Test Within Lot	800 & Above	Below 800	---	---	---
Type 8 and 8F WC and BC					
Lot (Average)	1800 & Above	---	1650 to 1799	1500 to 1649	Below 1500
Individual Test Within Lot	1500 & Above	Below 1500	---	---	---
Type 9 Shoulder WC					
Lot (Average)	1000 & Above	---	900 to 999	800 to 899	Below 800
Individual Test Within Lot	800 & Above	Below 800	---	---	---
Pavement Density: (% of Laboratory Density)					
96.0	96.0 & Above	---	95.0 to 95.9	93.0 to 94.9	Below 93.0
95.0	95.0 & Above	---	94.0 to 94.9	92.0 to 93.9	Below 92.0
Surface Tolerance, Inches/Mile/Lot					
Multi-lift New Construction and Overlays More Than Two Lifts	0.0 to 3.0	---	3.1 to 4.0	4.1 to 6.0	Over 6.0
Single-Lift Construction Over Cold Planed Surfaces and Two-lift Overlays	0.0 to 5.0	---	5.1 to 6.0	6.1 to 10.0	Over 10.0
Single-lift Overlays Over Existing Surfaces	0.0 to 8.0	---	8.1 to 10.0	10.1 to 15.0	Over 15.0
Aggregate Gradation:					
Deviations From Job Mix Formula					
Limits for Extracted Aggregate					
No. 4 Sieve	0.0 to 1.0	1.1 to 4.0	4.1 to 8.0	---	Over 8.0
No. 40	0.0 to 1.0	1.1 to 3.0	3.1 to 6.0	---	Over 6.0
No. 200	0.0 to 0.5	0.6 to 1.0	1.1 to 2.0	2.1 to 3.0	Over 3.0
Anti-Strip Additive, % Below Job Mix Formula	Within Job Mix Formula	0.2 or less	More than 0.2	---	---

[1]Portion of lot placed on the project
[2]At the option of the engineer

Section 502

RESERVED FOR FUTURE USE

Section 503
Asphaltic Concrete Equipment and Processes

503.01 DESCRIPTION: This Section specifies requirements for certification of plant and paving equipment used in producing, placing and compacting asphaltic concrete mixtures. It includes methods and equipment for handling and storing materials and transporting asphaltic concrete to the jobsite.

When less than 250 tons of mixture are required for a project or at separate locations within a project or for short irregular sections within a project, the paving equipment shall conform to the requirements of this Section, except that pavers without electronic screed and slope control devices may be permitted.

503.02 PLANT EQUIPMENT.

(a) General: Plants furnishing asphaltic concrete mixtures in accordance with Section 501, and 508 shall be certified in accordance with current Departmental procedures. The plant and laboratory equipment, meters, scales, and measuring devices, shall be tested, inspected and certified every 90 calendar days, and more often when directed, by a qualified independent scale service or the Weights and Measures Division, Louisiana Department of Agriculture and Forestry.

Asphaltic concrete shall be mixed at a central mixing plant by either the batch, continuous, or drum mixing process. Aggregates, additives and asphalt shall be proportioned in accordance with the approved Job Mix Formula.

The complete process, including plant with necessary auxiliary equipment and controls, operating procedures, and testing and sampling methods shall be approved during operation prior to use. Such approval will require a verification that the hardening properties of asphalt recovered from samples of mixture taken at the plant will not exceed the absolute viscosity value obtained on residue from the thin film oven test of the original asphalt by more than 2,000 poises. When samples of mixture are taken from the pavement, the absolute viscosity of recovered asphalt shall not exceed 12,000 poises. Asphalt shall be extracted from the mixture in accordance with DOTD TR 308 and recovered in accordance with AASHTO T 170. Absolute viscosity at 60°C (140°F) of the recovered asphalt shall be tested in accordance with AASHTO T 202.

The contractor shall have a plant site laboratory conforming to Section 722 as a part of the plant facilities. The plant site laboratory shall be equipped with a constant temperature oven capable of maintaining any temperature between 100°F and 400°F±5°F for drying aggregates and determining the moisture content of loose mix, a specimen ejector for removing specimens from Marshall molds, and other laboratory equipment used to perform Quality Control Testing.

(b) Asphalt Preparation Equipment: The asphalt working tank shall be capable of uniformly heating the material by approved methods, under positive control, to the required temperature. The asphalt circulating

system shall be of adequate size to ensure proper and continuous circulation (except while asphalt is being measured). Pipelines and fittings shall be heated or insulated. Proper mixing temperature of asphalt shall be maintained. A sampling spigot shall be provided in each tank or the supply line.

(c) Anti-Strip Additive Equipment: Anti-strip additive shall be dispensed directly into the asphalt feed line at a location between the asphalt control valve and the end of the asphalt discharge line. The process for accomplishing this shall be approved and shall provide that the required quantity of anti-strip additive is uniformly proportional to the quantity of asphalt. The process shall have a means by which such uniformity can be easily verified. The equipment shall include a positive displacement accumulating meter which accumulates and displays materials used, and reads to the nearest 0.25 gallon. The additive storage tank shall be a recirculating tank provided with uniform heat and an indicating thermometer at an approved location near the tank discharge point.

(d) Cold Aggregate Feeder: The plant shall be provided with accurate mechanical means for uniformly feeding aggregate into the dryer. Feeders shall be capable of uniformly delivering the maximum number of required aggregate sizes in their proper proportion. When more than one cold bin feeder is used, each shall operate as a separate unit. The individual controls shall be integrated with a master control for all materials.

Cold aggregate bins shall be of sufficient size to store the amount of aggregates required for continuous plant operation. Partitions between bins shall extend a minimum of 1 foot above the top of bins and be sufficient to eliminate contamination. The unit shall include a feeder mounted under bins with each bin compartment having an accurately controlled individual gate to form an orifice for measuring the material drawn from it. The orifice shall be rectangular, with one dimension adjustable by positive mechanized adjustment with locking system. Indicators shall be provided on each gate to show the gate opening in inches.

The plant shall be modified as required to permit recycling operations in conformance with air pollution standards. A separate cold feed system, including weight indicating apparatus, shall be provided for reclaimed asphaltic pavement.

Calibration of gate openings shall be based on the weight of samples taken from bin material. Material shall be fed from a bin through the individual orifice and bypassed to a container to be weighed. Material from each bin shall be calibrated separately. Weight calibration curves shall be developed and kept on file. The calibration process shall be part of the contractor's quality control and shall be shown as a function of belt speed and gate opening. The method and frequency shall be as directed.

When a cold feed system is the only system used to control the proportioning of aggregates, an automatic plant shutoff shall be provided to operate when any aggregate bin becomes empty or flow is interrupted.

(e) Hydrated Lime Additive Equipment: When hydrated lime additive is mixed with aggregate on the belt feed, the hydrated lime additive equipment shall be interlocked and synchronized with cold feed controls to operate concurrently with the cold feed operation. A positive signal system which shall automatically shut the plant down when a malfunction causes an improper supply of additive or water shall be installed. The

plant shall not operate unless the entire additive system is functioning properly. The hydrated lime additive system shall consist of the following equipment.

(1) A separate bulk storage bin with a vane feeder or other approved feeding system which can be readily calibrated. The system shall provide a means for easy sampling of additive and verification of the quantity dispensed by weight. The feeder system shall require a totalizer.

(2) An approved spray bar or other approved system capable of spraying the composited aggregate with potable water before the addition of hydrated lime additive when the moisture content of the composited aggregate falls below 3 percent. An alternate system for spraying coarse aggregate stockpiles may be allowed when approved. The approved equipment and methods shall consistently maintain the aggregates in a uniform, surface wet condition. The moisture content of the aggregate-lime additive mixture following spraying and mixing shall be introduced into the automatic moisture controls of the plant.

(3) An approved pugmill or other approved mixing device to uniformly coat the composited aggregates with the hydrated lime additive shall be located between the point at which the additive is placed on the composited aggregate and the dryer.

The hydrated lime additive shall be dispensed directly onto the composited aggregate between the cold feed and the dryer. When cold feed control is used, the additive shall be introduced after the composited aggregate has passed through the vibrating scalping screen. The additive shall be uniformly blended with the composited aggregate before entry into the dryer. The process and equipment used for mixing the lime additive and aggregate shall be approved and shall provide that no less than the required amount of additive is continuously blended with the aggregate. When a belt scale is used on the composited aggregate feed belt, it shall be positioned to record the combined weight of the blended aggregate and hydrated lime additive.

(f) Mineral Filler Equipment: Mineral filler shall be proportioned separately from a hopper equipped with an adjustable feed which can be accurately and conveniently calibrated and which shall be interlocked with the aggregate and asphalt feeds. The feeder shall accurately proportion the mineral filler and shall be designed to give a constant flow of material. For batch plants, the mineral filler shall be batched into the mix along with the aggregates. For continuous mix and drum mixer plants, the mineral filler shall be introduced to the mix at an approved location sufficiently in advance of the addition of the asphalt to give proper drying time.

(g) Screening System: Plant screens shall be provided as required for proportioning, capable of screening aggregates to the required sizes and having normal capacity in excess of the full capacity of the mixer or dryer. The screens shall be exposed for inspection as directed.

The plant shall have a scalping system on the fine sand cold bin and other bins as necessary, to ensure removal of objectionable material.

When a belt scale is used, an additional vibrating scalping screen will be required between the aggregate cold feed discharge and belt scale. Other processes will require a vibrating scalping screen between the cold feed discharge and mixing process. The screens shall be sized to remove all oversize aggregate and other objectionable material.

(h) Dryer: The plant shall include one or more dryers that shall continuously agitate aggregates during heating and drying. The equipment shall be capable of heating and drying aggregates in the necessary quantities to supply the mixing unit continuously at its operating capacity and at a specified temperature and acceptable moisture content. The dryer shall be equipped with automatic burner controls. Slope of dryers shall be in accordance with approved recommendations of the dryer manufacturer.

(i) Hot Bins: Bin sizes shall be adequate for continuous operation of the plant at rated capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of aggregate. Adequate dry storage shall be provided with an overflow pipe or chute to prevent contamination of materials. Each size of aggregate shall be stored in separate bins when screens are used. For screenless operation, aggregate shall be stored in one or more bins with adequate provisions to prevent segregation.

(j) Thermometers: The plant will not be permitted to operate with faulty or inadequate thermometers, and the thermometers listed herein shall be immediately repaired or replaced when faulty operation is detected. The plant shall be equipped with the following thermometers.

(1) Asphalt: A thermometer graduated in 5°F increments and having an accuracy of ±5°F shall be fixed in the asphalt feed line at an approved location near the discharge valve at the mixer unit to indicate the temperature of asphalt from storage.

(2) Anti-Stripping Additive: A thermometer graduated in 5°F increments and having an accuracy of ±5°F shall be placed at an approved point near the anti-stripping tank discharge point prior to the meter.

(3) Heated Aggregates For Asphaltic Mixture: The plant shall be equipped with an approved recording thermometer graduated in maximum 10°F increments and having an accuracy of ±5°F and a sensitivity which will provide an indication of temperature change at a rate of at least 10°F per minute. It shall be placed at the dryer discharge chute to register automatically the temperature of heated aggregates for batch plants, and at an approved location for continuous or drum-mixer plants to register automatically the temperature of the asphaltic mixture at discharge.

(k) Dust Collector: When a dust collection system returns fines to the mixture, the fines shall be returned at a uniform and regulated rate and at an approved location. In the drum-mix process, baghouse fines shall be added near the asphalt discharge. Baghouse fines shall be dispensed into the aggregate mixture by an approved feed control device from a collector box, surge bin or filler silo. This provision does not apply to primary collectors.

(l) Asphalt Measuring Equipment: Asphalt may be measured either by weight or volumetric measurement.

(1) Weight Measurement: Scales shall conform to Heading (n) of this Subsection and shall read to the nearest pound.

(2) Volumetric Measurement: Measurement by volume shall be by means of a positive displacement pump and shall be recorded in digital form to the nearest gallon. Provisions shall be made to periodically check by weight the quantity of asphalt delivered. The rate of asphalt delivered shall be continuously displayed in digital form corrected to 60°F and the quantity totalized. The quantity of asphalt shall be corrected to the approved job mix temperature. Measurement shall be continuous and accurate to 1.0 percent of the required measurement.

(m) Mixer Unit: The mixer unit shall produce a uniform blend at the specified production rate, with rapid and complete asphalt coating of aggregate that will give a minimum coating of 95 percent of the coarse aggregate particles retained on the No. 4 sieve when tested in accordance with AASHTO T 195.

(1) Batch Plants: Batch plants shall have an approved pugmill and spray bar. The pugmill shall have an approved rated capacity. It shall be operated at an approved capacity not to exceed the rated capacity. The mixer shall have an approved timing device to prevent entrance of additional material during mixing. The discharge gates shall be locked to ensure proper mixing. The device shall also lock the asphalt bucket throughout the dry mixing period.

(2) Drum-Mixer Plants: Drum-mixer plants shall have an approved drying and mixing operation. Aggregate and asphalt shall be fed into the drum-mixer so that aggregates are dried, uniformly mixed and adequately coated with asphalt.

(3) Continuous Mix Plants: Continuous mix plants shall have an approved drying and mixing operation. The plant shall have an approved pugmill and spray bar. The pugmill shall be operated at an approved capacity not to exceed the rated capacity with the aggregates uniformly mixed and adequately coated with asphalt.

(n) Weigh Hoppers: Weigh hoppers used in weighing aggregates, asphalt and mixtures shall be constructed to prevent leakage and shall be suspended from scales conforming to this Subsection.

In batch plants, asphalt and aggregate hoppers shall be of sufficient size to weigh the total batch in one operation.

Hoppers for weighing a mixture from a storage or surge bin shall be constructed and used to prevent segregation of mixture loaded into the haul truck.

(o) Scales and Printer Systems:

(1) Scales: Scales shall be accurate to ±0.5 percent of the indicated load. They shall be designed, constructed and installed so that operations do not affect their accuracy.

To determine the total weight of mix loaded in trucks, the contractor shall provide springless dial scales or load cell scales for weigh hoppers. When weigh hoppers are not used, the contractor shall provide truck platform scales. The contractor shall provide belt scales for conveyor systems when the drum-mixer process is used.

(2) Printer System for Batch Plants: To determine percent asphalt cement for the mix, the contractor shall provide an approved printer system which will print separately the weight of aggregates and asphalt. These weights shall be used for calculating the percent asphalt in the mixture. When a mixture is loaded directly into the haul truck, these weights shall be used for the purpose of determining pay weights for the mix. Printing equipment shall also print zero weight for each batch and total weight of mixture loaded in trucks.

In the event of a breakdown of the printing mechanism, the contractor may be permitted to operate during the 48-hour period immediately following the breakdown, provided an accurate weight of mixture can be determined and provided repeated breakdowns do not occur.

(3) Printer System for Plants Using Storage or Surge Bins: When storage or surge bins are used, the contractor shall provide truck-platform scales or weigh hopper to determine pay weights for the mix. The weigh hopper shall be equipped with an approved automatic printer

system that will print zero weight, batch weight and total weight of mixture loaded into the truck.

Truck-platform scales shall be of sufficient length to weigh the entire unit transporting the mix. Scales shall be equipped with an approved automatic printer system that will print the tare weight as well as the total weight of the unit and the mix.

Scales with electronic digital readout displays, that do not automatically reset to zero after the tare weight is obtained, shall print the tare weight, zero weight, and either the total weight of mix loaded into the unit or the total weight of the unit and mixture. Scales with electronic digital readout displays that automatically return to zero after the tare weight is obtained, shall print the tare weight and either the total weight of mix loaded into the unit or the total weight of the unit and mixture.

When scales are located so that a truck leaves the scales between empty weighing and loaded weighing, the printer shall print the tare weight, zero weight before loaded weighing, and total weight of the unit and mix. In the event of a breakdown of the printing mechanism, the contractor may be permitted to operate during the 48-hour period immediately following the breakdown provided an accurate weight of mixture can be determined and repeated breakdowns do not occur.

(p) Mix Release Agent Dispenser System: The plant shall be equipped with an approved pressurized system capable of spraying a uniform coating of an approved asphalt mix release agent into the haul unit bed prior to loading. Diesel is not allowed as a mix release agent.

503.03 STORAGE SILOS AND SURGE BINS. Storage silos or surge bins for storing asphaltic concrete mixtures may be used with approval.

(a) Conditions of Use: Use of silos or bins shall conform to the limitations on retention time, type of mixture, heater operation, bin atmosphere, bin level or other characteristics set forth in these specifications and other requirements stated in granting approval of these facilities. An indicator device which is activated when material in the bin drops below the top of the sloped portion shall be affixed to each bin and be visible to the loading operator. Mixtures shall be maintained above this level during production, except for extended periods when the plant is not in operation.

(b) Heated Silos: The storage silo heating system shall be capable of uniformly maintaining mix temperature without localized heating.

Maximum allowable storage time for asphaltic concrete mixtures is 18 hours. The Department may grant permission to exceed the storage time, provided test results and other data indicate that the additional storage time is not detrimental to the mix.

(c) Unheated Surge Bins: The maximum allowable storage time for unheated surge bins is 2 hours. The Department may grant permission to exceed the 2-hour storage time, provided test results and other data indicate that the additional storage time is not detrimental to the mix.

(d) Loading and Unloading Mixtures: The system shall be capable of conveying the mixture from plant to bin or silo by a drag slat enclosed conveyor system or other approved system. The conveyor shall be of an enclosed continuous type designed to prevent spillage and to remove the mix from the plant as fast as it is produced.

The mix shall be transported directly from plant to silos or bins by means of the conveyor system. The mixture from the silo or surge bin shall remain within ±15°F of plant discharge temperature.

When the mixture is placed into a silo or bins through a surge device, an automatic warning system shall be provided to audibly warn the operator of a gate malfunction.

Silo or bin unloading gates shall be either clam shell gates operating under gravity feed or other approved gates that will not cause segregation or be detrimental to the mix.

503.04 HAULING EQUIPMENT: Equipment for transporting asphaltic mixtures shall have tight, clean, smooth metal beds, sprayed daily or as often as directed with an approved asphalt mix release agent. Diesel fuel will not be allowed as a release agent.

Each vehicle shall have a cover of canvas or other suitable material large enough to completely cover the top and extend over the sides of the bed to protect the mixture from the weather or loss of heat due to excessive haul time. The cover shall have sufficient tie-downs to hold the cover to the bed during hauling. The covers shall be used as directed.

The hauling unit shall discharge the mixture in a continuous manner so the spreader apron of the paver will not be overloaded. When the hauling unit/paver combination causes a surface deviation in excess of 1/8 inch, measured longitudinally with an approved 10-foot metal static straightedge, or other surface defects, the use of such hauling unit or paver shall be immediately discontinued. When profilograph results indicate surface deviations which result in less than 100 percent payment or excessive correction of bumps, the profile trace will be analyzed to determine if the deviations are caused by the hauling unit/paver combination. If the hauling unit/paver combination is determined to be the cause, their combination shall be discontinued.

Equipment such as bottom dumps shall be capable of discharging the mixture in a uniform windrow longitudinally down the pavement. A maximum of one truck load shall be allowed on the pavement. The temperature of the material in the windrow shall not drop below 275°F. The maximum amount of windrowed material allowed will be reduced if temperature requirements cannot be met. Distortions in surface tolerance resulting from improper unloading of the mixture shall be corrected immediately.

When size, speed and condition of trucks interfere with orderly paving operations, changes in equipment and/or operations shall be made. Load restrictions shall be in accordance with Subsection 105.14.

503.05 PAVING EQUIPMENT: Pavers shall be equipped with automatic screed and slope control devices for use with a 30-foot (minimum) traveling reference plane or erected stringline, as directed.

Equipment that is pushed by the paver shall be of such size and capacity that the paver will push them without affecting surface smoothness or edge line of the mixture.

Pavers shall be capable of placing mixtures within specified tolerances. A screed or strike-off assembly shall be used to distribute the mixture over the entire paving strip. The width of the paving strip will be approved. Assemblies including extensions, shall place mixtures uniform in appearance and quality. The assembly shall be adjustable to provide the required cross section. The assembly shall be equipped with a heater and either a vibrator or tamping bars.

In hilly terrain, when mix is discharged directly into the paver hopper, a positive connection shall be provided between paver and hauling unit. When the hauling unit discharges directly into the paver hopper, the paver shall be capable of pushing the hauling unit.

Pavers shall be equipped with hoppers adequately designed and maintained to prevent spillage. Pavers shall also be equipped with augers to place the mix evenly in front of the screed, including extensions. Pavers shall be equipped with a quick and efficient steering device and shall be capable of traveling both forward and in reverse. Pavers shall be capable of spreading mixes to required thickness without segregation or tearing.

For shoulder construction, modified pavers or widening machines may be used when permitted.

A screed extension shall consist of a screed plate or plates, which meet all requirements for the screed set forth in these specifications The bottom surface of the screed extension shall be in the same plane as the bottom surface of the screed plate. A screed extension shall be used when mix is being placed within the traveled way and the paving strip is wider than the screed. Auger assembly extensions shall be used when screed extensions in excess of 1 foot on a side are to be consistently used in the pavement operation. Such auger extensions shall extend to within 1 foot of the end of the screed. With approval, the use of an auger extension with screed extensions in excess of 1 foot on one side may be waived for transitions, taper sections and similar short sections. The engineer may waive the requirement for auger extensions when hydraulically extended screeds, which trail the main screed assembly, are used, provided required density and surface texture are obtained.

A strike-off assembly or boxed extension shall not be used for paving within the traveled way, except when approved for short irregular sections or sections which are exceptions to the typical.

Pavers shall be equipped with automatic screed and adjustable slope control devices capable of placing the mixture to grade within the tolerances specified, and distributing the mixture over the entire lane width and such partial lane widths as may be approved. Pavers shall be equipped with two grade sensors when required.

Pavers shall be equipped to work from an erected stringline, shoe device or a traveling reference plane that will accurately reflect, for a minimum 30-foot length, the average grade of the surface on which it is to be operated.

When a malfunction occurs in the automatic screed control device during laydown operations, work may continue for the balance of that day on any course other than the final wearing course. Any overrun resulting from placing material without the automatic screed control device shall be borne by the contractor. When a screed control device malfunctions during final wearing course paving operations, plant operations shall be immediately discontinued and shall not be resumed until the screed malfunction has been remedied. Material in transit may be placed; however, slope tolerance, surface tolerance and grade tolerance shall be met.

When less than 250 tons of mixture are required for a project or at separate locations within a project or for short irregular sections within a project, the paving equipment shall conform to the requirements of this Section, except that pavers without electronic screed and slope control devices may be permitted.

503.06 COMPACTION EQUIPMENT:

(a) General: Compaction equipment shall be self-propelled and be capable of reversing without backlash. Compaction equipment shall be certified prior to use.

Poorly performing compaction equipment will be decertified and shall be replaced with suitable equipment or supplemented as necessary.

(b) Steel Wheel Rollers: Steel wheel rollers may be either vibratory or nonvibratory. Wheels shall be true to round and equipped with suitable scrapers and watering devices. Vibratory rollers shall be designed for asphaltic concrete compaction and shall have separate controls for frequency, amplitude and propulsion.

(c) Pneumatic Tire Rollers: Pneumatic tire rollers shall weigh a minimum of 11 tons when fully loaded with wet sand and shall be capable of exerting the full range of contact pressures from 60 to 80 psi. The engineer may require a roller with an increased wheel load. Tires shall have smooth tread, shall be the same size and ply rating, shall be inflated to a uniform pressure not varying more than ±5 psi between tires. The contractor shall supply appropriate calibration charts to determine wheel load and contact pressure. Wheels shall not wobble and shall be aligned so that gaps between tires on one axle are covered by tires of the other axle. Tires shall be equipped with scrapers to prevent adhesion of mixture. The engineer may require additional cleaning and water apparatus on tires if material adhesion is detrimental to the mat.

503.07 MISCELLANEOUS EQUIPMENT AND HAND TOOLS. Power revolving brooms or power blowers and asphalt distributors shall be provided and maintained in a satisfactory working condition.

In areas that are inaccessible to conventional rollers, satisfactory mechanical compaction equipment, or hot hand tampers, shall be used. Tamping tools may be used for compacting edges.

The asphalt distributor shall be equipped with a suitable spray bar and nozzles designed to distribute material within the specified temperature range and shall be equipped with thermometers to indicate temperature of material in the tank. The distributor shall be designed to maintain a constant uniform pressure on asphaltic material as it passes through nozzles and to apply asphaltic material at the required rate. The distributor shall be equipped with a valve system that controls the flow of asphaltic materials, a pump tachometer or pressure gauge that registers pump output, a bitumeter and odometer that indicates both the speed of the distributor in feet per minute and total distance traveled, and measuring devices, as necessary.

Charts shall be provided for an accurate, rapid determination and control of the amount of asphaltic materials being applied per square yard of surface under operating conditions. The bitumeter shall be calibrated to ensure accurate spraying operations and shall be kept clean of asphaltic buildup. The distributor shall be equipped with a hand-held spray attachment for applying asphaltic materials to areas inaccessible with the spray bar.

503.08 HANDLING OF AGGREGATES. Aggregates shall be stored at the plant site so that no intermixing will occur. Material shall be stockpiled so that no detrimental degradation or segregation of aggregates will occur; no appreciable amount of foreign material will be incorporated into aggregates; and there will be no intermingling of stockpiled materials. Stockpiles shall be well drained.

Blending of aggregates shall be done from cold feed bins and not in stockpiles or on the ground at the plant site or the source.

Gradation and other properties of aggregate in stockpiles shall be such that when the aggregates are combined in proper proportions, the resulting combined gradation will meet the requirements of the approved job mix formula.

Proportioning of material at the cold feed shall be established to meet the approved job mix gradation requirements. Plants operating with only cold feed control shall not require additional manipulation to meet job mix requirements.

(a) Drying: Aggregates shall be heated and dried to produce a mixture meeting specification requirements. The quantity of material fed through the dryer shall be held to an amount which can be adequately heated and dried. When proper drying is not achieved and the quality of the mix is impaired, the contractor shall adjust the rate of production of the dryer to obtain satisfactory results. The burner fuel used shall be clean burning so there is no contamination of aggregates. Contaminated aggregates or mixtures will be rejected.

(b) Hot Aggregate Storage: When batch plants are used, hot aggregate shall be stored in bins. Storage shall be accomplished to minimize segregation and loss of temperature of aggregates. When plant operation is interrupted and the temperature of material in hot storage cools to 25°F or more below the specified mixing temperature, bins shall be pulled and the material discarded. When a plant changes type of mix and the change requires a change of materials, bins shall be pulled and the material discarded.

503.09 PROCESSING OF ASPHALT, ADDITIVES AND AGGREGATES: Aggregates shall be combined, either before or after drying, depending on the type of plant used, to meet the approved job mix formula. Asphalt shall be measured and introduced into the mixer or dryer in the quantities specified on the approved job mix formula.

The aggregate, asphalt and the mixture shall be processed at the temperature specified in the approved job mix formula. The temperature of the mixture at discharge from the mixer shall be within ±25°F of the optimum mixing temperature in the job mix formula. When the mixing, coating, placing or density requirements are not being met, the engineer may require that the job mix temperature be changed or that the foregoing temperature range be restricted.

The moisture content of the final mixture shall be minimized and uniformly controlled to ensure that placing and density requirements are met. The maximum allowable moisture content of the final mixture shall be 0.5 percent by weight when tested in accordance with DOTD TR 319.

When the automatic adjustments or other critical control and shutoff devices are not functioning, the plant shall not operate.

(a) Plants with Pugmills: Prior to adding asphalt, the combined aggregate shall be thoroughly mixed dry, after which the proper amount of asphalt shall be sprayed over aggregates and mixed to produce a homogeneous mixture in which all aggregate particles are uniformly coated. Mixing times shall be in accordance with the approved job mix formula.

(b) Drum-mixer and Continuous Mix Plants: The system shall provide positive weight control of cold aggregates fed by a belt scale or other device interlocked with the asphalt measuring system to maintain required proportions of combined aggregates and asphalt. Aggregates shall be heated, dried and mixed with asphalt to produce a homogeneous mixture in which all aggregate particles are uniformly coated. Approved methods

shall be provided to waste the first and last output of the plant after each interruption.

The contractor's Certified Asphaltic Concrete Plant Technician shall measure the moisture content of the cold feed aggregates daily when starting the plant. Adequate scheduled tests during plant operations and adjustments to the plant shall be made to correct for moisture in the aggregate. The schedule for moisture content testing will be subject to approval.

Provisions shall be made for introducing the latest moisture content of the cold feed aggregates into the belt weighing system, thereby correcting wet aggregate weight to dry aggregate weight. Dry weight of the aggregate flow shall be displayed digitally in appropriate units of weight and time, and the quantity used totalized. The rate of flow of asphalt anti-strip, and lime (when used) shall also be digitally displayed and the quantity used totalized.

For mineral filler, a separate bin and feeder in accordance with Subsection 503.02(d) shall be furnished with its drive interlocked with the aggregate feeders. Mineral filler shall be introduced directly into the drum near the asphalt discharge.

Section 504
Asphaltic Tack Coat

504.01 DESCRIPTION. This work consists of preparing and treating existing asphaltic or concrete surface with asphaltic material in accordance with these specifications and in conformity with the lines shown on the plans or established.

504.02 ASPHALTIC MATERIALS. Tack coat shall be cutback asphalt (Grade RC-70 or RC-250) or emulsified asphalt (Grade SS-1, SS-1h, CRS-2, CMS-2 or CSS-1h) conforming to Section 1002.

504.03 WEATHER LIMITATIONS. Asphaltic tack coat shall not be applied on a wet surface or when the ambient air temperature is below 40°F.

504.04 EQUIPMENT. The contractor shall provide equipment for applying asphaltic material and preparation of the surface to be tacked. Equipment shall conform to Subsection 503.07. A hand-held pressure nozzle may be used for tack coat application in lieu of the spray bar/tachometer combination for irregular sections or short sections of 1500 feet or less.

504.05 SURFACE PREPARATION. The surface shall be cleaned by sweeping or other approved methods. Edges of existing pavements which will form joints with new pavement shall be satisfactorily cleaned before tack coat is applied.

504.06 APPLICATION. Asphalt shall be uniformly applied to a clean dry surface with no bare areas, streaks or puddles with an asphalt distributor at a rate in accordance with Table 3. These rates may be raised or reduced as directed.

TABLE 3
ASPHALTIC TACK COATS

Existing Surface	Rate (Gal/sq yd)[1]
Bleeding Surface Treatment	0.02
Dry Surface Treatment	0.03
New Hot Mix	0.03
Old Hot Mix	0.07
Portland Cement Concrete	0.07
Friction Course	0.05
Cold Planed Surface[2]	0.08

[1]Rates are minimum rates of undiluted asphaltic material.
[2]Minimum of two applications.

The minimum application temperature for cutback asphaltic materials are RC-70 - 100°F, RC-250 - 140°F and emulsified asphalts - 70°F.

Tack coat shall be applied in such manner as to cause the least inconvenience to traffic. The contractor will be permitted to apply the tack coat 1 calendar day prior to the mixture laydown; however, when tack coat has been damaged by traffic pick-up or contaminated by dirt, dust or mud, the surface shall be cleaned and retacked prior to the mixture laydown at no direct pay. Tacked surfaces exposed to traffic for more than 24 hours or damaged due to inclement weather shall be retacked at no direct pay.

504.07 MEASUREMENT AND PAYMENT. Asphaltic tack coat will not be measured for payment; however, payment under the contract will be subject to the payment adjustment provisions of Section 1002 for specification deviations of the asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for asphaltic materials.

Section 505
Asphaltic Prime Coat

505.01 DESCRIPTION. This work consists of preparing and treating a surface with asphaltic material in conformance with these specifications and in conformity with lines shown on the plans or established.

505.02 ASPHALTIC MATERIALS. Prime coat shall be cutback asphalt Grade MC-30, MC-70, or AEP Emulsified Asphalt conforming to Section 1002.

505.03 WEATHER LIMITATIONS. Asphaltic materials shall not be applied on a wet surface or when ambient air temperature is less than 35°F in the shade.

505.04 EQUIPMENT. The contractor shall provide the necessary equipment for proper construction of the work. Equipment shall be approved before construction begins and shall be maintained in satisfactory working condition. Equipment shall conform to Subsection 503.07.

505.05 SURFACE PREPARATION. The surface to be coated shall be shaped to required grade and section, shall be free from ruts, corrugations, segregated material or other irregularities, and shall be compacted to required density. Delays in priming may necessitate reprocessing or reshaping to provide a smooth, compacted surface.

505.06 APPLICATION. Prime coat shall extend 6 inches beyond the width of surfacing shown on the plans. The prime coat shall not be applied until the surface has been satisfactorily prepared and is dry.

Prime coat shall be applied at the rates and temperatures shown in Table 4. Quantities of prime coat shall not vary from that shown in Table 4.

TABLE 4
PRIME COATS

	Application Rate (Gal/Sq Yd)		Application Temperature (°F)	
Asphalt Grade	Min.	Max.	Min.	Max.
MC-30	0.25	0.30	60	120
MC-70	0.25	0.30	100	180
AEP	0.25	0.30	60	120

505.07 PROTECTION. After prime coat has been applied it shall cure for a minimum of 24 hours before the surfacing is placed. The contractor shall keep traffic off the surface until the prime coat has properly cured, unless otherwise permitted.

If traffic is permitted, the contractor may be required to spread approved granular material, as directed, over the prime coat at no direct pay.

The prime coat shall be maintained intact. When required, the primed surface shall be thoroughly cleaned prior to the placement of surfacing.

Where the prime coat has failed, the failed area shall be cleaned and be recoated with prime coat at no direct pay. When the prime coat is generally unsatisfactory, the contractor shall reprime the unsatisfactory surface at no direct pay.

505.08 MEASUREMENT AND PAYMENT. Asphaltic prime coat will not be measured for payment; however, payment under the contract will be subject to the payment adjustment provisions of Section 1002 for specification deviations of the asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for asphaltic materials. Payment for surface preparation will be made under other items.

Section 506
Asphaltic Curing Membrane

506.01 DESCRIPTION. This work consists of the application and maintenance of an asphaltic curing membrane to the surface of cement or lime treated or stabilized materials in conformance with these specifications or as directed.

506.02 MATERIALS. Asphalt for curing membrane shall be an emulsified asphalt or an emulsified petroleum resin (EPR-1) conforming to Section 1002. Water shall conform to Subsection 1018.01.

506.03 WEATHER LIMITATIONS. Asphaltic curing membrane shall not be applied when the temperature is below 35°F, unless otherwise permitted.

506.04 EQUIPMENT. The contractor shall provide and maintain the necessary equipment for proper construction of this work. The equipment shall be approved before construction begins.

506.05 SURFACE PREPARATION. The surface to which curing membrane is to be applied shall be free from ruts, corrugations, loose material or other irregularities.

506.06 APPLICATION. The asphaltic curing membrane shall be applied immediately upon completion of final finishing of the final lift of the surface. The emulsified asphalt curing membrane shall be uniformly applied at a minimum rate of 0.10 gallon per square yard of undiluted emulsified asphalt. The EPR-1 curing membrane shall be uniformly applied at a minimum rate of 0.20 gallon per square yard of undiluted resin. The undiluted emulsified petroleum resin shall consist of 5 parts water and 1 part resin concentrate. Any additional applications required shall be placed by the contractor at no direct pay. When emulsified asphalt is diluted with water and applied in multiple passes of the distributor, the total amount of asphaltic material applied shall be increased so that the residual amount of asphaltic material equals a minimum of 0.1 gallon per square yard. Extraneous material which has collected on the base shall be removed before additional application of asphaltic curing membrane. The surface shall be maintained and repaired before additional applications.

506.07 PROTECTION. After the curing membrane has been applied, the contractor shall keep public and construction traffic off the surface until the curing membrane has properly cured, unless otherwise directed. The curing membrane shall be maintained by the contractor at no direct pay until the surfacing has been placed. When traffic is permitted, additional curing membrane shall be applied at intervals to protect and cure the surface at no direct pay.

506.08 MEASUREMENT AND PAYMENT. Asphaltic curing membrane will not be measured for payment; however, payment under the contract will be subject to the payment adjustment provisions of Section 1002 for specification deviations of the asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for asphaltic materials. Water will not be measured for payment.

Section 507
Asphaltic Surface Treatment

507.01 DESCRIPTION. This work consists of furnishing and constructing a wearing surface of aggregate and asphaltic material on a prepared base course or on existing pavement, in accordance with these specifications and in conformity with the lines, grades and typical sections shown on the plans or established.

Asphaltic surface treatment shall consist of one or more applications of each of the specified sizes of aggregate and the specified asphaltic material.

507.02 MATERIALS. The following combination of materials will be allowable depending on the Type of Asphaltic Surface Treatment (AST):

Type AST	Asphaltic Material	Friction Rating
A	CRS-2P	I, II
B	CRS-2P or CRS-2L	I, II or III
C	CRS-2P	I, II, III, or IV
D	CRS-2, CRS-2P, or CRS-2L	I, II, III, or IV

The asphaltic material shall conform to Section 1002. Aggregates shall conform to Section 1003.05.

507.03 EQUIPMENT. The contractor shall provide and maintain the necessary equipment for proper construction. The equipment shall have been approved before construction begins.

Storage tanks, piping, retorts, booster tanks, distributors and other equipment used in delivering, storing or handling asphaltic materials shall be kept clean and in good operating condition and shall be operated to avoid contamination of the contents with foreign materials.

Equipment shall consist of the following:

(a) Power distributor conforming to Subsection 503.07 amended as follows:

The distributor shall be capable of maintaining an allowable variation from any specified rate within ±0.02 gallon per square yard. The distributor shall be equipped with a height adjustable spray bar with spray nozzles recommended by the manufacturer which yield uniform double coverage. Each of the two end nozzles shall be specially designed to provide, a sharp line of asphaltic material on the roadway surface.

(b) Self-propelled pneumatic-tire rollers.

Pneumatic-tire rollers shall be self-propelled. Tires shall have smooth tread, shall be the same size and ply rating, shall be inflated to a uniform pressure not varying more than ±5 psi between tires. The contractor shall supply appropriate calibration charts to determine wheel load and contact pressure. Wheels shall not wobble and shall be aligned so that gaps between tires on one axle are covered by tires of the other

axle. Tires shall be equipped with scrapers to prevent adhesion of material. The engineer may require additional cleaning apparatus on tires if material adhesion is detrimental to the surface treatment. Rollers shall be capable of applying a minimum of 50 psi contact pressure under each tire and shall be of such weight that no damage is caused to the underlying base course or surface treatment being applied.

(c) Power revolving broom or a power blower.

(d) Self-propelled, pneumatic-tire power spreader so designed, equipped, and operated to spread aggregate uniformly at the designated rate with application being defined at edges.

The aggregate spreader shall be capable of maintaining an allowable variation from the specified rate within ±0.5 pounds per square yard (±0.25 pounds per square yard for expanded clay aggregate).

(e) A vacuum-sweeper will be required when using expanded clay aggregate when there is a dusting problem.

507.04 WEATHER LIMITATIONS. Asphaltic material shall not be applied on a wet surface nor when the air temperature in the shade is less than 60°F.

Asphaltic surface treatment shall not be applied during November, December, January, February or March.

507.05 PREPARATION OF EXISTING SURFACE. Potholes and surface depressions not included in any other patching items shall be repaired by removing loose and defective material, tacking, and replacing with a patching mixture meeting the requirements of Section 724. The patching mixture shall be compacted to produce a tight surface conforming to the adjacent area.

Immediately prior to application of the asphaltic material, existing pavements shall be cleaned over the full width to be treated. The outer edges of the pavement to be treated shall be thoroughly cleaned. Raised pavement markers shall be removed before application of asphaltic surface treatment.

Excess asphalt on patches and joints in existing pavements, when not covered by a contract item, shall be removed by a method approved by the engineer. The pavement shall then be swept with a power broom to remove all loose material. Areas not reached by the power broom shall be cleaned by hand brooming.

Prime coat or curing membrane shall be satisfactorily cured and maintained in accordance with Sections 505 and 506 prior to application of asphaltic surface treatment. The surface shall be approved prior to application of asphaltic surface treatment.

507.06 APPLICATION. After the existing surface has been approved, asphaltic material and aggregates shall be applied in the amounts and sequence specified herein.

Application temperatures and sequence of application and spreading for asphaltic surfacing shall be as given in Table 5. The quantities of material given in Table 6 may be adjusted by the engineer as field conditions warrant. The type and condition of the surface being covered will affect the required rate of asphaltic material. The quantities to be used shall be as directed and shall be established during the first distributor application.

(a) Asphaltic Material: The quantities of asphaltic material per square yard of treated surface shown in Table 5 are based on a temperature of 60°F. Volumetric measurements shall be converted to this temperature in accordance with DOTD TR 321.

The length of spread of asphaltic material shall not exceed that which can be covered within 3 minutes with aggregate.

The rate of asphaltic material placed shall not vary by more than 10 percent either longitudinally or transversely from the beginning to the end of each pass of the distributor.

Asphaltic material for each application shall be applied uniformly for the full width of treatment unless, due to the impracticality of detouring traffic, the engineer directs that the material be applied to less than the full width of roadway at a time. When the contractor is unable to keep the application of asphaltic material consistently within ±0.02 gallons per square yard of the quantity directed, operations shall be discontinued. Operations shall not resume until the contractor can provide an operator of greater experience, a better distributor, or both, or shall provide such precautions as necessary to keep the application within allowable variations.

The height of the spray bar and the angle of the nozzles shall be adjusted so that individual spray fans do not interfere with each other and uniform double coverage is achieved.

The height of the spray bar shall be adjusted during operations as the asphaltic material is distributed to maintain the proper distance between the spray bar and the surface to maintain uniform double coverage. A minimum of 100 gallons of asphaltic material shall be maintained in the distributor during operation.

Each of the special spray nozzles at the ends of the spray bar shall be adjusted and maintained to provide a sharp edge for the asphaltic material on the roadway surface. When the application is less in width than the length of the spray bar, these special nozzles shall be moved to provide the specified edge lines.

When any nozzles become blocked during application of asphaltic material, the distributor and flow of material shall be immediately stopped and the nozzles cleaned. When the engineer directs that application be made over less than the full width of the roadway at a time, there shall be a slight longitudinal overlapping of adjacent treatments. The distributor shall be operated along a marked edge to keep the surface treatment in proper alignment.

To secure uniform distribution at the transverse junction of two treatments, the distributor shall be promptly stopped before the flow decreases. Building paper or other suitable material shall be placed over the end of the previous application. The joining application shall start on the building paper. Building paper so used shall be removed and disposed of satisfactorily. Burning of building paper will not be permitted within the right-of-way.

During application of asphaltic material, adjacent pavements, structures, and trees shall not be splattered with asphaltic material. The distributor shall not be cleaned or discharged into ditches, borrow pits, on shoulders or along the right-of-way.

Excess asphaltic material at the junction between distributor loads shall be removed and satisfactorily corrected. Areas of the surface to be treated which are not covered with asphaltic material directly from the distributor shall be covered by means of a hand-held spray bar equipped with nozzles.

(b) Aggregates: Aggregate spreading operations shall begin immediately after the application of the asphaltic materials. Asphaltic material shall be covered with aggregate material within 3 minutes.

Aggregate shall be uniformly spread over the full width of asphaltic material with one or more passes of spreading equipment with the application being sharply defined at edges. Equipment shall not be driven on uncovered asphaltic material. When necessary to obtain uniform coverage, the surface shall be hand broomed. The spread rate shall be established and checked during the first distributor application.

Hand spreading will be permitted in conjunction with self-propelled spreaders over areas inaccessible to spreaders. Asphaltic material shall be covered with the appropriate rate of aggregate before rolling is allowed.

(c) Multiple Applications: When multiple applications are to be placed, a minimum of 24 hours shall elapse between the application of each successive treatment.

507.07 ROLLING COVER MATERIAL. Immediately after spreading and brooming cover material, the surface shall be rolled with a power roller. Rolling shall proceed in a longitudinal direction, beginning at outer edges of the application. Each pass shall overlap the previous pass by 1/2 the roller width. The first rolling shall be completed within 1/2 hour after cover material has been spread. Deficiencies or damage in the aggregate cover detected during rolling shall be immediately corrected and rerolled as directed. Rolling cover material shall be continued until uniform coverage has been obtained. The remaining applications shall be rolled as specified for the first application.

507.08 PROTECTION. Traffic shall not be allowed on the surface until the aggregate has been placed and rolled. Each treatment shall be lightly broomed the next morning to remove loose aggregate.

When directed, the surface, shall be lightly broomed to remove loose material or otherwise maintained for 4 days. Maintenance of the surface shall include the distribution of aggregate material over the surface to absorb any free asphalt, covering any area deficient with aggregate material, and additional rolling as directed at no direct pay. Maintenance shall be conducted not to displace imbedded material. Excess material shall be swept from the entire surface by means of rotary brooms at the time determined.

When expanded clay aggregate is used, a vacuum sweeper without the sweeper engaged will be required to remove loose aggregate when a dusting problem occurs. Loose aggregate material will not be permitted on the surface during the 4-day maintenance period. Loose aggregate shall be removed and discarded by the contractor.

507.09 MEASUREMENT. The quantities of asphaltic material and aggregate incorporated in the completed and accepted asphaltic surface treatment will be measured separately. Aggregates will be measured by the square yard and asphaltic material will be measured by the gallon. Design quantities are based on horizontal dimensions. Design quantities will be adjusted when the engineer makes changes to adjust to field conditions. Each size aggregate will be measured by the square yard per application. Asphaltic material will be measured in the distributor by the gallon converted to gallons at 60°F in accordance with DOTD TR 321.

507.10 PAYMENT. Payment for placement and maintenance of asphaltic material and aggregates will be made at the contract unit prices, subject to the payment adjustment provisions of Section 1002 for specification deviations of asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for asphaltic materials.

Payment will be made under:

Item No.	Pay Item	Pay Unit
507(01)	Asphaltic Material (Type)	Gallon
507(02)	Aggregate (Size)	Square Yard

TABLE 5
ASPHALTIC SURFACE TREATMENT (AST) REQUIREMENTS

TYPE AST		TYPE A[1]		TYPE B[1]		TYPE C[1]	TYPE D					
AGG. FRICTION RATING		I, II		I, II, III		I, II, III, IV	I, II, III, IV					
ASPHALTIC MATERIALS		CRS-2P		CRS-2P or CRS-2L		CRS-2P	CRS-2			CRS-2P or CRS-2L		
APPLICATION TEMP.												
MINIMUM		160°F		160°F		160°F	125°F			160°F		
MAXIMUM		175°F		175°F		175°F	175°F			175°F		
NUMBER OF APPLICATIONS		2	1	2	1	1	3	2	1	3	2	1
ASPHALTIC MATERIALS[2]	1	0.38	0.40	0.38	0.30	0.40	0.50	0.45	0.35	0.45	0.38	0.30
Application Rates	2	0.28	---	0.28	---	---	0.40	0.30	---	0.35	0.28	---
Per Course	3	---	---	---	---	---	0.30	---	---	0.25	---	---
AGGREGATE[3]	1	S2-0.0111	S2-0.0111	S2-0.0111	S3-0.0075	S2-0.0111	S1-0.0200	S2-0.0111	S3-0.0075	S1-0.0200	S2-0.0111	S3-0.0075
Application Rates	2	S3-0.0075	---	S3-0.0075	---	---	S2-0.0111	S3-0.0075	---	S2-0.0111	S3-0.0075	---
Per Course	3	---	---	---	---	---	S3-0.0075	---	---	S3-0.0075	---	---

[1]Only expanded clay, crushed slag or crushed stone shall be used for Types A, B or C Asphaltic Surface Treatment.
[2]Asphaltic material application rates are in gallons of asphaltic material at 60°F per square yard of AST.
[3]Size aggregate and application rates. For example, S2 is Size 2 aggregate and 0.0111 is the application rate in cubic yards of aggregate per square yard of AST.

Section 508
Asphalt Treated Drainage Blanket

508.01 DESCRIPTION. This work consists of furnishing and constructing an asphalt treated drainage blanket of the plant mix type in accordance with these specifications and in conformity with the lines, grades, thickness and typical sections shown on the plans or established.

Equipment and processes shall conform to Section 503, except that rolling equipment shall consist only of a static steel wheel roller weighing 8 to 10 tons.

508.02 MATERIALS. The contractor shall keep accurate records, including proof of deliveries of all materials for use in the asphaltic mixtures. Copies of these records shall be furnished to the engineer upon request. Materials shall conform to the following Subsections:

Asphalt	1002.01
Additives	1002.02
Aggregates	1003.06(b)

(a) Asphalt: Asphalt cement Grade AC-30 shall be used.

(b) Additives: Silicone and anti-strip additives shall be approved products listed in QPL-22 or QPL-57.

(1) Silicone: Silicone additives, when needed, shall be dispersed into the asphalt by methods and in concentrations given in QPL-22.

(2) Anti-Strip: An anti-strip additive shall be added at the minimum rate of 0.5 percent and a maximum rate of 1.2 percent by weight of asphalt, and thoroughly mixed with the asphalt at the plant in accordance with Subsection 501.03(b).

508.03 ACCEPTANCE: The Department will perform acceptance testing for percent anti-strip and percent asphalt cement from meters or scale reading in accordance with Subsection 501.12.

508.04 COMPOSITION OF MIXTURE. The mixture shall consist of coarse aggregate, anti-stripping additive, and asphalt proportioned to produce suitable water permeability. The mixture shall meet the requirements of Table 7.

508.05 DESIGN AND QUALITY CONTROL OF MIXTURE: The requirements of Subsection 501.03 shall be met with the following exceptions:

(1) Mixtures shall not be designed for Marshall properties in accordance with DOTD TR 303.

(2) The mixture shall be designed by the contractor and shall consist of crushed coarse aggregate, anti-strip additive, and asphalt proportioned to produce suitable water permeability. The mixture shall meet the requirements of Table 6.

(3) No recycled portland cement concrete or reclaimed asphaltic pavement material shall be used in the mixture.

(4) The standard lot size shall be in accordance with Subsection 501.12, except that expanded lots will not be permitted.

(5) Two samples of loose mixture per lot will be taken and tested for gradation, percent crushed and percent AC by the contractor's Certified Asphaltic Concrete Plant Technician in accordance with DOTD TR 309, 308 and 306.

508.06 CONSTRUCTION REQUIREMENTS. Weather limitations shall be as specified in Subsection 501.04.

Prior to placement of the mixture, the surface shall be prepared in accordance with Subsection 501.05.

Hauling, paving and finishing shall be in accordance with 501.07. Use of automatic screed control will not be required.

The asphaltic mixture shall be placed in one layer and rolled as directed. Sections of newly finished blanket shall be protected from traffic for 24 hours.

Subsequent construction activities that will impair drainage characteristics of the layer will not be permitted. Vibratory rollers shall not be used on the first lift of asphaltic concrete over the drainage blanket.

508.07 MEASUREMENT. The quantities of asphalt treated drainage blanket will be the design areas per square yard shown on the plans and adjustments thereto. Design areas are based on horizontal dimensions. Design quantities will be adjusted when the engineer makes changes to adjust to field conditions, or when design changes are necessary.

508.08 PAYMENT. Payment for asphalt treated drainage blanket will be at the contract unit price per square yard, subject to the payment adjustment provisions of Table 2 of Section 501 for anti-strip additive and Section 1002 for specification deviations of the asphalt cement. The Materials and Testing Section will provide the payment adjustment percentage for asphaltic materials.

Payment will be made under:

Item No.	Pay Item	Pay Unit
508(01)	Asphalt Treated Drainage Blanket (____" Thick)	Square Yard

Table 6
Requirements for Asphalt Treated Drainage Blanket Mixtures

U. S. Sieve	% Passing by Weight	JMF Limits
1"	100	---
3/4"	90 - 100	---
1/2"	70 - 100	±6
3/8"	50 - 80	±6
No. 4	10 - 35	±6
No. 10	0 - 20	±5
No. 80	0 - 5	---
Percent Crushed, Min.	60	---
Percent Asphalt by Weight	3 - 4	±0.4
Temperature of Mixture, °F	200 - 275	±25
Percent Anti-Strip by Weight[1]		

[1]Determined and added in accordance with Section 501 except DOTD TR 322 will not be required.

Section 509
Cold Planing Asphaltic Pavement

509.01 DESCRIPTION. This work consists of removing asphaltic concrete surfacing in accordance with these specifications and in conformity with the average depth, width, grade, cross-slope and typical sections shown on the plans or established.

509.02 EQUIPMENT. Equipment for cold planing asphaltic surfacing shall be certified, self-propelled planing machines or grinders. They shall have sufficient power, traction and stability to remove the thickness of asphaltic concrete necessary to provide profile grade and cross slope uniformly across the surface. Cold planing equipment shall be capable of working from an erected stringline, shoe device or a traveling reference plane that will accurately reflect, for a minimum length of 30 feet, the average grade of the surface on which it is to be operated and shall have an automatic system for controlling cross slope at a given rate. Adequate loading equipment shall be provided to immediately remove materials cut from the surface and discharge the cuttings into a truck or on the shoulder as specified or directed. When cuttings are placed directly on the shoulder or used in asphaltic concrete, surfacing with lightweight aggregate shall be removed separately. Adequate personnel shall be provided to ensure that the cuttings are removed from the surface daily. The drum shall be round and true with sufficient number of teeth to yield a uniform and fine textured surface for bonding of the subsequent overlay. The machine shall be equipped with means to control dust created by the cutting action and shall have a system providing for uniformly varying the depth of cut while the machine is in motion.

509.03 CONSTRUCTION REQUIREMENTS.

(a) General: The maximum forward speed of the planing machine shall be 40 feet per minute. The engineer may approve forward speeds greater than 40 feet per minute provided the planed surface is uniform and fine textured and conforms to the surface tolerance requirements for a binder course. This speed shall be reduced as directed to provide a planed surface of uniform and fine texture with the specified grade and cross slope. Ridges left in the surface due to missing teeth shall be corrected by additional passes. The maximum depth of cold planing shall be 2 inches per pass when traffic is being maintained. Teeth lost during planing shall be immediately replaced.

Thirty foot (minimum) traveling reference plane shall be used on each pass of the planing machine. A shoe device to match the curb may be used when directed. The reference plane shall be placed on the best available adjacent surface.

When the entire roadway width has not been planed to a flush surface by the end of a work period resulting in a vertical or near vertical longitudinal face exceeding 2 inches in height, this longitudinal face shall be sloped as directed. Transverse faces present at the end of a

work period shall be beveled as directed. Provisions shall be made at drives and turnouts to maintain local traffic.

Asphaltic concrete next to structures that cannot be removed by the planing machine shall be removed by other acceptable methods.

Pavement surfaces resulting from planing operations shall be of uniform texture, grade and cross-slope and free from loose material. Planed surfaces not meeting these requirements shall be replaned at no direct pay. No uneven, undulating surfaces will be accepted. The contractor shall provide drainage of planed areas by cutting through the shoulder to the ditch.

The cold planing operation shall not precede the subsequent paving operation by more than 15 calendar days. This time may be extended if extensive joint repairs or patching is required. For single lift overlays requiring shoulder stabilization, the cold planing operation shall not precede the subsequent paving operation by more than 30 days.

On roadways that are open to traffic, pavement striping removed by planing shall be replaced with temporary pavement markings at the end of each day's planing operations in accordance with Section 713.

Unless otherwise specified, surfacing material removed by planing shall become the property of the contractor and shall be disposed of in accordance with Subsection 202.02. When specified on the plans, a portion or all of the surfacing material removed by planing will be retained by the Department and shall be hauled by the contractor to the specified location and stockpiled as directed. Excess material shall then become the property of the contractor and shall be disposed of in accordance with Section 202.02.

Required joint repairs shall be made after planing. Pavement patching shall be completed before planing. When additional areas requiring patching are exposed by planing operations, such additional patching shall be performed after planing. Pavement patching shall be in accordance with Section 724.

(b) The surface tolerance requirements of the cold planed surface shall meet the requirements for binder course in Section 501.

509.04 MEASUREMENT. Measurement will be made by the square yard of asphaltic concrete surfacing satisfactorily removed.

509.05 PAYMENT. Payment of cold planing asphaltic pavement will be made at the contract unit price, which includes removal of asphaltic concrete surfacing and disposal of removed materials. Payment for temporary pavement markings will be included under appropriate pay items.

Payment will be made under:

Item No.	Pay Item	Pay Unit
509(01)	Cold Planing Asphaltic Pavement	Square Yard

PART VI — RIGID PAVEMENT

Section 601
Portland Cement Concrete Pavement

601.01 DESCRIPTION. This work consists of constructing portland cement concrete pavement, on a prepared subgrade or base course in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the engineer.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures."

601.02 MATERIALS. Materials shall conform to the following Sections or Subsections.

Portland Cement Concrete	901
Joint Materials	1005
Tie Bars	1009.03
Dowel Bars	1009.04
Curing Materials	1011.01
Epoxy Systems	1017
Hydrated Lime	1018.03
Water	1018.01
Non-Shrink Grout	1018.27
Geotextile Fabric	1019

The contractor will be permitted to furnish either Type B, C, or D concrete. The same Type of concrete shall be used throughout the project, unless otherwise authorized in writing. The contractor will also be permitted to furnish Class A or AA concrete in lieu of the mixtures listed above.

601.03 EQUIPMENT. Paving and miscellaneous equipment shall conform to the requirements of the appropriate Subsection. Equipment and tools necessary for handling materials and performing the work will be approved in writing. The equipment shall be at the job site sufficiently ahead of the start of operations to be examined for approval. Equipment shall be so designed and operated as to assure placing and spreading of concrete without segregation.

(a) Vibrators: Vibrators for full width vibration of concrete slabs shall be internal type with either immersed tube or multiple spuds. They may be attached to the spreader or finishing machine or mounted on a separate carriage. Spacing of vibrators shall not exceed 24 inches. The first vibrator shall be approximately 12 inches from the edge of the slab. The attached vibrators shall be capable of being raised to prevent contact with joints, dowel bars, subgrade, forms or other features extending into the pavement. Frequency of submerged

internal vibrators, both tube and spud vibrators, shall be 7,000 to 10,000 impulses per minute. This frequency also applies to internal vibrators used adjacent to forms. Vibrators mounted on any machine or carriage shall be interlocked with the forward travel mechanism so that they automatically start and stop vibrating when the machine starts and stops. Hand held vibrators shall be an approved type and design, capable of transmitting vibration to concrete at frequencies of at least 4,500 impulses per minute.

(b) Sawing Equipment: When joints are sawed in accordance with Subsection 601.09, the contractor shall provide adequate equipment to complete the sawing to required dimensions. Sufficient backup equipment shall be provided at the jobsite to continue sawing operations if the primary sawing equipment malfunctions.

(c) Forms:

(1) General: Forms shall have a depth not less than the specified edge thickness of pavement and a base width at least 0.8 of the depth, except as otherwise approved.

Forms shall be provided with adequate devices for secure setting. Flange braces shall extend outward on the base at least 2/3 the height of forms. Forms with battered top surfaces and bent, twisted or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved.

Materials used for keyway forms will be subject to approval.

Top face of forms shall not vary from a true plane more than 1/8 inch in 10 feet and the upstanding leg shall not vary more than 3/8 inch from the vertical. Forms shall contain provisions for locking ends of abutting sections together tightly.

(2) Straight Forms: Straight forms shall be made of metal at least 7/32 inch thick an shall be furnished in sections at least 10 feet long.

(3) Flexible or Curved Forms: Flexible or curved forms of proper radius shall be used on curves of 150-foot radius or less and shall be an approved design. On curves with a radius greater than 150 feet, straight forms of shorter lengths will be permitted.

(4) Built-up Forms: When approved, built-up forms may be used; however, the build-up shall not exceed 2 inches. No limitation will be made on the use of build-up forms or amount of build-up where the total area of pavement of a specified thickness is less than 2,000 square yards.

(d) Screed: The screed for the surface shall be at least 2 feet longer than the slab width and shall be an approved design, sufficiently rigid to retain its shape and constructed either of metal or other suitable material shod with metal.

(e) Floats: The machine float shall be composed of cutting and smoothing floats suspended from and guided by a rigid frame. The frame shall be carried by four or more wheels riding on, and constantly in contact with, side forms. Longhandled floats shall have blades at least 5 feet long and 6 inches wide.

(f) Straightedge: The straightedge shall be an approved minimum 10-foot metal static straightedge with handles approximately 3 feet longer than 1/2 the slab width.

(g) Carpet Drag: The carpet drag shall consist of an approved artificial turf. The artificial turf shall be made of molded polyethylene with synthetic turf blades approximately 0.85 inch long containing

approximately 7200 individual blades per square foot. The artificial turf carpet shall be full pavement width and of sufficient size that during the finishing operation approximately 2 feet of carpet parallel to the pavement centerline will be in contact with the pavement surface for the full pavement width. For pavement 16 feet or more in width, the artificial turf shall be mounted on a traveling bridge on forms. If necessary for maintaining intimate contact with the pavement surface, the carpet may be weighted.

(h) Tine Texturing Device: The tine texturing device shall have metal tines that produce grooves uniform in appearance and transverse to the pavement centerline and a continuously textured surface.

601.04 PREPARATION AND MAINTENANCE OF SUBBASE OR BASE. The surface on which the concrete is to be placed shall be prepared and maintained in accordance with plan details and in such a manner that the pavement depth, grade and surface finish requirements will be met. Additional preparation needed for the support of construction equipment will be at no direct pay.

The subbase or base course shall be cleaned of loose material and maintained in a satisfactory condition, and any deficient areas shall be corrected at no direct pay.

The subbase or base course shall be graded to proper cross section. High areas shall be trimmed to grade. Areas below grade shall be filled with concrete during paving. The finished grade shall be maintained in a smooth and compacted condition until pavement is placed. No concrete shall be placed until the subbase or base course has been approved.

Asphaltic concrete base courses shall be coated with a whitewash mixture consisting of hydrated lime and water. The proportions used in the whitewash mixture and the rate of application shall be such that a uniform color, not darker than uncoated concrete after curing, will be produced on the base course surface. The whitewash mixture shall be applied the day before paving unless otherwise permitted. The whitewash material shall be maintained until covered.

601.05 PLACING FORMS.

(a) Base Support: The foundation under forms shall be firm and true to grade so that the form will be firmly in contact for its whole length or firmly shimmed at the required grade.

(b) Form Setting:

(1) General: Form sections shall be tightly locked and free from movement in any direction. There shall be no excessive settlement or springing of forms under the finishing machine. Face and top of forms shall be cleaned and soil prior to placing concrete. A pin shall be placed at each side of every form joint. Pins shall be of sufficient length to provide adequate anchorage.

(2) Stabilized (or treated) and Asphaltic Concrete Base Courses: On asphaltic concrete base courses, or cement or lime stabilized or treated base courses, each 10-foot section of forms shall be staked into place with at least two pins installed in fullsize drilled holes.

(3) Other Types of Base Courses or Subbases: On other types of bases or subbases, at least three pins will be required in each 10-foot section. After forms have been set to correct grade and alignment, the base or subbase shall be thoroughly tamped, mechanically or by hand, at both inside and outside edges of forms.

(c) Grade and Alignment: Alignment and grade of forms shall be checked and corrections made by the contractor prior to placing concrete. When any form has been disturbed or the grade or alignment has become unstable, the form shall be reset and rechecked. Form sections shall not deviate from required alignment by more than 3/8 inch.

601.06 PLACING CONCRETE. The subbase or base shall be uniformly moist when concrete is placed. When directed, the subbase or base shall be sprinkled to dampen the surface, but the method of sprinkling shall not form mud or pools of water. Concrete shall be deposited on the base or subbase in such manner as to require as little rehandling as possible. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other approved tools, excluding rakes. Workers shall not walk in freshly mixed concrete with boots or shoes coated with dirt or foreign substances.

When concrete is to be placed adjacent to previously constructed pavement and equipment except for saws will be operated on the previously constructed pavement, the previously constructed pavement shall have attained an age of 10 days or a compressive strength of 3,000 psi when tested in accordance with DOTD TR 230. The contractor shall protect the finish from damage. Hot and cold weather limitations of Subsection 901.12 shall apply.

When only finishing equipment is carried on existing pavement, paving of adjoining pavement will be permitted after 3 days, exclusive of days when temperature is below 40°F.

Concrete shall be placed as near to joints as possible without disturbing them.

601.07 TEST SPECIMENS. The contractor shall furnish concrete for casting test specimens as required at no direct pay. Test specimens will be made and cured in accordance with DOTD TR 226.

601.08 STRIKE-OFF, CONSOLIDATION AND FINISHING.

The normal sequence of operations is: strike-off and consolidation, screeding, floating and removal of laitance, straightedging, surface finishing, and tine texturing.

(a) Strike-off: Concrete shall be struck off to the specified cross section and to an elevation such that when concrete is properly consolidated and finished, the pavement surface shall be at the established elevation.

(b) Consolidation: Concrete shall be consolidated for full width and depth of the slab. Vibrators shall not be operated longer than 15 seconds in one location. If satisfactory density of concrete is not obtained, the contractor shall use methods which will produce pavement conforming to specifications.

(c) Consolidation and Finishing at Joint Forming Devices:

(1) Concrete adjacent to joints shall be compacted without voids or segregation against joint material, also under and around load transfer devices, joint assembly units and other features extending into pavement. Concrete shall be thoroughly consolidated for its full width, along the faces of forms, and along the full length and on both sides of joint assemblies with internal vibrators or other acceptable methods. When hand-held vibrators are used, care shall be taken to void excessive vibration.

(2) After concrete has been placed and vibrated adjacent to joints, the finishing operations shall be brought forward, operating in a manner to avoid damage or misalignment of joints.

(d) Screeding: Concrete, as soon as placed, shall be struck off and screeded with an approved portable screed.

The screed shall be moved forward on forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which work is progressing and so manipulated that neither end is raised from side forms during the striking off process. This shall be repeated until the surface is of uniform texture, true to grade and cross section and free from porous areas. The screed shall be controlled to maintain a uniform roll of concrete ahead of the screed.

(e) Floating: Floating to provide the final smooth surface will be required using an approved machine float. When necessary, following machine floating, longhandled floats may be used to smooth and fill open-textured pavement areas. Longhandled floats shall not be used to float the entire pavement surface in lieu of the preceding method of floating. When strike-off and consolidation are done by hand and the pavement crown will not permit use of the machine float, the surface shall be floated transversely with the longhandled float. Care shall be taken not to work the crown out of the pavement.

(f) Straightedging: Excess water and laitance shall be removed from the pavement surface by a steel straightedge. The plastic concrete surface shall be tested for trueness with a straightedge. The straightedge shall be furnished and used by the contractor and shall be held in contact with the surface in successive positions parallel to pavement centerline. The whole area shall be checked from one side of the slab to the other. Advance along the surface shall be in successive stages of not more than 1/2 the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, and refinished. High areas shall be cut down and refinished. Attention shall be given to ensure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is free from deviations from the straightedge and the slab conforms to required grade and cross section.

(g) Surface Finishing: In general, addition of water to the surface of concrete to assist in surface finishing operations will not be permitted. If application of water to the surface is permitted, it shall be applied as a fog spray by approved equipment.

During final surface finishing operations, areas that are improperly finished shall be refloated and refinished as required.

Surface finishing shall be with an approved carpet drag. The carpet drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch deep. The adjacent concrete shoulder will require the same finish as the pavement. The carpet drag shall be free of hardened concrete. Carpet drag that cannot be cleaned or with worn blades shall be replaced.

(h) Tine Texturing: The metal tine texturing device shall be operated by approved mechanical means when texturing main roadway pavement lanes. When approved, manual methods may be used for tine texturing ramps, crossovers, turnouts, split slab construction or other pavement sections.

Tine texturing will not be required on parking areas, drives and other such areas.

The adjacent concrete shoulder will require the same finish as the pavement.

The metal tined grooves produced in the concrete shall be spaced on 1 inch centers and shall be 3/16 inch wide and 1/8 to 3/16 inch deep.

Depth of tine texturing will be checked in accordance with DOTD TR 229.

Pavement which does not meet the above requirements will be corrected by regrooving.

(i) Edging at Forms and Joints: After tine texturing but before concrete has reached its initial set, the edges on each side of pavement and each side of transverse expansion joints, Type EJ modified joints, and longitudinal construction joints which are not sawed shall be worked with an approved tool and rounded to the radius specified. A well-defined, continuous radius shall be produced and a smooth, dense mortar finish shall be obtained. A bridge shall be used to perform the working of joints. The pavement surface shall not be disturbed by tilting the tool during use.

Tool marks on the slab adjacent to joints shall be eliminated by brooming the surface, but the rounding of the slab shall not be disturbed. Concrete on top of joint filler shall be removed. Joints shall be tested with a straightedge before concrete has reached initial set and corrections made as necessary.

(j) Hand Finishing: Hand finishing methods will not be permitted except under the following conditions:

(1) In case of breakdown of mechanical equipment, hand finishing may be used to finish concrete already deposited on the grade when the breakdown occurs.

(2) Pavement widths not exceeding 16 feet or areas of irregular dimensions where operation of mechanical equipment is impractical may be hand finished.

(k) Finish for Concrete to be Overlaid: If concrete pavement is to be overlaid with asphaltic concrete, tine texturing will not be required; and the pavement shall be satisfactorily finished to required lines, grades and typical section. Machine or hand finishing methods may be used. The final surface finish shall be equivalent to that normally achieved with a wood float.

601.09 JOINTS.

(a) Longitudinal Joint (Type LJ): The longitudinal joint shall be constructed such that the transverse joint is continuous across the slab. Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, steel side forms or other approved methods shall be used. Only Grade 40 tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before concrete of the adjacent lane is placed. In lieu of bending tie bars, approved mechanical butt splicing devices conforming to Subsection 806.07 may be used.

Tie bars which break or show evidence of fracture upon straightening shall be replaced when directed by using an approved adhesive anchor system listed in the QPL-52 or by epoxying with a Type I, Grade C epoxy resin system. When epoxy is used, holes for tie bars shall be drilled

approximately 1/8 inch larger than the diameter of the bar to be anchored. Holes shall be clean and moisture free. Adhesive anchor systems shall be used in accordance with the manufacturer's recommendations.

The Type I, Grade C epoxy resin system shall be mixed in accordance with the manufacturer's recommendations with no fillers or extenders added. The maximum quantity of epoxy which may be mixed is that quantity which can be applied within the manufacturer's designated time limit as directed by ambient temperature or other job conditions. The surface of the steel tie bar shall be coated with epoxy. Epoxy shall be injected into the hole using a caulking gun or other approved method to completely fill the hole. Epoxy injected shall be sufficient to fill the void between the bar and hole as evidenced by epoxy squeeze-out when the bar is inserted. Precautions shall be taken to prevent bars from being disturbed until epoxy has sufficiently cured. Epoxy shall not be applied when ambient temperature is below 40°F.

When shoulder and roadway pavement slabs are placed separately, a longitudinal joint will be required between the slabs; however, when shoulder and roadway pavements are placed monolithically, and the total width of roadway and shoulder does not exceed 15 feet, no longitudinal joint will be required between the shoulder and roadway pavements. Ramps which exceed 15 feet in width shall have a longitudinal joint at the centerline.

Longitudinal joints may be formed by any of the following methods.

(1) For design speeds of 45 mph and greater, the longitudinal joint (Type LJ) shall be formed by sawing. The sawing operation shall begin as soon as the concrete has reached sufficient strength to support the sawing equipment and tearing of the concrete does not occur. The sawing operation shall be completed in a timely manner (generally within 10 hours of placing concrete) such that random cracking does not occur.

Joint width shall be a minimum of 1/8 inch; joint depth shall be as specified in the plans. The joint sealant shall be placed to a minimum depth of 1 inch and shall conform to Subsection 1005.02(b) or (c).

After each joint is sawed, the saw cut and adjacent concrete surfaces shall be cleaned of materials removed during sawing.

No equipment, other than the sawing machine, will be permitted on the pavement during sawing operations. Sufficient back-up equipment shall be provided at the jobsite to continue sawing operations in case of a breakdown of the primary sawing equipment.

During paving operations, joint locations shall be clearly marked by approved methods.

When sawing operations are not providing proper crack control, the contractor shall modify sawing operations as required to provide proper crack control.

The contractor shall repair or replace any random cracking, chipping, spalling or tearing of the concrete at no direct pay by approved methods to the satisfaction of the engineer.

(2) For design speeds less than 45 mph, the longitudinal joint (Type LJ) shall be sawed as above or formed by using strips of joint filler material conforming to Subsection 1005.01(c) or (d). The joint filler material shall be inserted in a groove formed by a "T" iron wheel or other device that will ensure a groove that is true in both vertical and horizontal alignment. Grooves shall be cut to the specified depth in such a manner that the surface of the freshly placed concrete will not be depressed or otherwise disturbed.

Strips of preformed joint filler material of specified dimensions shall be inserted in the groove and aligned. After insertion, the top edge of the strip shall be flush with the surface and the pavement surface floated and checked with an approved 10-foot metal static straightedge.

(3) Longitudinal Joints in the asphaltic concrete shoulders adjacent to concrete pavement shall be sawed in accordance with plan details and sealed with a sealant conforming to Subsection 1005.02(a).

(b) Transverse Expansion Joints (Type EJ): Concrete disturbed during expansion joint installation shall be replaced with fresh concrete and vibrated with a surface vibrator. The sealer shall be preformed elastomeric compression seal conforming to Subsection 1005.03. The expansion joint filler shall be one of the following types.

(1) Wood Filler: If wood filler conforming to Subsection 1005.01(b) is used to form the joint, the joint shall be sealed as specified. When wood filler is used, it shall be thoroughly saturated with water before installation. No board less than 6 feet long shall be used.

Dowel Bars shall provide bracing adequate to hold the wood filler in a vertical position.

Wood fillers which are damaged shall not be used. Finished joints shall not deviate more than 1/4 inch in horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted within the expansion space. Field modification of wood filler will not be allowed.

(2) Preformed Expansion Joint Filler: If expansion joint filler conforming to Subsection 1005.01(a) is used to form the joint, it shall be sealed as specified. No filler less than 6 feet long shall be used.

Load transfer devices shall provide bracing adequate to hold the preformed joint filler in a vertical position.

Joint fillers which are damaged shall not be used. Finished joints shall not deviate more than 1/4 inch in horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted within the expansion space. Field modification of joint fillers will not be allowed.

(c) Transverse Contraction Joints (Type TCJ): Transverse contraction joints shall consist of planes of weakness created in the cross section of the pavement. The joints shall include load transfer devices. Joints for pavement with a design speed of 45 mph or over shall be constructed by sawing as specified in Heading (1) below. Joints for pavement with a design speed less than 45 mph may be constructed by any of the following methods.

(1) Joints shall be constructed by sawing after the concrete has reached sufficient strength to support sawing equipment. During paving operations, joint locations shall be clearly marked by approved methods. Joints may be either sawed to required joint width and depth at one time, or may be initially sawed to a width of approximately 1/8 inch and to the required joint depth and subsequently widened by sawing to required joint width. Sawing shall be to the specified depth for the full width of roadway or lane. When the transverse contraction joint cannot be sawed to the edge of the pavement due to forms, an insert shall

be placed in the 6 inches adjacent to the forms. Initial sawing shall be done as soon as the concrete has hardened sufficiently that tearing of the concrete will not occur, and shall be completed in a timely manner such that random cracking does not occur (generally within 10 hours).

The joint sealant reservoir shall be sawed to the minimum width and depth shown on the plans.

After each joint is sawed, the saw cut and adjacent concrete surfaces shall be cleaned of materials removed during sawing.

No equipment other than the sawing machine and testing equipment will be permitted on the pavement during sawing operations. Sufficient back-up equipment shall be provided at the jobsite to continue sawing operations in case of a break-down of the primary sawing equipment.

If sawing operations are not providing proper crack control the contractor shall modify sawing operations, equipment, timing and/or concrete mix as required to provide proper crack control.

The contractor shall repair any random cracking, chipping, spalling or tearing of the concrete at no direct pay by approved methods to the satisfaction of the engineer.

(2) Install an approved removable joint device to form a joint to the required width and depth. This device shall be vibrated in place and raised 1/2 inch to 3/4 inch while concrete is workable, with all laitance removed along side of insert. The insert shall remain in place at least 12 hours. These devices may be reused provided they are cleaned of foreign materials and are undamaged in removal.

(3) Install a combination joint former/sealer approved as specified in Subsection 1005.04 to form a joint in fresh concrete to ensure proper bond and alignment.

(d) Transverse Construction Joints (Type CJ): Transverse construction joints shall be constructed when there is an interruption of more than 1/2 hour in concreting operations. No transverse joint shall be constructed within 10 feet of an expansion or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, concrete back to the preceding joint shall be removed and disposed of as directed. Hand vibrators shall be used to ensure proper consolidation of concrete adjacent to transverse construction joints. Joints shall include dowel bars.

(e) Longitudinal Construction Joint (Type LCJ): Longitudinal construction joints shall be constructed when adjacent lanes are constructed separately. Hand vibrators shall be used to ensure proper consolidation of concrete adjacent to longitudinal construction joints. Joints shall include tie bars. A heavy coat of curing compound shall be applied to the concrete before constructing the adjacent slab. Tie bars shall be protected from being coated with curing compound.

(f) Longitudinal Butt Joint (Type LBJ): Longitudinal butt joints shall be constructed when adding one or more additional lanes of pavement. Deformed tie bars of the specified length, size, spacing and material shall be placed perpendicular to longitudinal butt joints. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves.

Tie bars shall be installed in holes drilled in the existing pavement using an approved adhesive anchor system listed in the QPL 52 or by using a Type I, Grade C epoxy resin system. Holes shall be clean and moisture free.

Adhesive anchor systems shall be used in accordance with the manufacturer's recommendations.

When epoxy is used, tie bars shall be placed in the existing pavement in holes drilled approximately 1/8 inch larger than the diameter of the tie bar to be anchored.

The epoxy shall be mixed in accordance with the manufacturer's recommendations with no fillers or extenders added. The maximum quantity of epoxy which may be mixed is that quantity which can be applied within the manufacturer's designated time limit as directed by ambient temperature or other job conditions. The surface of the tie bar shall be coated with epoxy. Epoxy shall be injected into the hole using a caulking gun or other approved method to fill the hole with epoxy. Epoxy injected shall be sufficient to fill the void between the bar and hole as evidenced by epoxy squeeze-out when the bar is inserted. Precautions shall be taken to prevent the tie bar from being disturbed until epoxy has sufficiently cured. Epoxy shall not be applied when the ambient temperature is below 40°F.

(g) Transverse Butt Joint (Type BJ): Transverse butt joints shall be constructed when extending existing pavement. Smooth dowel bars of the specified length, size, coating, spacing and material shall be placed perpendicular to transverse butt joints.

Dowel bars shall be installed in the existing pavement by drilling holes approximately 1/8-inch larger than the diameter of the bar. The bar shall be installed using an approved Type I, Grade C epoxy resin system. Holes shall be clean and moisture free.

The epoxy shall be mixed in accordance with the manufacturer's recommendations with no fillers or extenders added. The maximum quantity of epoxy which may be mixed is that quantity which can be applied within the manufacturer's designated time limit as directed by ambient temperature or other job conditions. The surface of the dowel bar shall be coated with epoxy. Epoxy shall be injected into the hole using a caulking gun or other approved method to fill the hole with epoxy. Epoxy injected shall be sufficient to fill the void between the bar and hole as evidenced by epoxy squeeze-out when the bar is inserted. A grout retention ring shall be placed over the dowel bar against the slab face to prevent epoxy from flowing out of the hole. The grout retention ring shall be left in place. Precautions shall be taken to prevent bars from being disturbed until epoxy has sufficiently cured. Epoxy shall not be applied when the ambient temperature is below 40°F.

Transverse butt joints shall be formed by using a removable joint forming device after the concrete has been placed or by sawing in accordance with Heading (a)(1).

(h) Transverse Expansion Joints-Modified (Type EJ-Modified): Transverse expansion joints-modified shall consist of a 4-inch wide joint sawed over the bolster block. The bolster block shall be constructed from Class A concrete or one of the pavement types conforming to Section 901. One or more layers of tar paper equivalent to a minimum of 45 pounds shall be placed between the bolster block and the pavement. Joint material shall conform to Subsection 1005.07.

(i) Dowel Bars: Dowel bars shall have a uniformly round cross section and shall be saw-cut, smooth and free of burrs, projections and deformations. Dowel bars shall be plastic coated in accordance with Subsection 1009.04.

Dowel bars may be placed by an approved mechanical device equipped with suitable means to control proper depth and alignment of the dowel bars. Dowel bars shall be positioned parallel to the pavement centerline

and surface; and shall be firmly held in position by the mechanical device until concrete has been thoroughly consolidated around the bars.

Dowel bars placed in approved dowel assemblies shall have an approved expansion tube furnished with each bar used in expansion joints. The sleeve shall fit the dowel bar tightly and the closed end shall be watertight. The location of dowel bar placement for concrete shoulders shall conform to the plans.

(j) Asphaltic Concrete Overlaid Pavement: When new concrete pavement is to be overlaid with asphaltic concrete, joints shall be sawed or formed and sealed.

601.10 CURING AND PROTECTION. Immediately after completion of finishing operations and as soon as marring of concrete will not occur, the pavement surface shall be cured by covering with a white pigmented curing compound. Concrete shall not be left exposed for more than 1/2 hour during the curing period. Curing shall be maintained continuously for 72 hours.

(a) Curing: The pavement surface shall be uniformly sprayed with white pigmented curing compound immediately after completion of surface finishing and as soon as surface water evaporates. Curing compound shall not be applied during rainfall.

Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer, but in no case less than 1 gallon per 100 square feet of surface area. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At time of use, the compound shall be thoroughly mixed. During application, the compound shall be stirred continuously by mechanical methods. Hand spraying of irregular widths or shapes and on surfaces exposed by form removal will be permitted provided curing compound has been thoroughly agitated prior to placing in the sprayer. Curing compound shall not be applied to inside faces of joints to be sealed. In split slab construction, curing compound shall be applied in such manner as to prevent spraying exposed tie bars.

Should the film become damaged within the curing period, the damaged portions shall be immediately repaired with additional compound.

When the side forms are removed before the end of the 72-hour curing period, the exposed sides of slabs shall be immediately protected by applying a curing compound equal to that provided for the surface.

(b) Rain Protection: Prior to beginning daily paving operations, the contractor shall have available at the jobsite sufficient polyethylene sheeting material to properly protect the last 1 hour's operation against the effects of rain. The pavement surface and sides shall be covered with polyethylene sheeting, when required. Units shall be lapped at least 18 inches. Sheeting shall be placed and weighted down so that it will remain in contact with the surface. Sheeting shall be large enough to extend beyond pavement edges at least twice the pavement thickness.

(c) Cold Weather Protection: When concrete is being placed and the air temperature is expected to drop below 35°F, a sufficient supply of straw, hay, grass, approved curing paper or other approved blanketing material shall be provided along the work. When the temperature is expected to reach the freezing point during the day or night, the protective material shall be spread over the pavement to a sufficient depth to

prevent freezing of concrete. Concrete damaged by frost action shall be removed and replaced at no direct pay.

601.11 SURFACE TOLERANCE REQUIREMENTS (LONGITUDINAL).

(a) General: The pavement travel lanes will be tested using an approved Ames California Type 25-Foot Profilograph over each wheel path of each lane except that the outside wheel path will not be tested on projects which are classified in Table 1 as Category III projects and which have catch basins and curb along the outside edge of the pavement. The resulting profile trace will be evaluated to determine the location of high points (bumps) in excess of specification limits and to determine the pavement's Average Profile Index. The Average Profile Index is defined as the arithmetical average of the Profile Indexes of the wheel paths for each test section or lot of the travel lanes.

Associated pavements (acceleration lanes, deceleration lanes, continuous turn lanes and ramps) will be tested using the profilograph over the centerline of each lane or ramp. The resulting profile trace will be evaluated to determine the location of high points (bumps) in excess of specification limits.

Shoulders, turnouts, crossovers and the 25-foot areas of new travel lanes in tie-in areas shall be tested with an approved 10-foot metal static straightedge.

The operation of the profilograph, including evaluation of the profile trace, determination of the Profile Index for each wheel path in each travel lane, calculation of the Average Profile Index for each roadway and determination of high points (bumps) in excess of specification limits shall be in accordance with DOTD TR 641. The operation of the profilograph and evaluation of the profile trace shall be by trained, qualified personnel who have successfully completed the Department's training and evaluation program.

The Blanking Band Template for determining the Profile Index shall be 0.2 inch. The Bump Template for determining high points (bumps) in excess of specification limits shall be 0.3 inch in 25 feet or less for Category I or II in Table I or 0.4-inch in 25 feet or less for Category III in Table 1. The pavement profile determination will terminate approximately 25 feet from each bridge approach slab or existing pavement that is joined by new pavement constructed under these specifications. Obviously deficient areas, as determined by the engineer, shall be corrected before any profilograph testing is performed.

(b) Requirements: Surface finish testing will be conducted in the longitudinal direction. Deficiencies shall be isolated in both the longitudinal and transverse direction. All pavement travel lanes and associated pavements, regardless of design speeds or paving operations, with surface deviations represented by high points (bumps) in excess of 0.3 inch in 25 feet or less for Category I or II or 0.4 inch in 25 feet or less for Category III shall be corrected.

A report as required in DOTD TR 641 of each profile trace performed by the contractor shall be supplied to the engineer for review.

(1) Design Speed Greater than 45 MPH: For pavements with design speeds of 45 mph or greater, the contractor shall furnish paving equipment and employ methods that produce a riding surface having an Average Profile Index of not more than 6.0 inches per mile per lot.

(2) Urban Areas Using Continuous Paving Operations: For urban areas using continuous paving operations with design speeds 45 mph or

less, the contractor shall furnish paving equipment and employ methods that produce a riding surface having an Average Profile Index of not more than 12.0 inches per mile per lot.

(3) Urban Areas Not Using Continuous Paving Operations: For urban areas not using continuous operations (such as: areas with catch basins, manholes, crossovers, driveways, curb and gutter sections, and split-slab construction) with design speeds 45 mph or less, the contractor shall furnish paving equipment and employ methods that produce a riding surface having an Average Profile Index of not more than 20.0 inches per mile per lot.

(4) Tie-in Areas, Shoulders, Turnouts and Crossovers: For pavement tie-in areas, shoulders, turnouts and crossovers, the contractor shall furnish equipment and employ methods that produce an acceptable riding surface. Pavement tie-in areas with surface deviations in excess of 1/4-inch in 10 feet shall be corrected. Pavement shoulders, turnouts and crossovers with surface deviations in excess of 1/2-inch in 10 feet shall be corrected.

(c) Equipment: The profilograph used for daily paving quality control and to identify surface areas requiring corrective actions shall consist of an approved Ames California Type 25-Foot Profilograph furnished, calibrated and operated in accordance with DOTD TR 641 by the contractor.

The profilograph used for surface tolerance acceptance and to determine surface finish payment adjustments shall consist of an approved Ames California Type 25-Foot Profilograph furnished, calibrated and operated in accordance with DOTD TR 641 by the Department.

The pavement profile is recorded by the profilograph at a scale of 1:1 vertically and 1 inch equals 25 feet longitudinally.

An approved 10-foot metal static straightedge shall be furnished by the contractor for both quality control and acceptance surface tolerance testing of tie-in areas, shoulders, and turnouts and crossovers.

(d) Initial Surface Testing:

(1) Pavement Travel Lanes: During initial paving operations, for pavement travel lanes either when starting up or after a shut-down period, the pavement surface shall be tested with the profilograph and the Average Profile Index calculated by the contractor as soon as the concrete has cured sufficiently to allow testing. The purpose of this initial testing is to aid the contractor and the Department in evaluating the paving operations and equipment. If this initial testing and evaluation indicates that the Average Profile Index exceeds the minimum requirements given in Table 1 for payment, the contractor shall alter paving operations to produce pavement within these limits. If the contractor's operations continue to produce pavement outside these limits, the contractor shall stop and make all necessary corrections to produce pavements within these minimum limits.

(2) Associated Pavement: During initial paving operations for associated pavements, either when starting up or after a shut-down period, the pavement surface shall be tested with the profilograph and the high points (bumps) in excess of specification limits evaluated by the contractor as soon as the concrete has cured sufficiently to allow testing. The purpose of this initial testing is to aid the contractor and the Department in evaluating the paving operations and equipment. If this initial testing and evaluation indicates that there are excessive high points (bumps) in excess of the requirements given in Heading (b),

the contractor shall stop and alter paving operations to reduce and limit the number of high points (bumps) in excess of specification limits. Once the initial pavement smoothness and paving operations are acceptable, the contractor shall proceed with the paving operation.

(3) Shoulders, Turnouts and Crossovers: During initial paving operations, either when starting up or after a shut-down period, the surface shall be tested and evaluated by the contractor with an approved 10-foot metal static straightedge as soon as the concrete has cured sufficiently to allow testing. The purpose of this initial testing is to aid the contractor and the Department in evaluating the paving operations and equipment. If this initial testing indicates surface deviations in excess of 1/2-inch in 10 feet, the contractor shall stop and alter paving operations to produce pavement with surface deviations of 1/2-inch or less in 10 feet. Once the initial surface smoothness and paving operations are acceptable, the contractor shall proceed with paving operations.

(4) Curing membrane damaged during the testing operation shall be repaired by the contractor as directed at no direct pay.

(e) Quality Control Surface Testing: The contractor shall test each day's paving with the profilograph no later than during the first work day following placement of the pavement.

(1) Pavement Travel Lanes: If the contractor fails to meet the minimum requirements given in Table 1, the paving operation will be suspended and will not be allowed to resume until the paving and finishing operation is corrected by the contractor to meet the requirements of Table 1. After the paving and finishing operation has been corrected by the contractor and the engineer allows the paving operation to continue, the paving operation will be tested in accordance with Heading (d) above.

Areas with high points (bumps) in excess of the requirements given in Heading (b), shall be isolated both longitudinally and transversely and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (e)(5). Additional profiles as necessary shall be taken by the contractor to define the limits of all out-of-tolerance pavement requiring correction.

After correcting all individual deviations in excess of the requirements in Heading (b), additional corrective action shall be made by the contractor as necessary to reduce the Average Profile Index to the minimum requirements given in Table 1. Corrections shall be made in accordance with Heading (e)(5).

On those areas where corrective action is taken, the pavement shall be reprofiled as many times as necessary by the contractor to verify that corrections have produced an Average Profile Index conforming to the minimum requirements given in Table 1 and that the surface deviations in excess of the requirement given in Heading (b), have been corrected.

(2) Associated Pavement: Acceleration lanes, deceleration lanes, continuous turn lanes and ramps constructed under these specifications shall be tested after completion with the profilograph. High points (bumps) having deviations in excess of the requirements given in Heading (b), shall be isolated and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (e)(5). Verification of the required correction by reprofiling shall be conducted by the contractor.

(3) Shoulders, Turnouts and Crossovers: The surface of shoulders, turnouts and crossovers shall be tested after completion with

an approved 10-foot metal static straightedge. Surface deviations in excess of 1/2-inch in 10 feet will be isolated and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (e)(5).

(4) Tie-in Areas: The surface of the 25-foot areas of pavement in tie-in areas which are not tested with the profilograph shall be tested after completion in each wheel path for its entire length with the straightedge. The joint between the new and existing pavement or approach slab will also be tested with the straightedge placed longitudinally across the joint in each wheel path. Surface deviations in excess of 1/4-inch in 10 feet shall be isolated and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (e)(5).

(5) Corrections: Corrections shall be made using an approved profiling device or by removing and replacing the pavement as directed. The use of bush hammers or other impact devices will not be permitted. In cases where corrections are made using an approved profiling device the contractor shall reestablish transverse grooving by sawing to provide a uniform texture conforming to Subsection 601.08(h). Corrective work will be at no direct pay and shall be completed prior to determination of pavement or shoulder thickness.

(f) Acceptance Surface Testing:

(1) Travel Lanes: After corrective work and verification within a lot has been completed by the contractor in conformance with these specifications, the Department will test each pavement lot for surface tolerance acceptance. To determine surface tolerance payment adjustments, the Profile Index will be determined in each wheel path of each travel lane, the Average Profile Index will be calculated and any high points (bumps) in excess of specification limits will be identified. When high points (bumps) are found in excess of the requirements given in Heading (b), the contractor shall make corrections in accordance with Heading (e)(5). The entire lot, except for the exceptions at approach slabs and adjacent to existing pavement tie-ins, will be tested and evaluated.

(2) Associated Pavement: After corrective work and verification within a lot has been completed by the contractor in conformance with these specifications, the Department will test the approximate centerline of associated pavement lots for surface tolerance acceptance. Ramps which have a centerline joint will be treated as having 2 lanes. The Department will determine that there are no high points (bumps) in excess of the requirements given in Heading (b). When high points (bumps) are found in excess of these limits, the contractor shall make corrections in accordance with Heading (e)(5). All associated pavement shall be tested except for the exceptions at approach slabs and adjacent to existing pavement tie-ins.

(3) Shoulders, Turnouts and Crossovers: After corrective work has been completed, the surface of shoulders, turnouts and crossovers will be tested longitudinally by the engineer at one randomly selected location in each 300 linear feet using the straightedge. Areas with surface deviations of 1/2 inch in 10 feet will be isolated by the engineer and shall be corrected by the contractor at no direct pay to within 1/2 inch deviation in accordance with Heading (e)(5).

(4) Tie-in Areas: After corrective work has been completed, the surface of the 25-foot area of new pavement adjacent to tie-ins with

existing pavements or approach slabs which is not tested with the profilograph will be tested in each wheel path for its entire length with an approved 10-foot metal static straightedge. The joint between the new and existing pavement or approach slab will also be tested with the straightedge placed longitudinally across the joint in each wheel path. Surface deviations in excess of 1/4-inch in 10 feet will be isolated by the engineer and shall be corrected by the contractor in accordance with Heading (e)(5).

(5) If the Department determines the Average Profile Index for pavement travel lanes does not conform to the specification requirements for 100 percent payment, given in Table 1, the contractor will be allowed to make corrections in accordance with Heading (e)(5) and the Department will reprofile for acceptance one additional time.

601.12 REMOVING FORMS. Forms shall not be removed from freshly placed concrete until it has set (generally after 10 hours). Forms shall be removed carefully to avoid damage to pavement. After forms are removed, sides of the slab shall be cured in accordance with Subsection 601.10. Minor honeycombed areas shall be filled with mortar composed of one part cement and two parts fine aggregate. Major honeycombed areas shall be removed and replaced. Any area or section so removed shall not be less than 10 feet in length nor less than the full width of the lane involved. When it is necessary to replace a section of pavement, any remaining portion of the slab adjacent to joints that is less than 10 feet long shall also be replaced.

601.13 SEALING JOINTS.

(a) General Requirements: Each joint will be subject to approval for proper width, depth, alignment and preparation before sealing. Sealing of joints will be required when concrete is to be overlaid with asphaltic concrete.

Pavement may be opened to traffic prior to sealing provided the joint forming device or insert has not been removed or sawed. When the insert is removed or sawed, pavement may be opened to traffic provided joints are protected during the interval between sawing and sealing. Protection of joints shall be accomplished by placement of a backer material immediately after sawing or removal of insert. When poured or extruded sealants are used, the concrete shall be 7 days old prior to sealing joints.

Joints shall be thoroughly cleaned immediately prior to sealing. Poured or extruded sealants require joint faces to be sandblasted immediately prior to sealing. Sandblasting is not required for preformed elastomeric compression seal except when the joint insert is sawed.

Sealant shall be placed as soon as possible after curing of concrete. Traffic will not be permitted while sealing and until after sealant is cured. When a poured or extruded sealant in accordance with Subsection 1005.02 is used, the pavement shall be closed to traffic for at least 1 day after sealing. When elastomeric compression seal is used, the pavement may be opened to traffic immediately following completion of sealing.

Joints shall be free of spalls, fractures, breaks or voids. Areas requiring repairs shall be chipped back to sound concrete and repaired with an approved nonshrinking patching system in accordance with the manufacturer's recommendations.

Joint sealants shall be installed in accordance with the manufacturer's recommendations. Sealants shall conform to the following:

(1) Longitudinal joints (Type LJ) shall be sealed as specified in Subsection 601.09(a).

(2) Transverse expansion joints (Type EJ) shall be sealed as specified in Subsection 601.09(b).

(3) Transverse contraction (Type TCJ) and construction joints (Type CJ) shall be sealed with either silicone polymers conforming to Subsection 1005.02(c), preformed elastomeric joint sealer conforming to Subsection 1005.03(a), or combination joint former/sealers conforming to Subsection 1005.04.

(4) Longitudinal and transverse joints to be overlaid with asphaltic concrete with any sealant conforming to Subsection 1005.02.

(5) Type EJ Modified Joints sealed with a preformed polyurethane foam sealant conforming to Subsection 1005.07.

(6) Transverse Butt Joints (Type BJ) shall be sealed with either silicone polymer conforming to Subsection 1005.02(c) or preformed elastomeric joint seal conforming to Subsection 1005.03(a).

Transverse shoulder and roadway joints shall be sealed with the same sealant.

(b) Poured Sealants and Preformed Joint Sealers: The following additional requirements apply to the installation of poured sealants and preformed joint sealants conforming to Subsections 1005.02, 1005.03 and 1005.07.

(1) Hot Poured Rubberized Asphaltic Sealants:

a. Joint Preparation: Joints shall be formed or sawed in accordance with Subsection 601.09. Removal of joint-forming devices or sawing operations shall not commence until immediately before cleaning and application of sealant material. Joints shall be thoroughly cleaned by sandblasting to effectively remove concrete curing membrane, laitance and other foreign matter from the joint. Sandblasting operations shall continue until the joint exhibits a uniformly etched surface. Upon completion of sandblasting, the joint and adjacent areas shall be dry and cleaned of dust and sand.

b. Application: Poured sealants and backer material conforming to Subsections 1005.02(a) shall be installed in accordance with the following requirements.

The sealant shall not be installed until the joint has been approved. A backer material conforming to Subsection 1005.02 shall be placed as shown on the plans. The joint shall be sealed without formation of entrapped air or voids. Air temperature at the time of installation shall be at least 50°F.

A mobile, heated, double-walled agitator-type kettle with suitable oil medium in the outer space for heat transfer capable of maintaining a sealant temperature of 380°F to 410°F will be required. Kettles shall have easy access to facilitate cleaning. They shall be thoroughly cleaned of foreign substances or previously used compounds and shall be flushed daily with flushing oil. This equipment shall be provided with an automatic continuous temperature recording chart for constant kettle temperature surveillance. A direct connecting pressure-type extruding device with nozzles shaped for insertion into the joint shall be provided. Application equipment shall be so designed that sealant material may be recirculated in the inner kettle when not in use and shall be

capable of filling the joint with sealant material free of voids or entrapped air. The applicator shall be subject to approval.

(2) Polyurethane Sealant: Polyurethane sealant shall conform to Subsection 1005.02(b). The material's shelf life shall not be exceeded. The ambient air temperature at the time of application shall be at least 50°F.

(3) Preformed Elastomeric Compression Seals: Preformed elastomeric compression seals shall conform to Subsection 1005.03. When the adhesive-lubricant material is to be pumped, a maximum of 30 percent dilution with a material recommended by the manufacturer will be allowed. The adhesive-lubricant shall be applied just prior to installation of the seal and shall be sufficient to completely cover the seal's sidewalls.

Seals shall be installed by machine on projects requiring 3,000 feet or more of joint sealing. Stretching of the compression seal shall not exceed 5 percent. Prior to beginning installation, a length of seal equal to the pavement width shall be cut and installed so that stretching may be measured. Random checks for stretching shall be made as deemed necessary by the engineer. If the adhesive-lubricant has chemically set and maximum stretch limits are exceeded, the seal shall be removed and cleaned, the joint recleaned and the seal reinstalled. Field splicing will not be allowed.

(4) Silicone Sealant: The silicone sealant shall conform to Subsection 1005.02(c). The sandblasted joint faces shall be dry and dust free prior to sealant installation. The air temperature at the time of placement shall be at least 50°F. Backer material conforming to Subsection 1005.02 shall be placed as shown in the plans.

The material shall be forced against the joint walls by approved methods that will ensure proper adhesion.

(5) Preformed Polyurethane Foam: Preformed polyurethane foam shall conform to Subsection 1005.07. Preformed polyurethane foam shall be installed using an approved, moisture insensitive lubricant-adhesive according to manufacturers' instructions.

601.14 PROTECTION OF PAVEMENT. The contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the contractor's employees and agents. This shall include watchmen to direct traffic, and erection and maintenance of warning signs, lights, pavement bridges or crossovers, etc., as necessary.

Any damage to pavement occurring prior to final acceptance shall be repaired or the pavement replaced at no direct pay.

601.15 SPLIT SLAB CONSTRUCTION. Split slab construction methods will only be permitted with the written approval of the DOTD Construction Engineer Administrator when required for traffic maintenance, for short pavement sections (generally, less than 400 linear feet), or for turnouts, crossovers and other irregular sections.

There will be no additional payment for split slab construction. Longitudinal joints in pavement constructed by the split slab method shall conform to Subsection 601.09(a). Pavement constructed by this method shall in all other respects conform to these specifications. Split slabs placed with slip-form pavers shall conform to Subsection 601.16.

The use of split slab construction methods will not preclude the use of approved paving equipment as specified elsewhere herein.

601.16 SLIP FORM PAVING METHOD. The slip-form paving method may be used at the option of the contractor.

(a) Grade and Alignment: After the grade or base has been placed and compacted to required density, areas which will support the paving machine shall be cut to required elevation by means of a properly designed machine. The requirements of Subsection 601.04 shall apply for preparing and maintaining the grade during paving operations. The slip-form paver shall have the capability of maintaining correct alignment and grade. Edge lines shall not deviate from true alignment by more than 1/2 inch at any point.

(b) Placing Concrete: Concrete shall be placed with an approved slipform paver designed to spread, consolidate, screed and float-finish freshly placed concrete in one pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense, homogeneous pavement in conformance with plans and specifications. The machine shall be equipped with vibrators conforming to Subsection 601.03(a). Concrete shall be vibrated for the full pavement width and depth. Sliding forms shall be rigidly held together laterally to prevent spreading of forms. Jointed concrete paving shall use trailing forms except in confined areas where deemed impractical by the engineer. Forms shall trail behind the paver for such distance that slumping of concrete will not exceed the tolerances given in Heading (c). Vibration of concrete and vibratory placement of load transfer devices shall occur within trailing forms.

Concrete shall be of a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible. Mixing, delivering and placing concrete shall be coordinated to provide uniform progress. Concrete plants shall have sufficient mixing capacity to provide such continuous delivery of concrete to enable the paver to advance at a minimum rate of 1.5 feet per minute. If it is necessary to stop forward movement of the paver, the vibrator 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.

(c) Finishing: Pavement finishing and texturing shall conform to Subsection 601.08. Surface tolerances shall be as specified in Subsection 601.11 with the following modifications. In addition to longitudinal testing, edges of slabs placed without conventional forms shall conform to the following tolerances when tested transversely with an approved 10-foot metal static straightedge.

(1) Edges not along Longitudinal Joints: The surface within the 6-inch width adjacent to the edge shall not vary more than 1/4 inch.

(2) Edges at Longitudinal Joints: Conventional forms will not be required at slab edges along longitudinal joints, provided the surface within the 6-inch width adjacent to the edge does not vary more than 1/8-inch. If the 1/8-inch tolerance is not being met, the slab edges shall be formed by use of approved conventional metal forms. Top of forms shall be set to required grade. Forms shall be adequately supported to maintain required line and grade during concrete placement and finishing operations.

(d) Curing: Curing shall be done in accordance with Subsection 601.10.

(e) Joints: Joints shall be constructed and sealed in accordance with Subsections 601.09 and 601.13.

(f) Rain Protection: The contractor shall have adequate materials available for protection of edges and surface of unhardened concrete from damage due to rain prior to each days paving. Such protective materials for pavement edges shall consist of standard metal forms or wood planks having a nominal thickness of 2 inches and a nominal width of not less than the pavement thickness. Protective materials for pavement surfaces shall conform to Subsection 601.10(b). When rain appears imminent, paving operations shall stop and all available personnel shall begin placing forms against pavement edges and covering the surface of the unhardened concrete with polyethylene sheeting.

(g) Cold Weather Protection: Cold weather protection shall conform to Subsection 601.10(c).

601.17 OPENING TO TRAFFIC. The pavement shall not be opened to traffic until standard test specimens conforming to Subsection 601.07 have attained a compressive strength of 3,000 psi when tested in accordance with DOTD TR 230. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after concrete has been placed. The pavement shall be cleaned and joints sealed in accordance with Subsection 601.13 prior to opening to traffic.

601.18 ACCEPTANCE REQUIREMENTS.

(a) General: Sampling and testing for acceptance will be conducted on each lot of pavement for thickness, compressive strength and surface tolerance. Any pavement that is obviously deficient shall be satisfactorily corrected or removed and replaced.

A lot of portland cement concrete pavement or shoulders is an identifiable area of approximately 4,000 square yards paid under the same item. The final area of pavement placed will be considered as a lot if it is at least 2,000 square yards; otherwise, it will be included in the previous lot.

(b) Thickness and Compressive Strength: Strength and thickness of pavements will be determined from hardened concrete cores in accordance with DOTD TR 225. Each lot will be divided into five equal segments and one core will be obtained from each segment after the pavement has met surface tolerance requirements.

All core holes in the pavement from acceptance coring shall be patched by the contractor using an approved pavement or structural concrete mixture meeting the requirements of Section 901. The surface of the patch shall be finished to match the surrounding pavement.

(1) Thickness: The average thickness of the pavement lot shall not be less than the specified thickness by more than 0.10 inch. Underthickness deficiencies in excess of 0.10 inch will be subject to the payment adjustments shown in Table 1. Overthickness will be waived at no direct pay.

In calculating average pavement thickness, individual measurements in excess of specified thickness by more than 0.25 inch will be considered as specified thickness plus 0.25 inch.

Individual areas found deficient in thickness by more than 1.00 inch will be evaluated by the engineer, and if in the engineer's judgment the deficient areas warrant removal, they shall be removed and replaced with concrete of specified thickness. If the deficient area is allowed to

remain in place, payment will be made at 50 percent of the contract unit price for that fraction of the lot with greater than 1.00 inch underthickness. Payment for the remainder of the lot will be made in accordance with Table 1 based on the average thickness of the entire lot.

(2) Compressive Strength: Average compressive strength for the lot shall not be less than 4,000 psi (3,600 psi when air entrainment is used).

When the average strength for the lot is less than 4,000 psi (3,600 psi when air entrainment is used), the contract unit price will be adjusted in accordance with Table 1. When an individual core indicates compressive strength less than 3,000 psi, and if in the judgment of the engineer the concrete may be left in place, payment for the quantity of concrete represented by the deficient core will be made at 50 percent of the contract unit price. If removal is warranted, the entire deficient section shall be replaced with concrete of the specified quality.

The compressive strength of cores will be determined after a minimum of 28 days.

(3) Projects with less than 2,000 square yards: Projects with less than 2,000 square yards of pavement may be cored as required in Headings (1) and (2) above, or may be accepted on the basis of compressive strength cylinders and thickness measurements taken by the engineer.

(c) Surface Tolerance: The surface of each pavement lot will be tested longitudinally with an approved profilograph as described in Subsection 601.11. If sections of pavement do not meet the requirements for surface tolerance, an adjustment in unit price for the lot will be made in accordance with Table 1. There is no payment adjustment for associated pavements, tie-in areas, shoulders, and turnouts and crossovers.

601.19 QUALITY CONTROL: The contractor shall be responsible for the production, transporting, placement, joint construction, surface finishing, maintenance and curing of all concrete pavement and shoulders constructed in accordance with these specifications. The contractor shall control the work to produce concrete pavement and shoulders which are uniform and conform to the plan dimensions and test requirements. The contractor shall perform whatever tests necessary to ensure the concrete pavement and shoulders conform to these specifications. Construction methods shall be such that random cracking does not occur.

601.20 MEASUREMENT. The quantities of portland cement concrete pavement for payment will be the design quantities specified in the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary. Design areas of pavement are based on the horizontal dimensions shown on the plans, the length being along the centerline of the pavement.

601.21 PAYMENT. Payment for portland cement concrete pavement will be on a lot basis at the contract unit price per square yard, which includes furnishing and placing all materials including tie bars, dowel bars and joint material. If the pavement does not conform to acceptance requirements, payment will be made at an adjusted unit price in accordance with Table 1. When payment adjustments are made for more than one deficiency, they shall be cumulative.

Payment will be made under:

Item No.	Pay Item	Pay Unit
601(01)	Portland Cement Concrete Pavement (_____" Thick)	Square Yard
601(02)	Portland Cement Concrete Pavement (_____" Thick) (Crossovers and Turnouts)	Square Yard
601(03)	Portland Cement Concrete Shoulder (_____" Thick)	Square Yard

TABLE 1
PAYMENT ADJUSTMENT SCHEDULE

	Payment (Percent of Contract Unit Price/Lot)[1]					
	100	98	95	80	50 or remove and replace[2]	Correct or remove and replace[2]
Deficiency in Average Thickness of 5 cores per lot, inches	0 to 0.10	- - - -	0.11 to 0.25	0.26 to 0.50	Over 0.50	- - - -
Average Compressive Strength, psi Without Air Entrainment With Air Entrainment	 4000 & over 3600 & over	 - - - - - - - -	 3500 to 3999 3150 to 3599	 3000 to 3499 3000 to 3149	 Below 3000 Below 3000	 - - - - - - - -
Category I Average Profile Index (inches/mile/lot) for pavement travel lanes with design speed greater than 45 mph[3]	6.0 or less	6.1 to 7.0	7.1 to 8.0	- - - -	- - - -	over 8.0
Category II Average Profile Index (inches/mile/lot) Urban Areas using continuous paving operations with design speeds 45 mph or less[3]	12.0 or less	12.1 to 13.0	13.1 to 14.0	- - - -	- - - -	over 14.0
Category III Average Profile Index (inches/mile/lot Urban areas not using continuous paving operations with design speeds 45 mph or less[3]	20.0 or less	20.1 to 22.0	22.1 to 24.0	24.1 to 26.0	- - - -	over 26.0

[1]Payment adjustments shall be cumulative.
[2]At the option of the Department after investigation.
[3]As defined in Subsection 601.11 using an approved profilograph.

PART VII — INCIDENTAL CONSTRUCTION

Section 701
Culverts and Storm Drains

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

701.02 MATERIALS. Materials shall conform to the following:

Usable Soil	203.06(a)
Select Soil	203.06(b)
Plastic Soil Blanket	203.10
Mortar	702.02
Portland Cement Concrete	901
Granular Material	1003.07
Bedding Material	1003.08
Concrete Sewer Pipe	1006.02
Reinforced Concrete Pipe	1006.03
Reinforced Concrete Pipe Arch	1006.04
Gasket Materials	1006.06
Plastic Culvert Pipe	1006.07
Sewer Pipe	1006.07
Split Plastic Coupling Bands	1006.07(b)(6)
Plastic Yard Drain Pipe	1006.09
Bituminous Coated Corrugated Steel Pipe and Pipe Arch	1007.02
Fiber Bonded Bituminous Coated Corrugated Steel Pipe and Pipe Arch	1007.03
Structural Plate for Pipe and Pipe Arch	1007.05
Corrugated Aluminum Pipe and Pipe Arch	1007.06
Polymer Coated Corrugated Steel or Aluminum Pipe and Pipe Arch	1007.08
Coupling Bands	1007.10
Geotextile Fabric	1019

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

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

(c) Cross Drain Pipe or Cross Drain Pipe Arch: When the Item for Cross Drain Pipe or Cross Drain Pipe Arch is included in the contract,

the contractor has the option of furnishing conduit of reinforced concrete pipe, corrugated metal pipe or plastic culvert pipe, unless otherwise specified.

(d) Storm Drain Pipe and Storm Drain Pipe Arch: When the Item for Storm Drain Pipe or Storm Drain Pipe Arch is included in the contract, the contractor has the option of furnishing conduit of reinforced concrete pipe or plastic culvert pipe, unless otherwise specified.

(e) Material Type Abbreviations:

(1) Reinforced Concrete Pipe:

RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch

(2) Corrugated Metal Pipe:

CAP	Corrugated Aluminum Pipe
CAPA	Corrugated Aluminum Pipe Arch
PCCAP	Polymer Coated Corrugated Aluminum Pipe
PCCAPA	Polymer Coated Corrugated Aluminum Pipe Arch
BCCSP	Bituminous Coated Corrugated Steel Pipe
BCCSPA	Bituminous Coated Corrugated Steel Pipe Arch
PCCSP	Polymer Coated Corrugated Steel Pipe
PCCSPA	Polymer Coated Corrugated Steel Pipe Arch
FBBCCSP	Fiber Bonded Bituminous Coated Corrugated Steel Pipe
FBBCCSPA	Fiber Bonded Bituminous Coated Corrugated Steel Pipe Arch

(3) Plastic Culvert Pipe:

PCP	Plastic Culvert Pipe
PVC	Polyvinyl Chloride Plastic Pipe
RPVCCP	Ribbed Polyvinyl Chloride Culvert Pipe
PVCCP	Polyvinyl Chloride Culvert Pipe (Smooth Wall)
PE	Polyethylene Plastic Pipe
CPECP	Corrugated Polyethylene Culvert Pipe (Double Wall)
RPECP	Ribbed Polyethylene Culvert Pipe
PECP	Polyethylene Culvert Pipe (Smooth Wall)
PERCP	Polyethylene Ribbed Culvert Pipe
PVCRCP	Polyvinyl Chloride Ribbed Culvert Pipe

(f) Joint Type Abbreviations

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

(g) Yard Drain Pipe: When the Item for Yard Drain Pipe is included in the contract, the contractor has the option of furnishing concrete sewer pipe, plastic yard drain pipe or plastic culvert pipe unless otherwise specified.

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

701.04 FORMING CONDUIT BED. When excavation is necessary below specified grade, the excavated area shall be replaced with material conforming to Subsection 203.06. This replacement material shall be compacted to at

least the density of the surrounding soil. The depth of the excavated area shall be at least 1/2-inch per foot of fill height over the top of the conduit. The minimum depth of the excavation shall be 8 inches.

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

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

When a suitable foundation cannot be obtained, unstable soil below established grade shall be removed and replaced with material conforming to Subsection 203.06 in accordance with Section 726.

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

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

701.06 JOINING CONDUIT.

(a) Joint Usage:

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

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

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

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

An approved mechanical pipe puller shall be used for joining conduits over 36 inches in diameter. For pipe less than 36 inches in diameter, any approved method for joining conduit may be used which does not damage the pipe.

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

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

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

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

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

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

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

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

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

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

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

An approved mechanical pipe puller shall be used for joining conduits over 36 inches in diameter. For pipe less than 36 inches in diameter, any approved method for joining conduit may be used which does not damage the pipe.

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

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

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

(e) Approved connections shall be used when joining new to existing conduits, and at no direct pay.

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

701.08 BACKFILLING.

(a) General: Conduits found to be damaged or out of alignment or grade shall be removed and reinstalled, or replaced, at no direct pay.

(b) Side Drain Conduits: Backfill for side drain conduits for drives, field roads and similar installations shall conform to the following.

(1) Nonpaved Areas: Conduit backfill material, except for plastic culvert pipe, shall be usable soil placed by approved methods and satisfactorily compacted. Plastic culvert pipe shall be backfilled with granular material.

(2) Paved Areas: Conduit backfill material, placement and compaction shall be as specified in Heading (c).

(c) Conduits other than Side Drains: Backfill material for conduits, except for plastic culvert pipe, other than side drains for drives, field roads and similar installations shall be selected soil or granular materials. Plastic culvert pipe shall be backfilled with granular material at no direct pay.

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

If the top of conduit is even with or below the top of the trench, backfill material shall be brought up evenly on both sides of conduit for its full length to an elevation of 1 foot above the top of conduit (or to subgrade if less than 1 foot) or to natural ground elevation, whichever is greater.

When the top of the conduit is above the top of the trench, backfill material shall be brought up evenly on both sides of conduit for its full length to 1 foot above the top of conduit (or to subgrade if less than 1 foot). Material in the trench and above the top of the trench for a distance on each side of the conduit equal to the horizontal outside diameter and to 1 foot above the top of conduit (or to subgrade if less than 1 foot) shall be backfill material.

The embankment shall be constructed to a minimum of 2 feet over the conduit before heavy construction equipment is allowed to cross the installation. Where practical, installations with less than 2 feet of cover over the top of the conduit shall be constructed after heavy hauling is completed over the conduit location. After completion of hauling operations, the contractor shall remove excess cover material. Conduit damaged by hauling and backfilling operations shall be removed and reinstalled, or replaced, at no direct pay.

(1) Backfill Methods:

a. General: Compaction by flooding will not be allowed. When plastic culvert pipe is used, the backfill shall be granular materials.

b. Selected Soils: Backfill shall be placed at or near optimum moisture content determined in accordance with DOTD TR 418 in layers not exceeding 6 inches compacted thickness. Backfill material shall be thoroughly compacted under the haunches. Each layer shall be compacted by approved methods to at least 95 percent of maximum density prior to placement of a subsequent layer.

c. Granular Material: Backfill shall be placed at or near optimum moisture content determined in accordance with DOTD TR 418. Backfill material shall be thoroughly compacted under haunches and then

compacted in layers not exceeding 12 inches compacted thickness. Each layer shall be compacted by approved methods to at least 95 percent of maximum density prior to placement of a subsequent layer. Exposed slopes at the conduit ends shall be covered by at least 12 inches compacted thickness of plastic soil blanket.

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

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

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

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

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

Unless otherwise permitted, overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled, but shall be removed and replaced with new pipe. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be removed and replaced with new pipe.

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

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

Mandrel testing shall be conducted by the contractor in the presence of the engineer.

Mandrel testing shall be at no direct pay.

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

(c) Cleaning Conduit: Prior to final acceptance, conduits installed by the contractor shall be cleaned of all debris and soil to

the invert of the conduit. Existing conduits which are extended shall be cleaned of debris and soil to the flow line elevation of the outfall ditch at no direct pay.

701.10 STUBBING AND PLUGGING CONDUITS. When it is required that conduits be plugged, such plugs shall be constructed of Class R concrete conforming to Section 901. Thickness of plug and method of construction shall be as directed.

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

701.11 MEASUREMENT. The length of conduit, both new and relaid, will be measured in linear feet by the following methods:

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

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

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

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

(e) Excavation required for installation of conduits will not be measured for payment, except as otherwise specified in Subsection 203.15.

(f) Furnishing and placing backfill material for conduits will not be measured for payment. Backfill material needed to complete backfill above natural ground and around conduits that extend above natural ground will be measured and payment will be made under applicable earthwork items.

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

701.12 PAYMENT. Payment for conduit will be made at the contract unit price per linear foot of the types and sizes specified.

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

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

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

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

Payment will be made under:

Item No.	Pay Item	Pay Unit
701(01)	Cross Drain Pipe (Size & Type)	Linear Foot
701(02)	Cross Drain Pipe Arch (Size & Type)	Linear Foot
701(03)	Storm Drain Pipe (Size & Type)	Linear Foot
701(04)	Storm Drain Pipe Arch (Size & Type)	Linear Foot
701(05)	Side Drain Pipe (Size)	Linear Foot
701(06)	Side Drain Pipe Arch (Size)	Linear Foot
701(07)	Yard Drain Pipe (Size)	Linear Foot
701(08)	Relaying Conduit	Linear Foot
701(09)	Fabricating Conduit Fittings	Each

Section 702
Manholes, Junction Boxes and Catch Basins

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

702.02 MATERIALS. Materials shall conform to the following Sections or Subsections:

Cast-in-Place Concrete (Class M)	901
Portland Cement	1001.01
Mortar Sand	1003.02(b)
Sewer Brick	1004.01
Asphaltic Varnish	1008.03
Metal Work Paint	1008.05
Reinforcing Steel	1009.01
Precast Reinforced Concrete Drainage Units	1016
Manhole Frames, Grates and Covers	1018.04
Geotextile Fabric	1019

The contractor may furnish structures of either cast-in-place concrete or precast concrete units. For precast structures which are not covered by the plans, design and installation procedures will be submitted for approval.

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

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

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

702.04 CONSTRUCTION REQUIREMENTS: Concrete construction shall conform to Section 805. Joints shall be full mortar joints not more than 1/2 inch wide. When specified, outside faces of structures shall be plastered with 1/2 inch thick cement-sand mortar. Exposed surfaces of concrete and masonry shall be cured in accordance with Subsection 805.10 for at least 48 hours.

Precast concrete units shall be cast with the specified number and size of pipe openings to incorporate the unit into the drainage system; however, if additional pipe is required during construction for which no openings have been provided, the contractor may make such openings provided any damaged units are replaced or satisfactorily repaired. Precast

units shall be set to established grade within ±1/2 inch. Joints for sectional precast units shall be sealed with flexible plastic gasket material conforming to Subsection 1006.06(b) installed as to form a watertight seal. The joints of precast units shall be wrapped with geotextile fabric a minimum of 18 inches on each side of the joint. Ends of the fabric shall be lapped at least 10 inches. The edges and ends of the cloth shall be suitably secured.

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

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

New structures shall be cleaned of silt, debris or other foreign matter, and nongalvanized metal parts of new or adjusted structures shall be coated with asphaltic varnish or metalwork paint.

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

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

702.05 MEASUREMENT. New and adjusted junction boxes, manholes and catch basins will be measured by the unit.

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

702.06 PAYMENT. Payment for new and adjusted junction boxes, manholes and catch basins will be made at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
702(01)	Junction Boxes	Each
702(02)	Manholes	Each
702(03)	Catch Basins	Each
702(04)	Adjusting _____	Each

Section 703
Underdrain Systems

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

703.02 MATERIALS. Materials shall conform to the following Sections and Subsections:

Asphaltic Concrete (Type 9 Wearing Course)	501
Portland Cement Concrete (Class M)	901
Aggregate Backfill (Size 3)(Crushed or Uncrushed)	1003.05
Granular Material (Backfill)	1003.07
Perforated and Nonperforated Underdrain Plastic Pipe	1006.08
Perforated Bituminous Coated Corrugated Steel Pipe	1007.04
Perforated Corrugated Aluminum Pipe	1007.07
Reinforcing Steel	1009.01
Precast Concrete Headwalls	1016.04
Hardware Cloth Rodent Screen	1018.22
Geotextile Fabric	1019.01
Geocomposite Drainage Systems	1019.02
Geocomposite Wall Drains	1019.02

When an item for "Shoulder Underdrains" is included in the contract, plastic pipe or geocomposite edgedrains may be furnished unless otherwise specified.

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

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

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

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

703.03 CONSTRUCTION REQUIREMENTS.

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

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

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

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

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

(5) Replacement of Base Course and Surfacing: Asphaltic concrete shall be used for replacement of removed shoulder base course and surfacing as shown on the plans and shall be constructed in accordance with Section 724.

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

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

(2) Geocomposite Edgedrain Installation: The geocomposite edgedrain shall be placed in a trench immediately adjacent to the pavement or shoulder edge as shown on the plans. Products which have nodes shall be placed such that the nodes are in contact with the pavement side of the trench. Fittings and material necessary to make splices of the product and to make connections of the drainage product core to nonperforated pipe shall be from the same manufacturer as the geocomposite edgedrain. Fittings and material shall be designed and installed to prevent soil intrusion into the drainage product core or outlet piping. In cases where the product is terminated without an outlet, a fitting or other approved method shall be provided to prevent soil intrusion into the end of the drainage product.

(3) Backfill:

a. New installations shall be backfilled with granular material. Granular material shall be placed in lifts no greater than 6 inches of uncompacted thickness. The trench shall be backfilled and compacted in a manner that will not displace or damage the geocomposite underdrain. The backfilled and compacted trench shall be left in a condition ready to receive surfacing.

b. When replacing an existing underdrain system the backfill material shall be either granular material or excavated trench material which meets the requirements for granular material. When additional material is required the contractor shall provide granular backfill material at no direct pay. Granular material shall be placed in lifts no greater than 6 inches uncompacted thickness. The trench shall be backfilled and compacted in a manner that will not displace or damage the geocomposite underdrain. The backfilled and compacted trench shall be left in a condition ready to receive surfacing.

(4) Replacement of Base Course and Surfacing: Asphaltic concrete shall be used for replacement of removed shoulder base course and surfacing as shown on the plans and shall be constructed in accordance with Section 724.

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

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

(2) Nonperforated Plastic Pipe Installation: Nonperforated plastic pipe shall be placed in the trench and connected to plastic pipe or geocomposite edgedrain in accordance with manufacturer's recommendations. The pipe shall conform to the requirements of Subsection 1006.08 (a), (c), (d), or (e).

(3) Backfill: After pipe installation, the trench shall be backfilled in a manner that will not displace or damage the pipe. Backfill material shall be excavated trench material meets the requirements

for granular material. When additional material is required, the contractor shall provide granular material at no direct pay. The backfill material shall be placed in lifts no greater than 6 inches of uncompacted material. Backfill material shall be uniformly compacted by approved methods to the satisfaction of the engineer. The backfilled and compacted trench shall be left in a condition ready to receive surfacing.

(4) Replacement of Base Course and Surfacing: Asphaltic concrete shall be used for replacement of removed shoulder base course and surfacing as shown on the plans and shall be constructed in accordance with Section 724.

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

(d) Perforated or Nonperforated Pipe Underdrain: Perforated or nonperforated pipe underdrain shall be used as shown on the plans to drain wet areas. Installation of the underdrains and backfill shall follow immediately behind trenching operations.

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

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

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

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

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

703.04 MEASUREMENT.

(a) Shoulder Underdrains:

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

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

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

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

703.05 PAYMENT. Payment for underdrains will be made at the contract unit prices under:

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

Section 704
Guard Rail

704.01 DESCRIPTION. This work consists of furnishing and constructing beam type highway guard rail in accordance with these specifications, and in reasonably close conformity with lines and grades shown on the plans or established.

704.02 MATERIALS. Materials shall conform to the following Section or Subsections.

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

Welding shall conform to Section 815.

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

704.04 RAIL ELEMENTS. Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts, except adjustment bolts, shall be drawn tight. Bolts shall be of sufficient length to extend beyond nuts. Holes for special details may be field drilled or punched when approved. Damaged galvanized surfaces and drilled holes shall be repaired in accordance with Subsection 811.15.

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

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

704.06 PAYMENT. Payment for guard rail, anchor sections and transitions will be made at the contract unit prices. Payment adjustments for portland cement concrete of Section 901 will not apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
704(01)	Guard Rail	Linear Foot
704(02)	Guard Rail (Double Faced)	Linear Foot
704(03)	Blocked Out Guard Rail	Linear Foot
704(04)	Blocked Out Guard Rail (Double Faced)	Linear Foot
704(05)	Guard Rail Anchor Sections (BCT)	Linear Foot
704(06)	Guard Rail Anchor Sections (Trailing End)	Linear Foot
704(07)	Guard Rail Bridge Attachments	Linear Foot
704(08)	Guard Rail Transitions	Linear Foot

Section 705
Fences

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

705.02 MATERIALS. Materials shall conform to the following Section or Subsections:

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

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

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

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

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

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

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

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

705.04 REBUILT FENCE. When specified, the contractor shall take down, move back and rebuild existing fence. Fence shall be rebuilt in the same

manner as specified for new fence. Rebuilt ornamental fence, picket fence or other special type fence shall be equal in all respects to existing fence.

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

705.06 CHAIN LINK FENCE AND GATES.

(a) Concrete Post Anchorage: Posts shall be anchored in Class R concrete footings. Portable mixing of concrete in accordance with Subsection 901.11(h) will be permitted for small quantities of concrete.

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

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

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

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

Fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. Degree of tensioning shall be commensurate with air temperatures at time of installation to prevent undue sagging or tensioning of fabric due to changing temperatures. Fabric shall be fastened to line posts at approximately equal spaces and to top rail (or top tension wire) and bottom tension wire with tie wires or bands as specified.

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

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

(d) Repair of Protective Coatings: After completion of fence and gate installation, any damaged protective coatings shall be satisfactorily repaired in accordance with Subsection 811.15.

705.07 MEASUREMENT.

(a) New Fence and Gates: New fence will be measured by the linear foot between outside of end posts for each continuous run of fence,

exclusive of gates. Gates for new fence will be measured per each for single swinging gates, and per double gate for double swinging gates.

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

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

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

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

Payment will be made under:

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

Section 706
Concrete Walks, Drives and Incidental Paving

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

706.02 MATERIALS. Materials shall conform to the following Section or Subsections.

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

706.03 CONSTRUCTION REQUIREMENTS.

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

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

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

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

(d) Placing and Finishing: Concrete shall be placed on the subgrade, struck off to required thickness and tamped sufficiently to bring the mortar to the surface. The surface shall be finished with a wood float or steel trowel followed by brushing to a slightly rough finish. Joints and edges shall be rounded with an edging tool having a 1/4-inch radius.

(e) Joints:

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

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

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

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

c. Incidental Paving: Weakened planes for incidental paving shall be formed at intervals not exceeding 20 feet in length or width. Incidental paving poured adjacent to jointed concrete shall be jointed to match existing joints, with intermediate joints formed as necessary not to exceed the 20-foot maximum joint spacing.

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

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

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

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

706.05 PAYMENT. Payment for concrete walks, drives and incidental paving will be made at the contract unit price per square yard, subject to the payment adjustment provisions of Section 901.

Payment will be made under:

Item No.	Pay Item	Pay Unit
706(01)	Concrete Walk (_____" Thick)	Square Yard
706(02)	Concrete Drive (_____" Thick)	Square Yard
706(03)	Incidental Concrete Paving (_____" Thick)	Square Yard

Section 707
Curbs and Gutters

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

707.02 MATERIALS. Materials shall conform to the following Sections or Subsections:

Usable Soil	203.06(a)
Asphaltic Concrete	501
Portland Cement Concrete (Class M)	901
Joint Fillers	1005.01
Joint Sealant	1005.02
Joint Seals	1005.03
Curing Materials	1011.01
Form Release Agent	1018.25

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

(b) Asphaltic Curbs: Mixtures for these curbs shall be asphaltic concrete Type 9 Wearing Course.

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

707.04 CONCRETE FORMS. Forms for combination curb and gutter shall conform to Subsections 601.03(c) and 601.05. Forms for other curbs or gutters shall be wood or metal, straight, and of sufficient strength to resist pressure of the concrete without deforming. Forms shall be cleaned and coated with form release agent before concrete is placed against them. Forms which have become excessively worn, bent or broken shall not be used. An approved mechanical curb forming machine conforming to Subsection 707.06(c) may be used without forms.

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

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

707.06 PLACING CONCRETE.

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

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

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

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

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

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

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

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

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

707.11 MEASUREMENT. Quantities of curbs and/or gutters for payment will be the design lengths as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if design errors are proven, or if design changes are made. Excavation, backfill, joint materials, asphaltic tack

coat and steel tie bars will not be measured for payment. When combination curb and gutter is specified, gutters required at catch basins will be included in design quantities for combination curb and gutter.

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

(a) Asphaltic Mixtures: Asphaltic curbs will be subject to the payment adjustment provisions of Section 501 for deviations in Marshall stability, aggregate gradation, anti-strip additive and asphalt cement specifications. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphalt cement.

(b) Portland Cement Concrete: Portland cement concrete curbs and/or gutters will be subject to the payment adjustment provisions of Section 901.

Payment will be made under:

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

Section 708
Right–of–Way Markers

708.01 DESCRIPTION. This work consists of furnishing and installing concrete right-of-way markers in conformity with the design, dimensions and locations shown on the plans.

708.02 MATERIALS. Materials shall conform to the following Section or Subsection:

Portland Cement Concrete (Class M)	901
Reinforcing Steel	1009.01

708.03 FABRICATION. Markers shall be precast reinforced concrete posts cast, finished and cured in the following manner:

(a) Casting: Concrete posts shall be cast in mortartight forms. Care shall be exercised to puddle and tamp concrete around reinforcing steel and avoid formation of aggregate pockets. Concrete shall be placed continuously in each post.

(b) Finishing: Forms shall be removed as soon as concrete has hardened sufficiently to prevent damage to marker. Markers shall be given a Class 1 Finish in accordance with Subsection 805.13 and shall present a neat and uniform appearance.

(c) Curing: As soon as finished, markers shall be cured in accordance with Subsection 805.10 except that curing shall be for at least 3 days.

708.04 INSTALLATION. Marker posts shall be installed on right-of-way lines at points designated on the plans or as directed. Posts shall be set to the depth indicated on the plans or as directed. Post holes shall be backfilled and compacted as directed.

708.05 MEASUREMENT. Right-of-way markers will be measured by the marker.

708.06 PAYMENT. Payment for right-of-way markers will be made at the contract unit price per each, which includes concrete, reinforcing steel, manufacturing and installation. Payment adjustments for portland cement concrete of Section 901 will not apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
708(01)	Right-of-Way Marker	Each

Section 709
Steel Cattle Guards

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

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

709.02 MATERIALS.

Concrete (Class M)	901
Steel Pipe (Wingwalls)	1007.13
Reinforcing Steel	1009.01
Bolts, Nuts and Washers	1010.10
Treated Timber	1014

Steel shall be at least the minimum size specified and fabricated in accordance with Section 815. Pipe wings shall be 2-inch diameter standard strength steel pipe. Steel shall be painted in accordance with Section 811. Galvanized pipe will not require painting.

709.03 CONSTRUCTION REQUIREMENTS. Excavation shall extend a minimum of 1 foot outside neat lines of concrete walls or footings. Backfill shall be deposited in layers not exceeding 6 inches compacted thickness and each layer shall be compacted to the density of adjacent soil with mechanical tampers. When the cattle guard is placed in the roadway, the compaction requirements shall conform to Subsection 203.07.

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

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

709.05 PAYMENT. Payment for steel cattle guards will be made at the contract unit price per each. The concrete shall be subject to the payment adjustment provisions of Section 901.

Payment will be made under:

Item No.	Pay Item	Pay Unit
709(01)	Steel Cattle Guard	Each

Section 710
Removing, Relocating and Demolishing Structures

710.01 DESCRIPTION. Removing and relocating structures consists of the removal, preparation for moving and relocation of buildings or other structures, hereinafter referred to as "structure," with existing service connections, appurtenances and accessories and reconstruction of foundations and appurtenances, all in accordance with the plans and these specifications.

Moving of structures consists of moving the structures specified under the item for Removing and Relocating Structures from the original to the final location. This item includes extension of existing water, gas, sewer and other service lines and utilities and necessary materials.

Demolishing structures consists of demolishing and disposing of all parts of the structure indicated on the plans, including foundations, basements, cisterns, underground tanks, walks, drives or other appurtenances.

710.02 GENERAL REQUIREMENTS. The Department reserves the right to eliminate the relocating or demolishing of any structures under these items. Such elimination shall not affect contract unit prices on remaining structures to be moved or unit prices on other items of the contract. The contractor will not be entitled to compensation due to such elimination.

Cavities left by structure removal shall be immediately filled to the level of the surrounding ground. Soil shall be compacted as directed to at least the density of the surrounding ground at no direct pay.

(a) Non-Friable Asbestos: When a structure contains non-friable asbestos, the contractor shall carefully remove the asbestos without excessive breakage or crushing before removal, relocation or demolition of the structure. The non-friable asbestos material shall be disposed of at an industrial land fill.

(b) Friable Asbestos: When a structure contains friable asbestos, the contractor shall immediately notify the Department of Environmental Quality (DEQ), Air Quality Division. The DEQ will send a confirmation letter with an Asbestos Disposal Verification Form (ADVF). The ADVF will expire 90 days from the date of issue. When this information is available, the Department will indicate on the plans the structures containing friable asbestos. Only contractors certified by DEQ as an Asbestos Abatement Entity shall remove friable asbestos from structures. The asbestos removal shall be performed before removal, relocation or demolition of the structure. Friable asbestos removal, handling and disposal shall be performed in accordance with the latest requirements for Asbestos Abatement of the DEQ, Air Quality Division.

The Department will receive chain of custody verification records for the friable asbestos from the disposal site. These records will become part of the permanent project records.

(c) Underground Fuel Tanks: Fuel tanks to be removed shall be registered with the DEQ as abandoned fuel tanks by the Department before removal. The contractor shall notify the engineer in writing at least 35 calendar days prior to removal of tanks. The engineer will immediately notify the Materials and Testing Section. When necessary, samples will be taken by the Department before tank removal.

The contractor shall take all necessary precautions to prevent the infiltration of water into tanks during the work.

The contractor shall comply with the requirements of Subsections 107.01 and 107.02.

After removal, tanks shall be disposed of in accordance with all local, state, and federal laws and regulations.

Removal and aeration of contaminated soil, and removal and disposal of contaminated water will be in accordance with the project specifications.

710.03 REMOVING AND RELOCATING STRUCTURES. Structures shall be prepared for moving, removed and placed in their new locations as shown on the plans or as designated, and restored to at least equal to original condition. Structures removed and relocated shall be placed on foundations of the same type and character as original foundations.

Steps, outside stairways, canopies, porches, block or post supports, sills, chimneys on brackets and other appurtenances forming an integral part of the structure are considered part of the structure and shall be removed and relocated. Cellars, cellar steps, concrete or masonry porches, concrete floors, concrete and masonry foundations and supports, septic tanks, wells, fireplaces and chimneys standing on the ground, and other appurtenances connected to the structure shall be removed and relocated or replaced with foundations or appurtenances of the same size, type and character as existed before the structure was moved.

Sanitary sewers, water, gas, electric, television cable and telephone service lines connected to structures being removed and relocated shall be disconnected without unnecessarily discommoding the occupants of structures being moved. The contractor shall be responsible for all notices to public utility companies and for all fees charged by them.

Privies, washhouses, garages, other outbuildings, cisterns and other appurtenances used in conjunction with a structure shall be removed and relocated. The contractor shall also remove and rebuild existing yard fences, drives and walks and extend same as necessary. Existing shrubbery shall be removed and replanted at new locations as designated. All of the above shall be considered as appurtenances to the structures to be removed and relocated.

All abandoned wells shall be plugged and sealed in accordance with the "Water Well Rules, Regulations, and Standards, State of Louisiana. Relocated wells shall conform to the Sanitary Code of the State of Louisiana as prepared and promulgated by the Louisiana State Board of Health.

Relocation of a structure, any part of which is used as a service station, shall include the removal and relocation of gasoline pumps, tanks, pipes, signs and other appurtenances. Tanks shall be placed the same depth below the ground as existed before moving. Existing underground fuel tanks shall not be reused or used for other purposes.

Material in existing foundations, concrete or masonry floors, chimneys and other appurtenances, when not used in reconstruction of

appurtenances, shall be removed and disposed of in accordance with Subsection 202.02.

New material required in performing any of the above operations shall be furnished by the contractor at no direct pay.

Contents of structures shall be removed and relocated with the structure to its new site. When not feasible to remove structures with contents therein, the contents shall be removed from the structure at its original location and replaced in the relocated structure without damage or loss to contents.

Cattle pens, cane derricks, cattle guards or other structures shall be relocated or reconstructed on or beyond right-of-way line as directed. Materials in structures suitable for reuse may be utilized in their reconstruction. New materials required shall be similar in kind to that in place and shall be furnished by the contractor at no direct pay.

Prior to removal of butane or propane gas tanks, the contractor shall obtain written approval of the Louisiana Liquefied Petroleum Gas Commission so that they may have a representative present at time of removal if they so desire. Existing underground butane or propane gas tanks shall not be reused or used for other purposes.

The contractor will be reimbursed for the cost of the new tank upon presentation of the original receipted bill.

The contractor shall furnish the engineer a Certificate of Release from each property owner, and in case of separate ownership of structure and property, a Certificate of Release from each owner shall be furnished. This certificate shall state that the relocated structures are in an acceptable condition and that said owner waives all claims for damages to the property and structures relocated. When the contractor is unable to secure a Certificate of Release from the property owner, the contractor shall submit an executed Form 671-A, Contractor's Affidavit, to the engineer.

710.04 MOVING OF STRUCTURES. The limits of moving a structure unit shall be the distance from the center of the principal structure in its original location, measured along the shortest practical route of moving, to the center of the principal structure in its new location. Appurtenances to the principal structure will not be considered in the measurement, but shall be moved with the principal structure as a unit and re-established at the new location.

710.05 DEMOLISHING STRUCTURES. Materials in the designated structure shall become the property of the contractor and shall be removed and disposed of in accordance with Subsection 202.02.

Steps, outside stairways, canopies, porches, block or post supports, sills, chimneys on brackets and other appurtenances forming an integral part of the structure are considered part of the structure and shall be demolished. Cellars, cellar steps, concrete or masonry porches, concrete floors, concrete and masonry foundations and supports, septic tanks, wells, fireplaces and chimneys standing on the ground, and other appurtenances connected to the structure shall be demolished.

Privies, washhouses, garages, other outbuildings, cisterns and other appurtenances used in conjunction with a structure shall be demolished. The contractor shall also remove existing yard fences, drives and walks. Existing shrubbery shall be removed. All of the above shall be considered as appurtenances to the structures to be demolished. All abandoned

wells shall be plugged and sealed in accordance with the "Water Well Rules, Regulations, and Standards, State of Louisiana.

Demolishing of a structure, any part of which is used as a service station, shall include the removal of gasoline pumps, tanks, pipes, signs and other appurtenances. Existing underground fuel tanks shall not be reused or used for other purposes.

Material in existing foundations, concrete or masonry floors, chimneys and other appurtenances, shall be removed and disposed of in accordance with Subsection 202.02.

Cattle pens, cane derricks, cattle guards or other structures shall be demolished as directed.

710.06 MEASUREMENT. Removing and relocating structures will be measured by the unit. Each principal structure with its appurtenances will be considered as a separate unit.

Moving of structures will be measured along the shortest practical route in accordance with Subsection 710.04 in units of principal structure, including appurtenances, moved 1 foot which shall be designated a "structure foot".

Demolishing structures will be measured by the unit and shall include appurtenances, foundations, etc.

710.07 PAYMENT. Payment for structures acceptably removed, moved, relocated or demolished will be made at the contract unit price.

When a structure has been identified on the plans as containing friable or non-friable asbestos, the price for asbestos removal and disposal shall be included in the bid price for removal, relocation or demolition of the structure. When a structure is found to contain friable or nonfriable asbestos and it has not been identified on the plans as containing asbestos, payment for the removal and disposal of the asbestos will be made in accordance with Subsection 109.04.

Payment for removal and aeration of contaminated soil and removal and disposal of contaminated water will be made in accordance with the project specifications.

Payment will be made under:

Item No.	Pay Item	Pay Unit
710(01)	Removing and Relocating Structures	Unit
710(02)	Moving Structures	Structure Foot
710(03)	Demolishing Structures	Unit

If a structure is included as a unit under Item 710(01) for removal and relocation and the contractor enters into an agreement with a property owner for demolishing or other disposition; or if it is subsequently determined that said structure can remain in place, in whole or in part, with or without minor adjustments, and the contractor enters into an agreement with the property owner incorporating such revised determination and any accompanying adjustments regarding said structure, including any damages for leaving the structure in place; the contractor shall furnish said agreement to the engineer for approval.

The contractor will be paid for demolishing or other handling of the structure at the contract amount for the unit as listed under Item 710(01).

If the determination to allow the structure to remain in place involves a decrease in cost to the contractor, including any allowance for damages to the property owner and other adjustment of the contract amount for removal of said unit under Item 710(01), an allowance will be made in such amount as the engineer deems equitable.

If approval is given by the engineer, the contractor shall furnish the Department with a Certificate of Release from the property owner for the unit. In case of separate ownership of structure and property, a certificate of Release from each owner shall be furnished. This certificate shall state that said owner waives all claims for damages to the property and structure that has been demolished or otherwise handled to the owner's satisfaction. No measurement or payment will be made under Item 710(02) for any such structure handled as provided herein.

Section 711
Riprap

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

711.02 MATERIALS. Riprap shall be from an approved source listed in QPL 2. Stone riprap shall not disintegrate upon exposure to the elements or be easily broken from handling, and shall be reasonably free from earth and other foreign materials. When tested in accordance with AASHTO T 85, the solid weight of stone shall be at least 150 pounds per cubic foot (based on bulk specific gravity). Samples of stone from a source not previously approved shall be taken under supervision of the engineer and submitted for approval prior to delivery to the project. The least dimension of any individual stone shall be at least 1/3 its maximum dimension. Each shipment of stone shall be reasonably well graded within the specified limits.

Recycled concrete may be used as riprap unless otherwise indicated in Heading (a), provided its solid weight is at least 150 pounds per cubic foot (based on bulk specific gravity) and it is free of protruding reinforcement.

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

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

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

(a) Riprap: Riprap shall be reasonably well graded and shall conform to the following:

Riprap Class[1]	Stone Size, lb	Spherical Diameter Ft[2]	Percent of Stone Smaller Than
2 lb	10	0.50	100
	4	0.37	40-100
	2	0.29	15-50
	0.75	0.21	0-15
10 lb	50	0.83	100
	20	0.63	50-100
	10	0.50	15-50
	5	0.40	0-15
30 lb	140	1.17	100
	60	0.90	42-100
	30	0.72	15-50
	10	0.50	0-15
55 lb[3]	275	1.50	100
	110	1.11	42-100
	55	0.88	15-50
	20	0.63	0-15
130 lb[3]	650	2.00	100
	260	1.46	45-100
	130	1.17	15-50
	40	0.79	0-15
250 lb[3]	1250	2.50	100
	500	1.83	45-100
	250	1.46	15-50
	80	1.00	0-15
440 lb[3]	2200	3.00	100
	900	2.23	40-100
	440	1.76	14-50
	130	1.17	0-15
1000 lb[3]	5000	4.00	100
	2000	2.91	45-100
	1000	2.31	10-50
	300	1.55	0-15

[1]The stone size used to define the Riprap Class is the minimum median stone size for the stone class.
[2]Spherical Diameter based on a solid weight of 155 lb/cu ft.
[3]Recycled portland cement concrete may not be used in these riprap classes.

(b) Geotextile Fabric shall conform to Section 1019.01.

711.03 CONSTRUCTION REQUIREMENTS.

(a) Riprap: Areas on which riprap is to be placed shall be graded to the required section. Riprap shall be placed on the prepared slope or area in a manner which will produce a reasonably well-graded mass of

stone with a minimum practicable percentage of voids. The entire mass of stone will be placed to be in conformance with the lines, grades, and thickness at one operation and to avoid displacing underlying material. Placing of riprap in layers, or dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

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

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

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

711.04 MEASUREMENT. Riprap may be measured on either a square yard, cubic yard, or weight basis as specified.

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

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

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

Geotextile fabric will be measured by the square yard of covered area in place.

No measurement will be made for excavation or backfilling.

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

Payment will be made under:

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

Section 712
Revetments

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

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

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

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

The same type revetment shall be used at each location.

Revetment, except for cast-in-place revetment, shall be placed on geotextile fabric.

712.02 MATERIALS.

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

(b) Geotextile Fabric: Geotextile fabric shall conform to Subsection 1019.01.

(c) Cellular Concrete Blocks: Cellular concrete blocks shall conform to Subsection 1004.04.

(d) Wet-batched Sacked Concrete: Sacks shall conform to Subsection 1018.21. Concrete shall be Class R concrete conforming to Section 901. Concrete shall be wet-batched prior to placement in sacks, and sacked concrete shall be immediately placed in the revetment after batching. Mixing water for concrete shall be added as required to produce a slump of 4 inches to 6 inches.

(e) Stone and Recycled Portland Cement Concrete: Stone and Recycled Portland Cement Concrete shall conform to Section 711 Riprap Class 30 lb.

(f) Dry-Batched Prepackaged Sacked Concrete: Prepackaged concrete shall be an approved product listed in QPL 48, shall consist of one part portland cement and a maximum of 5 parts sand by weight or other approved mix with the same cement content, and shall be dry mixed until uniform in color.

(1) Portland Cement: Portland Cement shall conform to Section 1001.01.

(2) Sand: Sand shall conform to the gradation requirements of Subsection 1003.02.

(3) Sacks: Sacks shall conform to Subsection 1018.21 and shall be capable of holding the concrete mixture without leakage during handling.

(4) Water: Water shall be from an approved source.

(5) Sampling: Samples shall be taken at the rate of one sack of prepackaged materials per 1000 sacks for acceptance. The contents of the package shall be mixed with water as required to produce a slump of 2 to 5 inches. Compressive strength specimens shall be made by the engineer in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230. The compressive strength shall conform to Heading (a) above.

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

(a) Geotextile Fabric Placement: Ends of geotextile fabric shall be buried for anchorage as shown on the plans. Adjacent strips of geotextile fabric shall be lapped at least 10 inches. The laps shall be pinned at maximum 5-foot intervals. Geotextile fabric shall not be damaged during revetment placement. Damaged fabric shall be repaired in accordance with Subsection 203.11(c) or replaced at no direct pay.

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

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

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

(c) Cellular Concrete Block Placement: Placing of blocks shall commence in a trench or against suitable anchorage at the downslope end of the revetment area and shall progress upslope. Each block shall be laid flat on the slope and bedded firmly against adjoining blocks. Cement grout shall be used to fill unaligned joints or breaks at slope changes as directed. Individual blocks shall not be grouted to each other.

In lieu of placing geotextile fabric and blocks separately, revetment may be constructed of mattresses consisting of concrete blocks preset on the geotextile fabric with an adhesive. Both blocks and geotextile fabric shall be approved products. If mattresses are used, the foregoing placement requirements may be modified as required to permit proper placement of mattress panels; however, the 10-inch fabric overlap between adjacent panels shall apply.

After completion of cellular block revetment, topsoil conforming to Section 715 shall be loosely spread over the revetment to partially fill cell openings at no direct pay. Topsoil shall be seeded and fertilized in accordance with Sections 717 and 718 during seeding operations.

(d) Wet-Batched Sacked Concrete Placement: Sacks shall be uniformly filled to approximately 3/4 cubic foot. The open end shall be folded under the bag during placement. Sacks of wet-batched concrete

shall be placed in one layer in contact with adjacent sacks and tamped into position by approved methods. Placement of sacked concrete shall begin at the revetment toe and progress upslope. Sacked concrete revetment for stream channels and other relatively level areas shall be placed as directed.

(e) Dry-Batched Prepackaged Concrete Placement: Sacks shall be uniformly filled to approximately 3/4 cubic foot and the ends shall be sealed by tying, stitching or other approved methods. The filled sacks shall be tightly packed against each other. Placement shall begin at the revetment toe and progress upslope with staggered joints. At the end of each day's operations and upon completion at a location, the sacks and contents shall be saturated with water to the satisfaction of the engineer. The quantity of water required shall be as directed at no direct pay.

(f) Stone Placement: Toe and end walls shall be constructed by placing stone in the trench lined with geotextile fabric. Placement of stone shall begin at the bottom of the slope in a layer a minimum of 14 inches thick. Stone shall be placed by approved methods. A tolerance of 2 inches above or below the specified thickness will be allowed. Openings between stones exposing more than 4 square inches of geotextile fabric will not be permitted.

712.04 MEASUREMENT. Quantities of revetments for payment will be the design revetment areas as specified on the plans and adjustments thereto. Design quantities are based on surface areas shown on the plans to be revetted. Site preparation, geotextile fabric, expansion joint filler and topsoil will not be measured for payment. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Topsoil shall not be measured for payment.

712.05 PAYMENT. Payment for revetments will be made at the contract unit price. Payment for fertilizer and seeding will be made under the appropriate pay items. Payment for concrete cast-in-place, wet-batched sacked and dry batched prepackaged revetment will be subject to the payment adjustment provisions of Section 901. Payment will be made under:

Item No.	Pay Item	Pay Unit
712(01)	Concrete Cast-in-Place Revetment	Square Yard
712(02)	Cellular Concrete Block Revetment	Square Yard
712(03)	Sacked Concrete Revetment	Square Yard
712(04)	Stone Revetment	Square Yard
712(05)	Flexible Revetment	Square Yard

Section 713
Temporary Signs, Barricades and Pavement Markings

713.01 DESCRIPTION. This item consists of furnishing, installing and maintaining construction barricades, lights, signals, pavement markings and signs; providing flaggers; and complying with all other requirements regarding the protection of the work, workers and safety of the public. Signs, barricades, pavement markings, etc., shall conform to plan details, the MUTCD and these specifications.

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

713.02 MATERIALS. Materials for temporary signs, barricades and related devices shall conform to the following Subsections:

Backing Material	1015.04(b)
Reflective Sheeting	1015.05
Temporary Pavement Markings	1015.08
Raised Pavement Markers & Adhesive	1015.09
Thermoplastic Pavement Markings	1015.10
Traffic Paint	1015.12
Barricade Warning Lights	1018.12

Temporary pavement markings shall be a minimum of 4 inches wide.

713.03 FABRICATION: Fabrication of temporary signs, barricades and related devices shall conform to Subsection 729.04.

713.04 TEMPORARY SIGNS AND BARRICADES.

(a) Signs, barricades and related devices will be required when the contractor's work is in progress on portions of the work covered by the Notice to Proceed, or when operations are suspended but the traveled portion of the road is not in a safe condition for the traveling public. During such times that barricades are not in place, appropriate regulatory signs shall be erected and maintained by the contractor.

If a partial Notice to Proceed is issued, the contractor shall immediately begin erection of signs and barricades over the affected portions of the project to the extent necessary to comply with the requirements herein. When the full Notice to Proceed is issued, barricades shall be erected at the beginning and end of the project. Signing throughout the remainder of the project shall be completed.

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

When signs to be furnished and erected by the contractor are in place and approved, the Department's forces will remove or cover any standard signs that are in conflict with temporary signs.

When placing signs, the contractor shall cooperate with the engineer as well as the Department's forces responsible for removing Departmental signs, so that appropriate signs are in place at all times.

Signing shall remain in place and be maintained by the contractor, supplemented by additional signs as required, throughout the life of the contract. When previously used signs are to be erected on a project, the engineer will inspect and approve these signs before erection. Used signs showing less than 80 percent of the minimum specified reflectivity for type of sheeting used or which are faded more than the color standards furnished by the Materials and Testing Section will be rejected.

The engineer will periodically check construction signs for excessive fading using the color standards furnished by the Materials and Testing Section. The construction signs will be checked using current Departmental procedures. Faded construction signs which do not meet the minimum color standards shall be replaced by the contractor at no direct pay.

Rejected signs will be marked "NOT FOR USE ON STATE PROJECTS", and the date and stamp will be obliterated.

Signs placed by the contractor shall not be removed until the contract is completed and the Department's forces have erected permanent highway signs along the project. It will be the responsibility of the Department to see that all permanent highway signs are in place upon completion and acceptance of the project.

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

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

(b) When specified, advance warning arrow panels for temporary traffic control shall be provided at locations shown on the plans or as directed. Panels shall be one of the specified types conforming to the Department's MUTCD. If no type is specified, Type C panels shall be furnished.

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

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

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

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

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

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

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

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

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

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

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

TABLE 713-1
TEMPORARY PAVEMENT MARKINGS[1]

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

[1]No passing zones shall be delineated as indicated whenever a project is open to traffic.

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

713.06 MEASUREMENT.

(a) Temporary Signs and Barricades: When the contract does not include a pay item for "Temporary Signs and Barricades," the providing of temporary construction signs, barricades and related devices will not be measured for payment.

When a pay item for "Temporary Signs and Barricades" is included in the contract, the furnishing, erecting, maintaining and subsequent removing of temporary construction signs, barricades and related devices will be measured on a lump sum basis.

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

When the contract includes an item for "Temporary Pavement Markings", these markings acceptably furnished, placed, maintained and subsequently removed will be measured on a lump sum basis, or by the linear foot, or by the mile as specified.

When measurement is made by the linear foot of striping, gaps will not be measured.

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

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

Temporary reflectorized raised pavement markers will be measured by counting the number of markers furnished, placed and accepted. Removal of raised pavement markers will be at no direct pay.

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

713.07 PAYMENT. Payment for temporary construction signs, barricades and related devices will be at the contract lump sum price in accordance with the following schedule:

% of Total Contract Amount Earned	Allowable % of Lump Sum Price for Temporary Signs and Barricades
Initial Erection	20
25	40
50	60
75	80
100	100

Payment for temporary pavement markings will be made at the respective contract unit prices.

Payment will be made under:

Item No.	Pay Item	Pay Unit
713(01)	Temporary Signs and Barricades	Lump Sum
713(02)	Temporary Pavement Markings	Lump Sum

Item No.	Pay Item	Pay Unit
713(03)	Temporary Pavement Markings (____" Width)	Linear Foot
713(04)	Temporary Pavement Markings (Broken Line) (___" width)(___' length)	Mile
713(05)	Temporary Pavement Markings (Solid Line) (___" width)	Mile
713(06)	Temporary Pavement Legends and Symbols (Type)	Each
713(07)	Temporary Reflectorized Raised Pavement Markers	Each

Section 714
Slab Sodding

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

714.02 MATERIALS. Approved slab sod shall be either field grown grass or nursery grown grass.

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

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

Fertilizer shall conform to Subsection 1018.16 and agricultural lime shall conform to Subsection 1018.17.

Sod shall be free from noxious weeds or other vegetation.

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

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

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

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

714.04 HANDLING SOD. Sod shall be placed flat, grass side up on boards of convenient lengths and hauled to planting site with soil intact. Only one layer of sod shall be placed on each board. Boards shall be of sufficient thickness to prevent excessive bending and of sufficient width to prevent sod from hanging over edges.

Stacked sod shall be kept moist and satisfactorily protected from the elements.

714.05 PLANTING. Areas to receive slab sod shall be pulverized to a depth of at least 3 inches, graded and cleared of weeds, grass, stones and other debris. If an item for agricultural lime is included in the contract, liming shall be done when the area is being pulverized. When an item for fertilizer is included in the contract, approximately 90 percent shall be broadcast over the area to receive slab sodding, and the remaining 10 percent shall be broadcast over sod after placing and rolling. Upon delivery to the planting site, slab sod shall be transferred

onto the surface soil. Areas to be sodded shall be watered as directed. Sod shall be placed with minimum space between slabs. Slabs which do not fit closely shall be pulled together with suitable tools and pegged when necessary. When directed, sod surface will be top dressed with sand to smooth-out uneven spots.

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

714.07 WATERING. Slab sodding shall be watered as directed. Slab sod in rest areas and multiple use areas shall be kept moist for 30 days after sodding.

714.08 MEASUREMENT.

(a) Slab Sodding: Slab sodding will be measured by the square yard along the surface of completed sodding.

(b) Water: Water will be measured in units of 1,000 gallons in approved tanks.

(c) Fertilizer and Agricultural Lime: Fertilizer and agricultural lime will be measured for payment in accordance with Subsection 718.04.

714.09 PAYMENT. Payment for slab sodding and water will be made at the contract unit prices. Payment for fertilizer and agricultural lime will be made under Subsection 718.05.

Payment will be made under:

Item No.	Pay Item	Pay Unit
714(01)	Slab Sodding	Square Yard
714(02)	Water	M Gallons

Section 715
Topsoil

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

715.02 MATERIALS. Topsoil shall be workable, loamy soil, free of debris, refuse and similar foreign matter, and reasonably free of subsoil, hard lumps, gravel and other such materials. Topsoil shall have a minimum PI of 4, a maximum PI of 12, a pH of 5.5-8.0, a minimum organic content of 3 percent, and shall be capable of supporting adequate vegetation. Existing topsoil meeting the above requirements within construction limits may be used in accordance with Subsection 106.02. If agricultural lime or organic matter is added to a soil to bring topsoil into conformance with these specifications, it shall be at no direct pay.

715.03 CONSTRUCTION REQUIREMENTS. Areas to receive topsoil shall be scarified as directed. Agricultural lime, if required, shall be spread prior to scarifying the areas. Topsoil shall be uniformly spread over the areas to a depth of 6 inches and rolled to a uniform surface with a cultipacker or other suitable equipment.

715.04 MEASUREMENT. Topsoil will be measured by the cubic yard in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01.

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

715.05 PAYMENT. Payment for topsoil will be made at the contract unit price. Payment for a agricultural lime treatment will be made in accordance with Subsection 718.05.

Payment will be made under:

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

Section 716
Vegetative Mulch

716.01 DESCRIPTION. This work consists of furnishing and placing an asphalt-tacked mulch on seeded areas.

716.02 MATERIALS.

(a) Mulch: Mulch shall conform to Subsection 1018.19. The contractor shall notify the engineer at least 7 calendar days in advance of commencing operations so that the mulch can be inspected and approved prior to use.

Mulching material shall be delivered in bales of uniform size. Storage of mulching materials shall be in accordance with Subsection 106.08. Mulch stockpiles shall be protected from the weather.

(b) Asphalt: Asphalt for mulching shall be approved emulsified asphalt conforming to Section 1002.

716.03 GENERAL CONSTRUCTION REQUIREMENTS. Mulching shall follow seeding operations within 48 hours. Mulch shall be placed with equipment which will distribute mulch uniformly by blowing it onto the area. Equipment shall be provided with jet nozzles spaced in the muzzle of the blower through which asphalt is ejected simultaneously with mulch, thus coating mulch uniformly with asphalt as mulch is blown through the nozzle.

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

716.04 SPREADING RATES. Mulch shall be applied at a rate of 1 1/2 to 2 tons per acre simultaneously with asphalt at a minimum rate of 150 gallons of undiluted emulsion per ton of mulch. Application rates of mulch and asphalt within these limits will be determined by the engineer.

When required, emulsified asphalt shall be diluted with water as directed.

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

716.06 MULCHING OPERATIONS. Mulching operations shall begin within 48 hours after completion of seeding.

The asphalt-tacked mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and reduce the impact of rainfall on the soil surface. Mulching shall begin at the top of slopes and extend downward. Extensions to the blower pipe shall be supplied where slopes are encountered that cannot be reached by the blower under normal conditions. During windy conditions, the contractor shall make adjustments in operations to obtain uniform spreading.

Asphalt shall not be sprayed on structures. Asphalt stains shall be removed and the surface left in an acceptable condition.

716.07 MEASUREMENT. Vegetative mulch will be measured by the ton. The weight for measurement will be the product of the number of bales used and the average weight per bale as determined on scales provided by the contractor which have been certified by a qualified independent scale service or the Weights and Measures Division, Louisiana Department of Agriculture and Forestry.

Emulsified asphalt placed and accepted will be measured by the gallon. No measurement for payment will be made for water used to dilute emulsion.

716.08 PAYMENT. Payment for vegetative mulch and emulsified asphalt will be made at the contract unit prices, subject to the payment adjustment provisions of Section 1002 for specification deviations of emulsified asphalt. The Materials and Testing Section will provide the payment adjustment percentage for asphaltic materials.

Payment will be made under:

Item No.	Pay Item	Pay Unit
716(01)	Vegetative Mulch	Ton
716(02)	Emulsified Asphalt	Gallon

Section 717
Seeding

717.01 DESCRIPTION. This work consists of preparing seed beds and furnishing and sowing grass seed on the areas designated on the plans or as directed.

717.02 MATERIALS. Materials for seeding shall conform to the following sections:

Topsoil	715
Fertilizer and Agricultural Lime	1018.16
Seed	1018.18

The contractor shall furnish the engineer with a copy of the laboratory test report as described in Subsection 1018.18(b).

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

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

(1) Alluvial soils of Mississippi and Red River bottoms.
(2) Mississippi terraces and loessial hill soils.
(3) Coastal plain soils (rolling, hilly and flatwoods areas in central, northern and eastern part of the State).
(4) Coastal prairie soils.
(5) Ouachita River bottom.

717.04 PREPARATION OF SEED BED. Seed beds shall be prepared by disking, harrowing or other approved methods. Soil shall be thoroughly pulverized to a minimum depth of 3 inches and leveled as directed. Hardpan areas shall be rototilled, if necessary, to ensure that soil is in a condition to receive and sprout seed. If the contract requires topsoil, fertilizer or agricultural lime, they shall be incorporated at this time. Slopes shall be smoothed to grade and rolled prior to seeding.

717.05 PERMANENT SEEDING. Seed shall be planted within the dates shown in Table 1, unless otherwise permitted in writing. Seeding shall not be done in November, December, January, or February.

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

TABLE 1

Type	Seed Mixture[2]	Pounds per Acre	Soil Area[4]	Planting Dates
A	Hulled Bermuda	30	1,2,3,4,5	March - Sept.
B	Hulled Bermuda Crimson Clover[1]	20 25	1,2,3,5	Feb. - March
C	Kentucky 31 Fescue Unhulled Bermuda	25 20	1,2,3,4,5	Sept. - Feb.
D	Unhulled Bermuda Crimson Clover[1]	20 40	1,2,3,4,5	Sept. - Feb.
E	Pensacola Bahia[3]	25	1,2,3,5	March - Sept.
F	Bald Clover Unhulled Bermuda	25 20	1,2,3,4,5	Feb. - March
G	Vetch (Common) Unhulled Bermuda	40 20	1,2,3,4,5	Sept. - Oct.
H	Lespedeza	40	1,2,3,4,5	March - May

[1]Inoculated prior to planting with proper bacterial culture.
[2]Only Hulled Bermuda or Unhulled Bermuda will be planted in rest areas.
[3]Type E will be used only upon the approval of the Roadside Development Specialist.
[4]See Subsection 717.03.

The contractor will be allowed to apply seed by use of a hydroseeder. When hydroseeding methods are used, the contractor will be permitted to include fertilizer and lime in the seeding slurry for application during hydroseeding operations.

Prior to planting, the engineer will contact the Department's roadside development personnel to select the varieties of seed to be used.

717.07 WATERING. When deemed necessary due to dry conditions, seeded areas shall be periodically watered until final acceptance.

717.08 MEASUREMENT. Seeding will be measured by the pound. Water, topsoil, fertilizer, and agricultural lime will be measured in accordance with Sections 714, 715, and 718; however, water used in hydroseeding slurry will not be measured.

717.09 PAYMENT. Payment for seeding will be made at the contract unit price. Payment for water, topsoil, fertilizer, and agricultural lime will be made in accordance with Sections 714, 715, and 718.

Payment will be made under:

Item No.	Pay Item	Pay Unit
717(01)	Seeding	Pound
717(02)	Temporary Seeding	Pound

Section 718
Fertilizer and Agricultural Lime

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

718.02 MATERIALS.

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

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

718.03 APPLICATION.

(a) Commercial Fertilizer: Fertilizer shall be uniformly broadcast over areas to be fertilized by either hand or machine methods. The rate of fertilizer application shall be as follows:

Type	Pounds Per Acre
8-8-8	1,000
12-12-12	667
13-13-13	615
16-16-16	500

Other balanced fertilizer may be used at the proportional rate.

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

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

(c) Hydroseeding: If hydroseeding methods are used, the contractor will be permitted to include fertilizer and lime in the seeding slurry for application during hydroseeding operations.

718.04 MEASUREMENT.

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

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

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

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

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

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

Section 719
Landscaping

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

719.02 MATERIALS.

Materials for landscaping shall conform to the following Sections and Subsections, and the following requirements.

Fertilizer	1018.16
Agricultural Lime	1018.17

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

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

(a) Manure: The contractor shall furnish sterilized cow manure or horse manure for backfill soil and bed preparation areas.

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

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

5 parts topsoil
3 parts pine bark for bed preparation and backfilling
1 part manure
1 part coarse sand

Fertilizer shall be added in accordance with Section 718. Excavated material may be used, if it meets the requirements for topsoil for trees and shrubs.

(d) Topsoil for Trees and Shrubs: Topsoil for trees and shrubs shall be fertile, friable, natural surface soil obtained from a well drained area free of stones, brush, weeds, shale, roots, or other litter. Topsoil for trees and shrubs shall have a minimum of 2 percent organic matter and pH range between 5.5 to 7.0 inclusive.

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

When pine bark mulch is specified, mulch shall consist of 1-inch minimum size chipped pine bark. Excessively decomposed pine bark will be rejected. When fresh bark is used, the contractor shall add 1 1/2 pounds of nitrogen per cubic yard of mulch at no direct pay.

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

pruned, watered and maintained as necessary to ensure their healthy growth.

719.04 PLANT MATERIALS. Plants will be subject to approval at the contractor's source and the project site before planting. Trees and other plant materials shall be inspected by the Department's Landscape Architect, with the landscape contractor present at the contractor's nursery source. In the event that plant material is not found as specified at the contractor's nursery source, the contractor shall locate acceptable plant material from other nursery sources at no direct pay.

(a) State and Federal Regulations: Plant material shall be free from injurious insect pests and plant diseases and subject to regulations of Federal and State Departments of Agriculture. Shipments of plants shall comply with nursery inspection and plant quarantine regulations of the states of origin and destination. The contractor shall obtain proper certificates for movement of nursery stock intrastate and interstate, and shall comply with all other requirements before and during movement or shipment of plants. A copy of the Certificate of Inspection shall accompany each delivery.

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

(c) Grading Standards: Grading of plants shall conform to the latest edition of "American Standards for Nursery Stock," as published by the American Association of Nurserymen, Inc., unless otherwise specified.

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

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

Plants and trees shall equal or exceed the measurements specified in the Plant List. They shall be measured before pruning, with branches in normal position. Dimensions for height and spread refer to the main body of the plant and not from branch tip to branch tip. The determining measurements for trees shall be caliper and/or height as described in the Plant List. Caliper of the trunk shall be taken 6 inches above the ground level for sizes up to and including 4-inch and 12 inches above the ground level for larger sizes. Trees shall have a habit of growth which is normal for the species. Plants shall be healthy, vigorous, and free from insects, diseases and injuries.

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

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

Burlapped plants shall be watered prior to transportation and kept moist until planted.

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

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

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

(i) Delivery and Receipt of Plant Materials: The contractor shall notify the engineer at least 24 hours before delivery of plant materials to the project. Each shipment shall be accompanied by an invoice showing sizes and varieties in the shipment.

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

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

719.05 CONSTRUCTION METHODS.

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

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

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

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

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

(c) pH Readings: The Department will test the pH of the soil in the planting area. The soil shall have a pH between 5.5 and 7.0 when tested in accordance with DOTD TR 230 unless otherwise specified.

(d) Location of Plants: Plants shall be located in accordance with plans or as directed.

(e) Setting Plants: Plants shall be planted in pits dug to detail planting dimensions. Plants shall be set plumb and at such level that, after settlement, a normal relationship of the crown of the plant with the ground surface will be established. Each plant shall be in the center of the pit. When plants are set, backfill soil shall be tamped under and around the base of each root mass to fill all voids. Plants shall be planted in backfill soil conforming to Subsection 719.02(c) thoroughly settled by watering and tamping to minimize settling and leaning of plant material. Plants shall be staked as indicated on the plans.

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

When plants are grouped together in a plant bed or in a line less than 5 feet apart, the area shall be loosened and lumps broken to a minimum depth of 6 inches prior to excavating plant pits.

After planting has been completed, form a bowl around each plant as shown in the planting details. Bowls shall extend to the limits of the plant pit for trees and shrubs. No bowls are required in areas of bed preparation. Shrubs in lines or groups may share a common bowl around their perimeter. It is not necessary to use backfill soil in the preparation of these bowls.

(f) Fertilizer: The contractor shall furnish and place commercial fertilizer at the specified rate in accordance with Subsection 718.03(a). Fertilizer shall be spread uniformly on the excavated material in a circle at the outer edge of planting pit. Fertilizer shall be mixed with excavated soil before backfilling.

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

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

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

(i) Water: The contractor shall furnish and apply water in sufficient quantities for proper irrigation of the plants. Plants shall be watered during planting operations, immediately after planting and at intervals as directed until final acceptance.

(j) Bed Preparation: The contractor shall remove grass, weeds, sticks, stones and other debris from the planting bed. The contractor shall treat the planting bed with an approved pre-emergence herbicide in accordance with the manufacturer's recommendations. The contractor shall rototill the planting bed to a minimum depth of 10 inches with 3 cubic yards of peat moss, 7 cubic yards of pine bark for bed preparation and backfill soil, 3 cubic yards of manure, and 25 pounds of 8-8-8 fertilizer per 1000 square feet of bed area or other balanced fertilizer at proportional rates.

Beds shall be raked smooth and dirt lumps, stones, sticks, grass and other foreign matter shall be removed. Finish grades of beds next to walks or buildings shall be 1 to 2 inches below finish grade of adjoining surfaces unless otherwise shown on the plans or directed.

(k) Mulching: Mulch shall be placed uniformly to a minimum depth of 3 inches within the planting saucers and bed areas and watered. When plants are planted in rows or groups not more than 5 feet apart, the entire area between the saucers shall be mulched.

(l) Weeding: Weeds shall be removed from bed areas, the planting basin of each plant and groups of plants, including saucer walls. The contractor shall mow, for a distance of 5 feet, around plant materials not planted in beds. Use of selective herbicides will be permitted, provided it is an approved contact-type compatible with plants and provided the grass in the 10 foot circle has been cut to a satisfactory height. Weeding shall be performed as directed to maintain a neat appearance throughout the period of establishment and replacement.

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

(a) Period of Establishment: The contractor shall care for planted areas for a period of establishment, which shall be one full growing season, after provisional acceptance is made. A growing season shall begin April 16 and extend to October 31. During this period, the contractor shall preserve plants in a healthy, growing condition. Such plant establishment work shall include cultivation, watering, pruning, controlling insect pests and disease and other work necessary to ensure healthy plant growth.

The contractor shall contact the engineer every week and outline activities which will be performed on the project. The contractor shall weed in the vicinity of plants, place mulch, and water the plants as required. During the period of establishment, the contractor shall maintain a neat and clean appearance of planting areas.

(b) Semifinal Inspection: A semifinal inspection by the contractor and the engineer will be held 2 weeks prior to the end of the period of establishment to determine the acceptability of plants. Replacement planting, as required, shall be performed in accordance with Subsection 719.05(a).

Unsatisfactory plants shall be replaced in kind, quantity and size with live, healthy plants installed as originally specified. Substitute varieties of plants shall be used only when approved. These replacement plantings shall be made at no direct pay. Replacements made at this time will not require a period of establishment.

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

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

Plants that are unsatisfactory at the time of final inspection of the project shall be replaced by the contractor in kind, quantity and

size with live, healthy plants installed as originally specified. Substitute varieties of plants shall be used only when approved. These replacement plantings shall be made at no direct pay.

719.07 MEASUREMENT. Furnishing and planting the various types and sizes of plant materials will be measured per each. No measurement for payment will be made for pit preparation, topsoil, fertilizer, mulching, lime, herbicide, organic material, manure, peat moss, watering, plant maintenance or plant replacement of individual trees and shrubs outside of bed areas.

Bed preparation and top dressing mulch will be measured by the square yard.

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

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

Payment for bed preparation and top dressing mulch will be made at the contract unit prices. When an item for "Landscaping" is included in the contract, payment will be made at the contract lump sum price.

Partial payment during the period of establishment will be limited to 75 percent of the contract price for landscaping items until the end of the growing season. At the end of the full growing season, if plants have been properly maintained and replacement planting has been completed, the remaining contract price for landscaping items will be paid.

Payment for adjustment of pH will be made in accordance with Subsection 109.04.

Payment will be made under:

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

Section 720
Erosion Control Systems

720.01 DESCRIPTION. This work consists of furnishing and placing erosion control systems where shown on the plans or as directed. Erosion control systems include fiber glass roving, curled wood matting and erosion control covering.

720.02 MATERIALS.

(a) Fiber Glass Roving: Fiber glass roving shall consist of glass fibers and asphalt.

(1) Glass Fibers: Glass fibers shall conform to Subsection 1018.20.

(2) Asphaltic Materials: Asphaltic materials shall conform to Subsection 1002.01 and shall be approved grades of either asphalt cement or emulsified asphalt.

(b) Curled Wood Matting: Curled wood matting shall conform to Subsection 1018.24(b).

(c) Erosion Control Covering: Erosion control covering shall be either fiber glass roving or curled wood matting at the contractor's option.

(d) Staples: Steel staples shall conform to Subsection 1018.24(c).

720.03 EQUIPMENT. Equipment necessary to satisfactorily perform the work shall be furnished and maintained by the contractor.

(a) Fiber Glass Roving: Equipment for applying glass fibers and asphalt shall include the following.

(1) Pneumatic ejector capable of applying glass fibers at the rate of 2 pounds per minute (approximately 8 square yards per minute).

(2) Air compressor capable of supplying 40 cfm at 80 to 100 psi and acceptable air hoses for supplying air to areas inaccessible to compressor.

(3) Asphalt distributor with hoses and hand spray bar for areas inaccessible to distributor.

(b) Curled Wood Matting: There is no special equipment necessary for installation of curled wood matting.

720.04 CONSTRUCTION REQUIREMENTS. Slopes shall be seeded, smooth to grade, and rolled prior to application of erosion control systems. Erosion control systems shall be applied within 48 hours after completion of seeding operations.

(a) Fiber Glass Roving: A light coat of asphaltic material shall be applied using an asphalt distributor or hand spray bar to the soil surface prior to applying the glass fibers. The glass fibers shall be spread uniformly with a pneumatic ejector to form a random mat of continuous fibers at the minimum rate of 0.30 pound per square yard. Asphaltic materials shall be applied uniformly over the glass fibers using an asphalt distributor or hand spray bar at the minimum rate of 0.40 gallon

of undiluted material per square yard. When asphalt cement is used, it shall be heated to a temperature that provides for uniform spray. When required, emulsified asphalt shall be diluted with water as directed.

(1) In ditches, the fiber glass roving shall be placed beginning at the downstream end. At the downstream and upstream ends of the ditch the roving shall be buried a minimum of 1 foot. Along the sides of the ditch, the roving shall be buried a minimum of 4 inches. When the roving installation is not completed in one application, the upstream application shall overlap the down stream application a minimum of 3 feet. The completed roving shall be stapled at a maximum of 4 foot centers alternating rows to form an "X" pattern. Staples shall penetrate all layers of adjacent rows. Rows of staples with staples at 1-foot centers shall be placed at 25-foot centers perpendicular to the ditch centerline.

(2) On slopes, the outer edges of the roving shall be buried a minimum of 4 inches. The completed roving shall be stapled at a maximum of 6-foot centers alternating the center row so that the staples form an "X" pattern.

(3) Staples shall be installed flush to the ground.

(b) Curled Wood Matting: Curled wood matting with netting shall be placed with netting exposed and the fibers in contact with the soil.

(1) In ditches the matting shall be placed parallel to flow beginning at the downstream end. At the downstream and upstream ends of the ditch the matting shall be buried a minimum of 1-foot. Along the sides of the ditch the matting shall be buried a minimum of 4 inches. Roll splices shall be made with an overlap splice where the upstream matting is lapped a minimum of 3 feet over the downstream matting. Side by side rolls shall be joined with a 4-inch minimum overlap. Matting shall be stapled at a maximum of 4-foot centers alternating rows to form an "X" pattern. Staples shall penetrate all layers of adjacent rows. Rows of staples with staples at 1-foot centers shall be placed at 25-foot centers perpendicular to the ditch centerline.

(2) On slopes, the matting shall be applied either transverse or parallel to the slope, with ends and sides butted tightly and stapled. The outer edges of the matting shall be buried a minimum of 4 inches. Matting shall be stapled at a maximum of 6-foot centers alternating rows to form an "X" pattern.

(3) Staples shall be installed flush to the ground.

(c) Erosion Control Covering: Erosion control covering shall be constructed in accordance with either Heading (a) or Heading (b).

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

720.06 MEASUREMENT.

(a) Fiber Glass Roving: Fiber glass roving will be measured by the square yard along the surface of the completed roving.

The glass fiber application rate shall be calculated as the product of the number of pounds divided by the area of the completed surface.

The number of pounds of glass fibers will be determined as the product of the number of spools or packages of glass fibers used and the average weight of spools or packages.

The asphalt application rate shall be calculated in accordance with Subsection 720.04(a) as the product of the number of gallons of undiluted asphalt divided by the area of the completed surface. The number of gallons of asphalt used will be measured at application temperature.

(b) Curled Wood Matting: Curled wood matting will be measured by the square yard of completed surface.

(c) Erosion Control Covering: Erosion control covering will be measured by the square yard of completed surface.

720.07 PAYMENT. Payment for fiber glass roving, curled wood matting and erosion control covering will be made at the contract unit prices. Required burial of ends and edges, overlaps and staples will not be measured for payment. Payment will be made under:

Item No.	Pay Item	Pay Unit
720(01)	Fiber Glass Roving	Square Yard
720(02)	Curled Wood Matting	Square Yard
720(03)	Erosion Control Covering	Square Yard

Section 721
Asphalt Mulch

721.01 DESCRIPTION. This work consists of furnishing and placing asphalt mulch for erosion control on seeded areas as shown on plans or as directed.

721.02 MATERIALS. Asphalt mulch shall be an approved emulsified asphalt conforming to Subsection 1002.01. Water shall conform to the requirements of Subsection 1018.01.

721.03 GENERAL CONSTRUCTION REQUIREMENTS. Asphalt mulch shall immediately follow seeding operations. Areas to receive asphalt mulch that have not been sufficiently moistened by rainfall shall be watered as directed. Asphalt shall be spread with a mechanical spreader equipped with boom or hand spray nozzles.

721.04 SPREADING RATES. Emulsified asphalt shall be spread over seeded areas at the undiluted rate of 0.4 to 0.5 gallon per square yard. When required, asphalt shall be diluted with water as directed.

721.05 MEASUREMENT. Asphalt mulch will be measured by the undiluted gallon at application temperature. No measurement for payment will be made for water used in the emulsion.

721.06 PAYMENT. Payment for asphalt mulch will be made at the contract unit price, subject to the payment adjustment provisions of Section 1002 for specification deviations of asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic material.

Payment will be made under:

Item No.	Pay Item	Pay Unit
721(01)	Asphalt Mulch	Gallon

Section 722
Field Laboratories

722.01 DESCRIPTION. This work consists of furnishing laboratory buildings at the project sites or plant sites as specified.

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

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

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

Laboratory buildings shall be constructed, furnished, maintained and located as approved. The contractor shall provide suitable desks, chairs and file cabinets for personnel using these facilities. Sturdy work benches shall be constructed along at least one wall, or as directed, to provide sufficient work area for the types of tests being conducted. Laboratory buildings shall be heated and approved sanitary facilities provided. The required testing equipment for the contractor's Quality Control Program shall be furnished, installed and maintained in satisfactory condition.

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

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

722.04 PLANT SITE LABORATORY. The plant site laboratory will be approved as part of the Department's Plant Certification Program. It shall consist of a building or room which is air conditioned. Appropriate sinks and running water shall be provided as directed.

722.05 MEASUREMENT.

(a) Project Site Laboratory: Project site laboratories furnished, satisfactorily maintained, moved as directed, and subsequently removed from the project will be measured per each building.

(b) Plant Site Laboratory: Plant site laboratories will not be measured for payment.

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

Item No.	Pay Item	Pay Unit
722(01)	Project Site Laboratory	Each

Section 723
Granular Material

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

723.02 MATERIALS. Granular material shall conform to Subsection 1003.07.

723.03 CONSTRUCTION REQUIREMENTS. Materials shall be placed, properly shaped and uniformly compacted to a minimum of 95.0 percent of maximum dry weight density. Maximum dry weight density will be determined in accordance with DOTD TR 418 and in-place density will be determined in accordance with DOTD TR 401. Granular materials shall not be displaced during subsequent operations.

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

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

(b) Width: Underwidth shall not exceed 6 inches. Overwidth will be waived at no direct pay.

723.05 MEASUREMENT.

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

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

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

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

Section 724
Pavement Patching, Widening and Joint Repair

724.01 DESCRIPTION. This work consists of patching, widening and joint repair of existing pavements in accordance with these specifications and in conformity with the lines, grades and typical sections shown on the plans or as directed.

The contractor has the option of using either portland cement concrete or asphaltic concrete for patching and widening. Joints in existing asphaltic concrete overlays shall be repaired with asphaltic concrete.

724.02 MATERIALS. Portland cement concrete shall be Class A conforming to Section 901.

Asphaltic concrete shall be any type mixture listed in Section 501, except Type 5B. Asphaltic tack coat shall conform to Section 504.

Granular material shall conform to Subsection 1003.07.

Mix for joint repair shall be Type 9 Wearing Course conforming to Section 501.

724.03 EQUIPMENT. Equipment furnished shall meet the specification requirements for the types of material used.

724.04 GENERAL CONSTRUCTION REQUIREMENTS. The contractor shall remove existing surfacing and base materials and perform all required excavation for patching and widening. When through traffic is maintained, the contractor shall complete the replacing of pavement, place the widening material, or fill and compact open areas or trenches, at the end of each day's operations.

Excavation and compaction of the subgrade shall be in accordance with the plans or as directed. The subgrade shall be compacted uniformly.

Existing surfacing and excess excavation shall be disposed of beyond the right-of-way in accordance with Subsection 202.02.

For joint repair, contact surfaces of existing pavement shall be cleaned and a thin, uniform asphaltic tack coat applied prior to placing asphaltic mixture in the joint.

724.05 PATCHING AND WIDENING WITH PORTLAND CEMENT CONCRETE. Patching and widening with portland cement concrete shall conform to Section 601, except that either machine or hand finishing methods may be used. When granular material subbase is specified, the granular material shall be placed in accordance with Section 723.

724.06 PATCHING, WIDENING, AND JOINT REPAIR WITH ASPHALTIC CONCRETE. Patching and widening with asphaltic concrete shall conform to Section 501, except that priming of the subgrade will not be required. Contact surfaces of pavement shall be cleaned and a uniform coat of asphaltic

tack coat applied before asphaltic concrete is placed against them. Patches shall not be overlayed for a minimum of 15 calendar days.

Spreading, finishing and compaction of asphaltic concrete shall leave the surface smooth and level with, or slightly above, the edge of existing pavement.

To provide lateral support, the contractor will be permitted to construct temporary berms of excavated material against outside edge of widening strips prior to rolling.

724.07 MEASUREMENT.

(a) Patching: Patching of pavement will be measured by the square yard of existing pavement designated to be removed and replaced. Removal of existing surfacing and base course, tack coat, and required excavation will not be measured for payment.

(b) Widening: The quantities of widening for payment will be the design areas as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Design quantities are based on the horizontal dimensions shown on the plans. Required excavation, removal of existing pavement and base course, asphaltic tack coat and disposal of removed material will not be measured for payment. No measurement for payment will be made for widening placed outside the dimensions shown on the plans or established by the engineer.

(c) Joint Repair: Joint repair will be measured by the ton of asphaltic concrete used to fill the joint. Measurement will be made in accordance with Subsection 501.13(a).

724.08 PAYMENT.

(a) Patching and Widening: Payment for pavement patching and widening will be made at the contract unit prices per square yard, subject to the following provisions:

Payment adjustments for deficiencies in portland cement concrete, asphaltic concrete and asphaltic materials will be applied to 1/2 the contract unit price for pavement patching.

When the engineer orders additional thickness of patching in excess of plan thickness, payment for the additional thickness will be made as follows. The value per inch thickness will be determined by dividing the contract unit price per square yard by the plan thickness. Thickness of patches will be measured from the surface that exists at the time of patching. Payment for the additional thickness will be made at 50 percent of the value per inch thus determined.

When the engineer approves of an underthickness of patching less than plan thickness, a deduction in payment will be made. This deduction per inch of underthickness will be made at 50 percent of the value per inch. The value per inch will be calculated by dividing the contract unit price per square yard by the plan thickness.

(1) Portland Cement Concrete: Portland cement concrete will be accepted for payment on a lot basis. A lot will be a completed section or an identifiable pour completed in 1 day.

Two random batches will be sampled for each lot, and three cylinders molded for each batch. The six specimens per lot will be tested for compressive strength in 28 to 31 days. In the event of sudden cessation of operations, a minimum of three cylinders will represent a lot.

Acceptance and payment for each lot will be as specified in Subsection 601.18(b)(2) and Subsection 601.20.

(2) Asphaltic Concrete: Asphaltic concrete will be subject to the payment adjustment provisions of Section 501 for deficiencies in Marshall stability, pavement density, aggregate gradation, additives and asphaltic materials. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic material.

(b) Joint Repair: Payment for pavement joint repair will be made at the contract unit price per ton, subject to the following provisions:

Asphaltic concrete for joint repair will be subject to the payment adjustment provisions of Section 501 for deficiencies in Marshall stability, aggregate gradation, additives and asphaltic material; however, payment adjustments will be applied to 1/3 the contract unit price for joint repair. The Materials and Testing Section will provide the payment adjustment percentage for properties of asphaltic material.

(c) Payment will be made under:

Item No.	Pay Item	Pay Unit
724(01)	Pavement Patching	Square Yard
724(02)	Pavement Widening	Square Yard
724(03)	Pavement Joint Repair	Ton

Section 725
Temporary Detour Roads and Bridges

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

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

725.02 MATERIALS.

(a) Detour Roads: Materials for detour roads, except low profile runarounds, shall conform to applicable Sections of these specifications.

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

Temporary pavement markings shall conform to Section 1015.

(b) Detour Bridges: Timber shall be sound, new or used, treated or untreated. Splits, rot, unsound knots or other defects which, in the opinion of the engineer, materially affect the strength of the timber will not be permitted. Timber shall conform to species, grade and stress rating requirements of Subsection 1014.01.

Piles shall be pine, fir, cypress or oak of any grade which will satisfactorily withstand driving and shall be reasonably straight. Lumber and piling, in addition to meeting requirements herein, shall be satisfactory to the engineer. Peeling of bark from piles will not be required.

725.03 CONSTRUCTION REQUIREMENTS.

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

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

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

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

Low profile runaround type detour roads shall be surfaced with approved aggregate. Aggregate surfacing shall be placed to a minimum depth of 4 inches and a minimum width of 20 feet. Alignment and grade of runaround type detour roads shall be acceptable to the engineer. When directed, the contractor shall provide temporary culverts for low profile detours.

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

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

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

725.05 MEASUREMENT.

(a) Detour Roads: Temporary detour roads will be measured either by the linear foot or square yard, as specified, in accordance with the following provisions:

(1) Linear Foot: Measurement will be made along the centerline of detour roads unless otherwise shown on the plans. Detours with temporary bridging will be measured between the edge of surfacing of existing pavement and temporary bridging. Detours without temporary bridging will be measured between edges of surfacing of existing pavement. Low profile runaround will not be measured for payment.

(2) Square Yard: Measurement will be made on the surface of completed detour road surfacing.

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

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

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

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

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

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

Item No.	Pay Item	Pay Unit
725(01)	Temporary Detour Roads	Linear Foot
725(02)	Temporary Detour Roads	Square Yard
725(03)	Temporary Detour Bridging	Linear Foot

Section 726
Bedding Material

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

726.02 MATERIALS. Materials shall conform to the following Subsections:

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

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

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

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

Damaged fabric shall be either removed and replaced with new fabric or covered with a second layer of fabric extending 6 feet in each direction from the damaged area.

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

A plastic soil blanket in accordance with Subsection 203.10 shall be placed at structure ends when bedding material is exposed.

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

Geotextile fabric will not be measured for payment.

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

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

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

Section 727
Mobilization

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

727.02 PAYMENT.

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

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

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

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

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

Payment will be made under:

Item No.	Pay Item	Pay Unit
727(01)	Mobilization	Lump Sum

Section 728
Jacked or Bored Pipe

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

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

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

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

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

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

(a) Jacking: Heavy duty jacks suitable for forcing pipe through the embankment shall be provided. Even pressure shall be applied to all jacks and shall be transmitted to the pipe end through a jacking head. The jacking head shall be designed so that pressure is uniformly applied around the ring of the pipe. Backstop or jacking frame shall be adequate to resist pressure of the jacks under load. Pipe shall be set on guides properly fastened together to support the pipe in the proper direction at correct grade. Suitable cushioning material, such as plywood, shall be provided between sections of concrete pipe.

Material shall be excavated ahead of the pipe and shall be removed through the pipe. Excavation shall not extend more than 2 feet beyond the forward end of pipe. When the character of embankment material dictates, the distance shall be reduced to prevent the embankment from being damaged. Excavated material shall be disposed of in accordance with Subsection 202.02.

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

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

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

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

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

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

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

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

Pipe shall be joined as specified in Section 701.

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

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

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

Section 729
Traffic Signs and Devices

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

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

Signs shall be fabricated in an approved plant. The fabrication contractor shall show evidence of successful experience in fabrication and erection of quality reflectorized multipanel signs.

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

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

(a) Sign and Marker Sheeting: Sheeting material for sign panels, delineators, barricades and other markers shall conform to Section 1015. Reflective sheeting material shall be either ASTM Type I, ASTM Type II, or ASTM Type III, as specified. When not specified, either ASTM Type I, Type II, or Type III may be furnished.

(b) Ferrous Metal: Ferrous metals shall conform to Subsection 1015.02(a). Reinforcing steel shall conform to Section 1009. Ferrous metal, except reinforcing steel, shall be galvanized in accordance with Section 811.

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

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

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

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

(g) Concrete: Concrete shall be Class M conforming to Section 901.

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

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

729.03 GENERAL REQUIREMENTS. The contractor has the option of furnishing either steel or aluminum sign supports for both post mountings and overhead mountings and either rigid steel or flexible posts for small signs, markers and delineators. Sign panels shall be aluminum. Before beginning work, the contractor shall notify the engineer in writing as to the combination of signing materials he proposes to furnish. The same combination of signing materials shall be used throughout the project.

The contractor shall furnish fabrication and erection drawings of sign mountings except standard roadside mounted supports, and any sign face details not provided by the Department, all in accordance with Subsection 801.03. Approval of sign face details will be given before the sign structure drawings will be approved. Fabrication or construction shall not be started until drawings have been approved and distributed.

Fabrication of sign mountings shall conform to Section 807. An approved damper will be required for each aluminum overhead truss. Dampers shall be installed during truss fabrication and shall remain in place.

Structure mounted delineator and milepost assemblies shall be installed in accordance with plan details. Posts for ground mounted small signs, markers and delineators shall be driven with a suitable protective driving cap and shall be vertical.

Welding shall conform to Section 815.

729.04 FABRICATION OF SIGN PANELS AND MARKERS.

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

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

Splice plates joining sign panels shall not extend behind horizontal sills. Aluminum panels shall be a nominal 0.080 inch thick.

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

(1) Degreasing:

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

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

(2) Etching:

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

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

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

(c) Sheeting Application: Application of sign face and legend sheeting shall be in accordance with approved recommendations of the

reflective sheeting manufacturer. Unless otherwise approved in writing, reflective sheeting shall be applied to panels in such manner that there are no horizontal splices.

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

Legend shall be applied by one of the following methods:

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

(2) Demountable: Legend shall be an adhesive coated reflective sheeting as specified in Subsection 1015.05, permanently adhered to a 0.032-inch thick flat aluminum backing, except that route marker shields shall be 0.080-inch thick aluminum. Aluminum shall be treated in accordance with Heading (b). Legend shall be attached to sign face in such manner as to provide a smooth, flat surface. Sign fabrication rivets that prohibit such application shall be removed and replaced through legend, or legend may be raised by approved spacers. Legend shall show clean cut, uniform width of stroke and have essentially a plane surface.

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

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

(e) Object Markers, Milepost Markers and Delineators:

(1) Object Markers: Object markers shall be yellow reflectorized material conforming to Subsection 1015.05 and low gloss black nonreflectorized material conforming to Subsection 1015.06 or 1015.07 mounted on nominal 0.080-inch thick aluminum panels.

(2) Milepost Markers: Milepost markers shall be reflectorized green background sheeting with reflectorized silver white numerals in accordance with Subsection 1015.05, mounted on nominal 0.080-inch thick aluminum panels.

(3) Delineators: Delineators shall be ASTM Type III reflective sheeting (silver, red or yellow, as specified) conforming to Subsection 1015.05 applied to properly treated base panels, punched or sheared to specified dimensions for rigid steel posts or applied directly to flexible posts.

(f) Packaging: Before being packed, signs shall be allowed to stand for at least 12 hours after completion of screening. Signs shall

be slipsheeted and packed in such manner as to ensure their arrival at their destination in an undamaged condition. Packaged signs shall not be permitted to become wet during storage or shipment.

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

(a) Construction Stakes: Sign support locations will be as shown on the plans or as directed. Locations which are obviously improper because of topography, existing appurtenances or other conflicting conditions will be adjusted to the closest desirable location. The contractor shall determine elevations for post length determinations at the established sign support location.

Required information relating to lines and grades will be furnished by the Department; however, the contractor shall be responsible for orientation, elevation, offset and leveling of signs.

(b) Sign Positioning:

(1) Overhead Signs: Signs shall be constructed so that the sign face is tilted back two to three degrees (approximately one inch in two feet) from vertical and at right angles to the road, unless otherwise directed.

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

(3) Delineator, Object Marker and Milepost Assemblies: These assemblies shall be placed at least 2 feet beyond the outer edge of roadway shoulder, 2 feet beyond the face of curb, or in the line of guard rail.

(4) Vertical and Horizontal Clearances: For ground installations, signs shall be constructed to a minimum height of 6 feet above the edge of pavement to the bottom of signs. When, however, a secondary sign is mounted below another sign, the secondary sign shall be at least 4 feet above pavement edge. The bottom of the sign shall be a minimum of 7 feet above the existing terrain. Overhead sign mountings shall provide a minimum clearance of 18 feet over the entire width of pavement and shoulders.

Minimum horizontal clearance from edge of roadway to any ground sign or the nearest vertical member of an overhead sign structure shall be as shown on the plans or as directed.

(c) Sign Overlay Panels: When specified, existing signs shall be completely overlaid with new sign panels placed over the existing sign face. No partially overlaid signs shall be allowed to remain exposed overnight. Only one overlay shall be placed on a sign. When an overlay is to be placed on an existing overlaid sign, the previous overlay shall be removed prior to placement of the new overlay. Overlay panels shall conform to Section 729.04. Raised legends shall be removed from the existing sign face prior to placing the overlay panel. The size of the overlay panel shall not exceed the size of existing sign panel by more than 3 inches on any side. Overlay panels shall be attached to the

existing panel with 3/16 inch solid core rivets. Rivets shall be placed on 12-inch centers (maximum) along the perimeter of panel and at panel splices, and on 24-inch centers (maximum) both vertically and horizontally in interior portions of each panel. Rivets shall be centered horizontally on panels less than 24 inches wide. A 4-by-4-inch shim with a nominal 0.080-inch thick aluminum plate shall be placed between existing panel and overlay panel at interior rivet locations. Shims cut from salvaged sign panels may be used. The existing sign panels shall be kept reasonably flat during installation of the overlay panels. Splice arrangement for overlay panels shall conform to the requirements for traffic sign blanks.

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

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

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

(f) Bolt Tensioning: Slip plates for breakaway sign posts shall be assembled in the shop with high strength bolts tightened at a minimum bolt tension in accordance with Subsection 807.22. After field installation, high strength bolts in the breakaway base connection shall be tightened to the specified minimum bolt tension. The bolt tension in both the slip plate connection and the breakaway base connection will be checked by the engineer. Bolt tensioning shall be corrected as required.

(g) After erection, sign faces shall be cleaned to allow adequate visibility of the sign at direct pay.

729.06 DEAD END ROAD INSTALLATIONS. Dead end road installations shall be of the specified type and located as shown on the plans. Timber barricade type installations shall be constructed in accordance with Section 812 and the following requirements. Timber piling shall be set in full depth holes and backfilled as directed or driven to required depth. Steel posts for other type installations shall be driven with a suitable protective cap. Piles and posts shall be vertical. Guard rail shall be constructed in accordance with Section 704.

729.07 ACCEPTANCE OF SIGNS. After installation of signs is complete, the engineer or an authorized representative will inspect the signs, sign faces, mounts, installations, hardware and matters relating to the requirements of this Section.

After this inspection the engineer and the Department's Sign Inspection Team shall inspect for color match and for conformance to applicable plans, standards and project specifications.

Color match, uniformity and spacing of legend, specular glare, and sign type and design will be inspected for conformance to plans and specifications. When specular reflection is apparent on any sign, its positioning shall be adjusted by the contractor to eliminate this condition. Signs shall be clean at the time of inspection. Reflective sheeting shall be free of cuts, scratches, breaks or other defects which might allow moisture to infiltrate and damage reflective cells. Nonstandard or otherwise unacceptable signs and traffic control devices shall be replaced or repaired as directed. The contractor will be required to correct damage that is discovered at the time of the sign inspection.

When the damage was obviously caused by vandalism, the contractor will be paid for corrective work in accordance with Subsection 109.04.

In lieu of removing and replacing new sign faces that have been rejected, sign overlay panels conforming to Subsection 729.05(c) may be used to correct the deficiencies at no direct pay.

729.08 MEASUREMENT.

(a) Sign Faces and Overlay Panels: Quantities for payment will be the design areas in square feet of sign faces as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Material used in blanks and backing incidental to the sign face will not be measured for payment. In determining the area of sign faces, no deductions are made for corner radii or mounting holes. The area of octagonal signs and Interstate shields is computed as the area of its smallest rectangle or square. The area of triangular signs is computed as the area of the triangle.

(b) Post Mountings: Post sign mountings, including breakaway supports, will be measured per each post.

(c) Overhead Mountings: Overhead sign mountings will be measured per each structure.

(d) Delineator, Object Marker and Milepost Assemblies: Delineator, hazard marker and milepost assemblies will be measured per each assembly.

(e) Dead End Road Installations: Dead end road installations will be measured per each installation.

(f) Footings: Concrete footings for overhead sign mountings will be measured per each footing. Footings and aprons for post sign mountings will not be measured for payment.

729.09 PAYMENT.

(a) Sign Faces and Overlay Panels: Payment for sign faces and overlay panels will be made at the contract unit price per square foot, which includes furnishing, fabricating and constructing the signs and furnishing necessary attaching devices.

(b) Post Mountings: Payment for post sign mountings will be made at the contract unit price per each, which includes furnishing, fabricating and constructing the support complete, ready for affixing signs, and includes required excavation, concrete and reinforcement for footings and aprons for the sign mounting.

(c) Overhead Mountings: Payment for overhead sign mountings, including bridge fascia mountings, will be made at the contract unit price per each, which includes furnishing, fabricating and erecting the structure complete, ready for affixing signs.

(d) Delineator, Object Marker and Milepost Assemblies: Payment for delineator, object marker and milepost assemblies will be made at the contract unit prices per each, which includes posts.

(e) Dead End Road Installations: Payment for dead end road installations will be made at the contract unit price per each, which includes piling, posts, barricades, sign materials, reflectors, and any required guard rail.

(f) Footings: Payment for footings for overhead sign mountings will be made at the contract unit price per each, which includes excavation, piling, concrete, reinforcing steel, anchor bolt assemblies and backfill.

Payment will be made under:

Item No.	Pay Item	Pay Unit
729(01)	Sign (Type A)	Square Foot
729(02)	Sign (Type B)	Square Foot
729(03)	Sign (Type C)	Square Foot
729(04)	Sign (Type D)	Square Foot
729(05)	Sign (Type E)	Square Foot
729(06)	Sign (Overhead Mounted)	Square Foot
729(07)	Sign (Overlay Panel)	Square Foot
729(08)	Mounting (_____ Size Post)	Each
729(09)	Mounting (Overhead Truss)(Ground Mounted)	Each
729(10)	Mounting (Overhead Truss)(Structure Mounted)	Each
729(11)	Mounting (Overhead Cantilever)(Ground Mounted)	Each
729(12)	Mounting (Overhead Cantilever)(Structure Mounted)	Each
729(13)	Mounting (Bridge Fascia Mounted)	Each
729(14)	Delineator Assembly (Ground Mounted)	Each
729(15)	Delineator Assembly (Structure Mounted)	Each
729(16)	Object Marker Assembly	Each
729(17)	Milepost Assembly (Ground Mounted)	Each
729(18)	Milepost Assembly (Structure Mounted)	Each
729(19)	Dead End Road Installations (Type)	Each
729(20)	Footings for Overhead Mounting (Type)	Each

Section 730
Electrical Systems

730.01 DESCRIPTION. This work consists of furnishing all necessary equipment and materials, performing all necessary work and making any necessary modifications or fabrications required for a complete, operational and safe system. The work shall also include furnishing and installing electrical equipment and materials required for air conditioning equipment, motors, controls, pumps and other appliances. The plans and these specifications are supplemental to the applicable codes, manufacturer's instructions, and best prevailing construction trade practices.

730.02 EQUIPMENT AND MATERIALS. Equipment and materials shall be suitable for the intended use and shall be furnished with all necessary hardware and components.

References to a specific manufacturer's name and/or catalog number is intended to denote the quality of the equipment or material and not to specifically exclude other acceptable products. When specified model or catalog numbers are in conflict with descriptive specifications, plans or system compatibility, the descriptive specifications, plans, or system compatibility shall govern.

Except for those products designated as fabricated or those that are no longer produced, all specified products shall be manufactured by companies that are regularly engaged in the production of the specified products.

The products specified shall be specifically designed, tested and manufactured for the purpose for which they will be used. Modification of equipment for other than design purposes will be permitted only when no currently manufactured products meet the specifications.

All equipment and materials shall be new. Like equipment and materials shall be made by the same manufacturer.

The item descriptions and specifications do not necessarily include or define everything necessary for a complete and operational item. When required, the contractor shall provide any modifications, fabrications, extra hardware, and equipment necessary for the satisfactory installation and operation of the system to coordinate with other items or conditions at no direct pay.

Materials shall conform to the following Sections and Subsections:

Backfill	203.06(b) and 1003.07
Portland Cement Concrete (Class M)	901
Reinforcing Steel	1009
Timber	1014
Anchor Bolts, Nuts and Washers	1015.02(c)(1)
Stainless Steel Hardware	1018.08(c)
Conduit	1018.09
Electrical Conductors	1018.10

730.03 CONTRACTOR REVIEW. The drawings are diagrammatic and do not show the exact location and size of equipment. The contractor shall coordinate the work to avoid interference and conflicts. The work shall conform to the applicable requirements of the latest National Electric Code, National Electrical Safety Code and U.L. Standards except where superceded by applicable laws. The contractor shall check mounting space, equipment dimensions, and installation requirements before ordering equipment. The contractor shall establish the electrical circuit requirements of all equipment to be served before ordering material. Where circuits are to serve specific appliances, equipment or feeders, the contractor shall verify the electrical requirements and the exact location of connection before installing the service to the equipment.

730.04 DRAWINGS AND EQUIPMENT SUBMITTALS. The contractor shall submit to the Bridge Design Engineer for approval shop drawings, working drawings and equipment brochures for all required equipment and materials. Nine prints of each drawing shall be supplied. Drawings submitted shall show construction details, dimensions, and ratings. Each sheet of every submittal shall be identified with the state project number, project name, fabricator's or manufacturer's name, and contractor's name. Drawings and submittals shall measure 8 1/2 inches x 11 inches or 22 inches x 36 inches. Corrections and/or comments made on submittals are not intended to relieve the contractor from compliance with the contract documents. The review and approval of drawings and equipment submittals are to assure that the quality of the equipment and materials meet the requirements of the contract documents.

Approval of the brochures and drawings does not imply that the equipment described is complete, can be constructed or installed, will operate successfully, or will coordinate with existing or other equipment specified. The contractor shall remain responsible for confirming and correlating all quantities and dimensions; for selecting fabrication processes and construction techniques; for coordination of the work; for performing the work in a safe and satisfactory manner; and for satisfactory installation and operation of equipment.

(a) Working Drawings: Before beginning construction, the contractor shall submit for approval a complete set of working drawings for the project. The intent of the working drawings is to provide the extra detail necessary to communicate the exact scope and details of construction. The drawings are also intended to resolve all potential conflicts between subcontractors, equipment compatibilities and equipment mountings. When the contract drawings are of sufficient detail, the contractor may request approval to use the contract drawings as working drawings. However, any errors on the working drawings are the responsibility of the contractor. The engineer may require the contractor to submit additional details to resolve conflicts or ambiguities which arise during construction.

(b) As-Built Drawings: Upon completion of the project, the contractor shall furnish one set of plans which reflect the final as-built condition of the electrical portion of the project. The drawings shall reflect the plan or field changes and shall include a complete equipment list showing each manufacturer's name and catalog or shop drawing number for each piece of equipment furnished. The drawings shall show the exact location of the underground wiring, light poles, junction boxes, under roadway crossings, service poles, controllers and conduits or cables.

Complete schematic and wiring diagrams shall also be required. Light poles shall be located by station number. Underground equipment shall be located by dimensioning to fixed objects. Drawings shall be photographic reproductions on cloth or 0.003 inch to 0.004 inch thick translucent polyester film matte surfaces on both sides which incorporate a silver halide emulsion image of a permanent type from which satisfactory prints may be made. Drawings shall measure 22 inches x 36 inches and have a title block showing project number, name, parish, contractor and date.

730.05 MAINTENANCE AND OPERATION INSTRUCTION BOOKLETS. Maintenance and operation instruction booklets shall conform to subsection 801.03(f)(2).

730.06 SYSTEM TESTING. The contractor shall furnish all testing equipment and conduct the tests required by the plans and specifications. A copy of the test results shall be provided to the engineer.

(a) Performance Tests: Equipment shall be given a minimum two week performance test before final acceptance. The performance test shall allow for the normal operation of the equipment during the testing period. When the normal operation is insufficient to adequately test the equipment, artificial cycling or continuous "on" periods will be required. The contractor shall correct any defective equipment, materials and workmanship.

(b) Receptacle Tests: After completion of the electrical system, the contractor shall test each receptacle for proper polarity and continuity of the ground.

(c) Special Tests: The contractor shall conduct special tests when equipment or systems are suspected of improper operation, or when additional data is necessary to determine proper operation.

(d) Insulation Tests: The contractor shall conduct megohm tests on all direct buried conductors and all other A.W.G. No. 10 and larger conductors. Tests shall be made after the conductors are installed and before connecting equipment that may be damaged by the tests. Readings below 50 megohms, when measured with a 1000 volt D.C. insulation tester, will be considered defective.

730.07 ELECTRICAL SERVICE. The contractor shall make arrangements with the power company for temporary and permanent electrical service and shall verify the exact location and points of attachment before installation.

(a) Temporary Service: Temporary electrical service, including power usage and installation shall be at no direct pay.

(b) Permanent Service: The Department will pay the power company for line extensions when the charges are not the result of contractor errors or failure to verify or coordinate with the power company.

(c) Power Usage: Power usage during construction and testing shall be at no direct pay.

730.08 MEASUREMENT.

(a) Trenching and Backfilling: Trenching and backfilling will be measured by the linear foot of trench excavated and backfilled, which will include excavation, backfilling, and any required compaction.

(b) Conduit with Conductors: Conduit with conductors will be measured by the linear foot of conduit which will include furnishing and installing conduit, conductors, clamps, fittings, junction boxes,

enclosed circuit breakers on structure, flexible metal conduit, and miscellaneous hardware required for conduit installation.

(c) Underground Cable: Underground cable will be measured by the linear foot of cable furnished and installed.

(d) Jacked or Bored Casing: Jacked or bored casings will be measured by the linear foot of casing furnished and installed, which will include the casing, concrete duct markers, fittings, and required excavation and backfill.

(e) Light Pole: Light poles will be measured per each pole furnished and installed which will include the pole, decals, ownership plate, wiring and connections to circuit conductors, base assembly, grout and oxide-inhibiting compound. Measurement for ground mounted poles will also include the concrete foundation, concrete apron, underground junction boxes in apron, anchor bolts, reinforcing steel, conduits in foundation, ground rod, ground wires, ground clamp, excavation, backfill, and disposal of excess excavated material.

(f) High Mast Poles: High mast poles will be measured per each pole furnished and installed, which will include the pole, luminaire ring, lowering assembly, drive assembly, grounding, wiring, electrical connections, fuses, mounting hardware, and grout. Measurement for ground mounted poles will also include the concrete foundation, anchor bolts, reinforcing steel, conduit in foundation, ground rod, excavation, backfilling, disposal of excess excavated material, and all hardware and appurtenances required for a complete installation.

(g) Luminaire: Luminaires will be measured per each which will include the luminaire, ballast, lamp, fuse, lightning arrestor, mounting, connections and hardware.

(h) Electrical Service Points: Electrical service points will be measured per each which will include pole, controller assembly, footing, anchor bolts, ground rod, conduits in footing, rigid conduit and conductors on utility company pole connections, hardware, and all equipment as shown on the plans.

(i) Electrical System: Electrical system will be measured on a lump sum basis, which will include furnishing and installing all equipment and apparatus, and performing all work required for a complete and operational electrical system.

(j) Fabricated Light Pole Supports: Fabricated light pole supports will be measured per each, which will include fabrication and installation of the support, concrete anchors, anchor bolts and nuts, and grout.

730.09 PAYMENT. Payment for electrical work will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
730(01)	Trenching and Backfilling	Linear Foot
730(02)	Conduit with Conductors (Size and Type)	Linear Foot
730(03)	Underground Cable (Size and Type)	Linear Foot
730(04)	Jacked or Bored Casing (Size and Type)	Linear Foot
730(05)	Light Pole (Size and Type)	Each
730(06)	High Mast Pole (Size and Type)	Each
730(07)	Luminaire (Size and Type)	Each
730(08)	Electrical Service Point (Type)	Each
730(09)	Electrical System	Lump Sum
730(10)	Fabricated Light Pole Support	Each

Section 731
Raised Pavement Markers

731.01 DESCRIPTION. This work consists of furnishing and placing raised pavement markers in accordance with plan details.

731.02 MATERIALS.

(a) Markers: Markers shall conform to Subsection 1015.09. The same product shall be used throughout the project. Markers shall be the specified class, type, color, size and shape.

(b) Adhesive: Markers shall be placed with bituminous adhesive on asphaltic surfaces and epoxy adhesive on portland cement concrete surfaces.

(1) Bituminous Adhesive: Bituminous Adhesive shall conform to Subsection 1015.09(d)(2).

(2) Epoxy Adhesive: Epoxy adhesive shall be Type V epoxy resin system conforming to Subsection 1017.02. Epoxy components shall be mixed in equal parts by volume. Adhesive shall be mechanically mixed and dispensed, unless hand methods are permitted.

731.03 CONSTRUCTION REQUIREMENTS.

(a) Weather Limitations: Markers shall not be applied when there is moisture on the surface.

(1) Epoxy Adhesive: When a normal set adhesive is used, application of markers will not be permitted at ambient air temperatures less than 50°F. When a rapid set adhesive is used, application of markers will be permitted at ambient air temperatures between 35°F and 50°F, provided adhesive is adequately heated to obtain proper viscosity for mixing and application, and provided adhesive is identified as a rapid set type on container labels and Certificates of Delivery.

(2) Bituminous Adhesive: Markers shall be applied when the ambient air temperature is 50°F or greater.

(b) Cleaning of Surfaces: Surfaces on which markers are to be applied shall be cleaned of all materials that may reduce the bond of adhesive. Surfaces shall be cleaned by blast cleaning or other approved methods which do not damage the surface; however, blast cleaning equipment shall be provided with positive cutoff controls. Surfaces shall be maintained in a clean dry condition until placement of markers.

(c) Application of Markers: Surfaces on which markers are to be placed shall be blown dry immediately prior to marker placement. Markers shall be applied to surfaces with adhesive in accordance with the manufacturer's recommendations.

(1) Epoxy Adhesive: Mixed adhesive shall have a uniformly grey color with no streaks of either black or white on the surface or within mixed adhesive. Voids in a cured undisturbed sample approximately 1/16 inch thick from the extrusion nozzle shall not exceed 4 percent by volume. Machine mixer and applicator shall be capable of accurately and uniformly proportioning the two components in a 1 to 1 ratio within 5

percent by volume of each component (i.e., within 47.5 to 52.5 percent for each component). Periodic checks of proportioning equipment shall be made to determine the actual ratio of components. This shall be done by placing containers in front of the mixing chamber and measuring the actual volume of each component. Equipment shall be arranged so it is possible to bypass the mixer to perform these periodic checks. Temperature of adhesive shall be maintained between 70°F and 110°F before mixing. The temperature shall be adjusted to prevent excessive flow of epoxy from the marker when installed. The area of the epoxy adhesive bed shall be equal to the bottom area of marker. Adhesive shall be applied in sufficient quantity to cause excess adhesive to be forced out around the perimeter of the marker. Voids in markers with an open grid pattern on bottom shall be filled with adhesive immediately prior to placement.

(2) Bituminous Adhesive: The adhesive shall be heated and melted in either thermostatically controlled double boiler type units utilizing heat transfer oil or thermostatically controlled electric heating pots. The melter/applicator unit shall be suited for both melting and pumping application through heated applicator hoses. The adhesive shall be heated to between 375°F and 425°F and applied directly to the pavement surface from the melter/applicator by either pumping or pouring. The area of the bituminous adhesive bed shall be a minimum of 6 inches in diameter. Markers shall be applied to the adhesive within 10 seconds. The marker shall be placed in the adhesive bed by applying downward pressure until the marker is firmly seated. Adhesive on exposed surfaces of markers shall be immediately removed with soft rags moistened with mineral spirits or kerosene. Markers shall be protected against impact until the adhesive has hardened. The adhesive may be reheated and reused; however, the pot life at application temperatures shall not be exceeded.

731.04 MEASUREMENT. Raised pavement markers will be measured by counting the number of markers furnished, placed, and accepted.

731.05 PAYMENT: Payment for raised pavement markers will be made at the contract unit prices per each under:

Item No.	Pay Item	Pay Unit
731(01)	Nonreflectorized Raised Pavement Markers	Each
731(02)	Reflectorized Raised Pavement Markers	Each

Section 732
Plastic Pavement Markings

732.01 DESCRIPTION. This work consists of furnishing and placing reflective pavement markings of hot applied thermoplastic or preformed cold applied plastic at the locations shown on the plans or as directed, in conformance with the MUTCD, plan details and these specifications.

732.02 MATERIALS.

(a) Thermoplastic Markings: Thermoplastic marking material shall be a plastic compound reflectorized by internal and external application of glass beads, conforming to Subsections 1015.10 and 1015.13, respectively. Width and color of markings shall be as specified.

Thermoplastic material shall be delivered in containers of sufficient strength to permit normal handling during shipment and transportation without loss of material. Approved heat-degradable containers that can be placed in heating kettles along with the plastic material will be permitted. Each container shall be clearly marked to indicate color of material, process batch number, name of manufacturer and date of manufacture. Glass beads used in drop-on application to molten plastic shall be shipped in sacks of multi-ply paper or burlap, both with a polyethylene liner. The sacks shall be strong enough to permit handling without damage, and have a capacity of 50 pounds of beads. Sacks shall be sufficiently water-resistant so that beads will not become wet or caked in transit.

(b) Preformed Plastic Markings: Preformed plastic markings shall conform to Subsection 1015.11.

732.03 CONSTRUCTION REQUIREMENTS.

(a) Equipment for Thermoplastic Markings: Material shall be applied to pavement by either spray or extrusion methods. Equipment shall provide continuous mixing and agitation of material. Conveying parts of equipment between main material reservoir and discharge mechanism shall prevent accumulation and clogging. Parts of equipment which come in contact with the material shall be easily accessible for cleaning and maintaining. Mixing and conveying parts shall maintain material at the application temperature. Equipment shall be capable of producing continuous uniformity in dimensions of stripes. Equipment shall be capable of producing various widths of traffic markings. Glass beads shall be applied to the molten surface of completed stripes by an automatic bead dispenser attached to the striping machine in such manner that beads are dispensed simultaneously with the thermoplastic material at a controlled rate of flow on installed lines. The glass bead dispenser shall be equipped with an automatic cutoff control synchronized with cutoff of thermoplastic material. Kettles to hold a minimum of 1,000 pounds of material shall be provided for melting and heating thermoplastic material. Kettles shall be equipped with automatic temperature control devices so that heating can be done by controlled heat transfer liquid

rather than direct flame, to provide positive temperature control and prevent overheating of material. Applicators and kettles shall be equipped and arranged to comply with requirements of the National Board of Fire Underwriters. Applicators shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. Applicator equipment shall consist of a motorized mobile unit capable of installing traffic stripes either left or right of applicating unit so that only one lane of traffic will be occupied during installation.

Applicators shall produce sharply defined lines and provide means for cleanly cutting off stripe ends and applying broken lines. The applicator unit shall have a tachometer or other approved device to insure uniform application at the required rate. It shall be adjustable for applying 1, 2, or 3 adjacent lines simultaneously at the specified spacing. The ribbon extrusion die or shaping die shall not be more than 2 inches above the roadway surface during application.

(b) Weather Limitations: Application of markings will not be permitted when there is excessive pavement moisture or when the surface temperature or ambient temperature is below 50°F. The pavement shall be considered excessively moist when it is visibly wet or when a 1 square foot piece of polyethylene film condenses moisture after being placed on the pavement surface for 15 minutes.

(c) Cleaning of Surfaces: Surfaces on which markings are to be applied shall be cleaned of materials that may reduce adhesion of the thermoplastic marking materials to the pavement. Cleaning shall be done by blast cleaning or grinding. Surfaces shall be kept clean until placement of markings.

Existing thermoplastic markings on the roadway that are not flaking or peeling do not require removal prior to placement of new thermoplastic markings. When thermoplastic markings will replace the existing painted markings, the existing painted markings do not require removal prior to applying new thermoplastic markings, provided the existing painted markings are not flaking or peeling.

Existing lane line pavement markings on bridges shall be removed prior to applying new markings.

When preformed plastic markings will replace any of the existing markings, the existing markings shall be removed prior to applying the preformed plastic markings.

Removal shall be accomplished by methods which will not damage the pavement or bridge deck. Removal shall be to such extent that 75 percent of the pavement surface or bridge deck under the markings is exposed. At the end of each day's operations, temporary pavement markings conforming to Section 713 shall be placed in areas where existing markings have been removed and new markings not placed. Temporary pavement markings shall be satisfactorily removed prior to resuming plastic striping operations.

(d) Application of Markings: Material shall be installed in specified widths from 4 inches to 24 inches. Finish lines shall have well defined edges and be free of waviness. Measurements shall be taken as an average through any 36-inch section of line. Longitudinal lines shall be offset approximately 2 inches from longitudinal joints. A tolerance of +1/2 inch and -1/8 inch from the specified width will be allowed, provided the variation is gradual. Segments shall square off at each end without mist or drip. Transverse variations from the control device up to 1 inch will be allowed provided the variation does not increase or

decrease at the rate of more than 1/2 inch in 25 feet. Lines not meeting these tolerances shall be removed and replaced at no direct pay.

(1) Thermoplastic Markings: Thickness of material, not including drop-on beads, shall be not less than 90 mils for lane lines, edge lines and gore markings and not less than 125 mils for crosswalks, stop lines, and word and symbol markings. A binder-sealer material recommended by the thermoplastic marking manufacturer shall be applied to the portland cement concrete pavement surface or bridge deck prior to application of the thermoplastic markings. Thermoplastic material shall be applied either by extrusion at 390°F to 450°F or by spray at 410°F to 450°F. Immediately after application of the markings, glass beads shall be applied at a minimum rate of 300 pounds per mile. Material shall not scorch or discolor when kept at this temperature range for 4 hours.

(2) Preformed Plastic Markings: Plastic material shall be applied by removing release paper and applying adequate pressure to ensure proper adhesion. Material not adhering properly shall be satisfactorily corrected at no direct pay.

732.04 MEASUREMENT.

(a) Plastic Pavement Striping: Plastic striping will be measured by the linear foot or mile, as specified.

(1) Linear Foot: Measurement will be made by the linear foot of striping, exclusive of gaps.

(2) Mile: Measurement will be made by the mile of single stripe per roadway. No deduction will be made for standard 30-foot design gaps in broken-line striping; however, deductions will be made for the length of other gaps or omitted sections.

(b) Plastic Pavement Legends and Symbols: Plastic legends and symbols will be measured per each legend or symbol. Symbols shall include all letters, lines, bars or markings necessary to convey the message at each location.

(c) Removal of Existing Markings: Removal of existing markings will be measured by the mile and will include removal of lane lines, edge lines, gore markings, symbols and raised traffic markings for the full roadway and shoulder width.

732.05 PAYMENT. Payment for plastic pavement markings and removal of existing markings will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
732(01)	Plastic Pavement Striping (__" Width)	Linear Foot
732(02)	Plastic Pavement Striping (Solid Line) (__" Width)	Mile
732(03)	Plastic Pavement Striping (Broken Line) (__" Width)	Mile
732(04)	Plastic Pavement Legends and Symbols (Type)	Each
732(05)	Removal of Existing Markings	Mile

Section 733
Concrete Roadway Barriers

733.01 DESCRIPTION. This work consists of furnishing and constructing concrete barriers for roadways. Barriers may be precast or cast-in-place concrete, at the contractor's option.

733.02 MATERIALS. Materials shall conform to the following Sections and Subsections.

Portland Cement Concrete	901
Joint Materials	1005
Reinforcing Steel	1009
Curing Materials	1011.01
Special Surface Finish Materials	1011.03

Cast-in-place concrete shall be Class M. Precast concrete shall be either Class A or Class P, except that the compressive strength requirements of Class P concrete shall be the same as specified for Class A concrete.

733.03 CONSTRUCTION REQUIREMENTS. Barriers shall be constructed in accordance with Sections 805 and 806 as modified herein. Exposed surfaces of barriers shall be given a Class 2A finish in accordance with Subsection 805.13(c).

The contractor shall perform necessary excavation and backfilling for barriers and shall dispose of excess excavated material in accordance with Subsection 202.02.

Slip-formed concrete shall be placed with an approved slip-form placing machine designed to spread, vibrate, consolidate and finish concrete in one pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense, homogeneous unit. Sliding forms shall be rigidly held together to prevent spreading of forms. After passing there shall be no noticeable slumping of concrete. Concrete shall be held at a uniform consistency, having a slump of 1/2 inch to 1 1/2 inches.

Expansion joints shall be formed in accordance with plan details and shall be located at the junction of the barrier with bridge railings, footings for sign supports and light standards, and other fixed structures. Vertical joints in barriers shall match joints in existing underlying concrete pavement. When pavement joint spacing exceeds 20 feet, intermediate joints shall be placed as required, but shall not exceed a 20-foot spacing. Vertical joints shall be formed to a minimum depth of 1 1/2 inches by an approved jointing tool or sawing the plastic concrete.

733.04 MEASUREMENT. Quantities of concrete barriers for payment will be the design lengths as specified on the plans and adjustments thereto. Design lengths will be adjusted if the engineer makes changes to adjust

to field conditions, if plan errors are proven, or if design changes are made.

Design quantities are based on lengths of continuous sections of barrier, including joints but excluding other openings in the barrier. Required concrete, excavation, backfill, disposal of excess excavated material, reinforcement, joint materials and admixtures will not be measured for payment.

733.05 PAYMENT. Payment for concrete barriers for roadways will be made at the contract unit price per linear foot under:

Item No.	Pay Item	Pay Unit
733(01)	Concrete Roadway Barrier (Type)	Linear Foot

Section 734
Breaking and Seating Pavement

734.01 DESCRIPTION: This work shall consist of breaking and seating existing portland cement concrete pavement for full depth and full lane width in accordance with these specifications.

734.02 MATERIALS: Materials shall conform to the following Sections:

Asphaltic Concrete	501
Asphaltic Tack Coat	504

734.03 EQUIPMENT: Equipment necessary for satisfactorily breaking and seating pavements shall be furnished and maintained by the contractor and shall include the following.

(a) Breaking Device: The breaking device shall be capable of delivering adequate energy to satisfactorily break the pavement. The breaker shall be equipped with plate-type shoe with a minimum striking area of 1 square foot designed to prevent penetration into the existing surface. A screen satisfactory to the engineer shall be provided to prevent flying chips during the breaking process. The breaking operation shall not damage the base course, approach slabs, and drainage structures.

(b) Roller: The roller shall be a pneumatic-tire roller consisting of 4 rubber-tired wheels equally spaced across the full width of the roller and mounted in line on a rigid steel frame in such a manner that all wheels carry equal loads, regardless of surface irregularities. Roller tires shall be capable of satisfactory operation at a minimum inflation pressure of 100 psi, and tires shall be inflated to the pressure necessary to obtain proper surface contact pressure to satisfactorily seat pavement slabs. At the contractor's option, tires may contain liquid. The roller shall have a gross weight of either 35 or 50 tons. Ballast shall be such that gross roller weight can be readily determined and controlled to maintain the gross roller weight. The roller shall be towed with a rubber-tired prime mover capable of maintaining speeds of 2 mph and capable of turning 180 degrees within a 30-foot width.

The roller may be a two-axle self-propelled pneumatic-tire roller, providing the roller is equipped with no more than 7 tires. The requirements listed above shall be met.

734.04 CONSTRUCTION REQUIREMENTS:

(a) Size Requirements: The existing portland cement concrete pavement shall be broken so that the pavement is generally 24-inches or smaller, with no more than 20 percent of the material larger than 24 inches and no individual fragments larger than 30 inches. The extent of the breakage will be based on cracks visible to unaided normal vision when the pavement surface is dry. The use of water to detect additional cracks will not be permitted.

The engineer shall continuously monitor the breaking operation. The contractor shall make adjustments in the striking pattern, striking energy, number of passes, or other factors to continually achieve acceptable breaking throughout the project with the approval of the engineer.

(b) Test Section: Before breaking operations begin, the engineer will designate a test section. The contractor shall break the test section using varying energy and striking patterns and, when necessary, repeated passes of the equipment over the pavement until the test section is acceptably broken as specified in Heading (a). The extent of breakage of the test section shall be used as a guide for breaking the pavement on the remainder of the project. The engineer may require additional test sections any time during the course of the work that the size requirements are not met. The contractor shall not deviate from the approved pattern unless directed by the engineer.

(c) Seating: A minimum of five one-way passes of a 50-ton roller, or seven one-way passes of a 35 ton roller, will be required. A rolling pattern shall be used that will ensure that the entire area of the broken pavement is well seated. During operation of the roller, no bridges or drainage structures shall be displaced, overloaded or otherwise disturbed. The loaded roller shall not be operated outside of construction limits.

(d) Leveling: Unless otherwise directed, after completion of breaking and seating operations, the contractor shall place asphaltic tack coat and a minimum of 1 1/2 inches of asphaltic concrete as a leveling course. Leveling course shall consist of either binder or wearing course, at the contractor's option. Pavement areas that have been broken and seated shall not be left unsurfaced longer than 24 hours.

There shall be no application of the seating roller after placement of the leveling course.

734.05 MEASUREMENT:

The area of existing portland cement concrete pavement acceptably broken and seated will be measured by the square yard. The width for measurement will be the actual width of the existing portland cement concrete pavement. The length will be the centerline length measured along the surface of each roadway or ramp.

734.06 PAYMENT: Payment for breaking and seating pavement will be made at the contract unit price per square yard and shall include all labor, equipment, materials and incidentals necessary to acceptably break and seat the existing portland cement concrete pavement. Payment for asphaltic concrete will be made under Subsection 501.14.

Payment will be made under:

Item No.	Pay Item	Pay Unit
734(01)	Breaking and Seating Pavement	Square Yard

Section 735
Undersealing Pavement

735.01 DESCRIPTION. This work consists of drilling holes in concrete pavement and pumping fly ash/cement slurry under the pavement to fill cavities (undersealing) or to raise the elevation of the pavement slabs (slabjacking).

735.02 MATERIALS.

(a) Portland Cement: Cement shall be Type I or I(B) conforming to Section 1001.

(b) Water: Water shall conform to Subsection 1018.01.

(c) Fly ash: Fly ash shall conform to Subsection 1018.15.

(d) Powdered Ammonium Lignin Sulphonate: Powdered ammonium lignin sulphonate may be used as a fluidifier and water-reducing agent.

735.03 EQUIPMENT. Equipment shall include the following.

(a) Air Compressors and Drills: Air compressors shall be equipped with air-lift pneumatic drills capable of drilling the required holes.

(b) Mixer: Mixer shall be a high speed (800 to 2000 RPM) colloidal mixer, or as approved, capable of thoroughly mixing slurry ingredients.

(c) Roller: The roller shall be a pneumatic-tire vehicle capable of exerting a single-axle load of 9 tons.

735.04 PROPORTIONING AND CONSISTENCY.

(a) Proportioning: The slurry shall consist of one part portland cement and three parts fly ash by volume and water sufficient to meet the consistency requirements of Heading (b). When directed or approved, powdered ammonium lignin sulphonate shall be added at the rate of 0.5 to 1.5 percent by weight of cement.

(b) Consistency: The slurry shall be of such consistency that the efflux time from the flow cone, when tested in accordance with DOTD TR 633, is 12 to 18 seconds for undersealing, and 15 to 26 seconds for slabjacking.

735.05 CONSTRUCTION REQUIREMENTS.

(a) General: Holes of approximately 1 1/2 inches in diameter shall be drilled through pavement at locations specified on the plans or as directed. Drills shall be rotated to avoid cracking pavement and shall be held as nearly perpendicular as possible to pavement surfaces. Holes shall be cleaned with compressed air under pressure prior to undersealing. Holes which cannot be satisfactorily used shall be filled with slurry and new holes drilled. No more holes shall be drilled than can be used during a day's operations.

After holes are drilled, a pipe connected to the discharge hose of the pressure pump shall be lowered into the hole. Discharge end of the pipe shall not extend below the bottom of pavement.

When stooling of slurry occurs, additional holes shall be provided in the slab as directed. A more fluid slurry shall be pumped through these new holes to fill voids between stools.

When back pressure forces slurry out of the hole onto the slab after withdrawal of discharge pipe, the hole shall be temporarily plugged until the slurry has set. After completion of pumping in a hole, the discharge pipe or plug shall be removed and the hole filled with slurry.

Drainage structures shall be kept clean of slurry mixture. The contractor shall monitor all drainage structures within the areas being pumped. When the pumping operation is forcing the slurry into a drainage structure, the contractor shall discontinue pumping operations and immediately clean the drainage structure of slurry mixture.

When directed, undersealed or slabjacked pavements shall be proof rolled with the specified roller; however, proof rolling shall not be conducted until at least 24 hours after completion of undersealing at no direct pay. When such proof rolling indicates that cavities exist beneath the slab, such cavities shall be filled as directed at no direct pay.

Pavement and shoulder surfaces shall be kept free of slurry mixture during undersealing operations.

Pumping operations shall be discontinued at least 1 hour before opening the pavement to traffic.

(b) Undersealing: Pumping of slurry into a hole shall continue until all voids beneath the pavement are filled. Lifting of the slab or slurry flowing out of an adjacent hole, through pavement joints or cracks, or out of the shoulder-pavement joint shall be sufficient evidence that all cavities are filled within range of the hole being pumped. Pumping pressures over 200 psi will not be permitted. When pressures cause pavement lifting, a lower pumping pressure shall be used. Lifting of the slab as a result of pumping shall not exceed 1/8 inch. The contractor shall monitor the slab lifting by approved methods at all times during undersealing. Any pumping operation that causes voids to form under the pavement in the immediate area shall be terminated. The sequence of pumping from hole to hole shall be as directed.

(c) Slabjacking: Pumping operations for slabjacking shall be conducted in an approved manner and sequence. The contractor shall monitor the slab lifting at all times during pumping operations. Pumping shall continue until pavement slabs have been raised to the required grade within a tolerance of ±1/8 inch.

735.06 MEASUREMENT. Undersealing or slabjacking pavement will be measured per hundredweight (CWT) of portland cement used in the slurry. Holes for undersealing or slabjacking will be measured per each. Fly ash, admixtures and water will not be measured for payment.

735.07 PAYMENT. Payment for undersealing pavement, slabjacking pavement and holes will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
735(01)	Undersealing Pavement	CWT
735(02)	Slabjacking Pavement	CWT
735(03)	Holes	Each

Section 736
Traffic Signals

736.01 DESCRIPTION. This work consists of furnishing and installing necessary materials and equipment to complete new traffic signal systems or modify existing systems in accordance with plan details and these specifications.

Unless otherwise specified, all materials shall be new.

When existing systems are to be modified, the existing material shall be incorporated in the revised system, salvaged or abandoned, as specified.

Incidental parts which are not shown on the plans, specified herein or in the project specifications, and which are necessary to complete the traffic signal or other electrical systems or required for modifying existing systems, shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the engineer at the time of final acceptance.

736.02 MATERIALS: Materials shall conform to the following Sections and Subsections:

Usable Soil	203.06
Portland Cement Concrete, Class M	901
Reinforcing Steel	1009
Precast Reinforced Concrete Junction Boxes and Manholes	1016
Manhole Frames and Covers	1018.04
Ground Rods	1018.05
Rigid Metal Electrical Conduit	1018.09
Electrical Conductors	1018.10
Traffic Signal Heads	1020.01
Traffic Detectors and Associated Equipment	1020.02
Traffic Signal Hardware and Equipment	1020.03
Pedestal Anchor Bolts	1020.03(c)
Support Cable	1020.03(d)
Guy Components	1020.03(e)
Traffic Signal Cable	1020.03(f)
Electrical Junction Boxes	1020.03(g)
Poles for Traffic Signal Systems	1020.04
Steel Standards and Mast Arms	1020.04(c)

736.03 REGULATIONS AND CODE. Electrical equipment shall conform to the latest standards of the NEMA or the RMA, whichever is applicable. In addition to the requirements of these specifications, the plans, and the project specifications, material and work shall conform to the latest requirements of NFPA No. 70 National Electrical Code and ANSI C2 National Electrical Safety Code, the Standards of ASTM, ANSI, MUTCD, ITE and IMSA. The term code as referred to in this Section shall be the NFPA

No. 70, National Electrical Code, and ANSI C2, National Electrical Safety Code. Discrepancies between codes or standards and these specifications, shall be resolved in accordance with Subsection 105.04.

736.04 GENERAL REQUIREMENTS.

The contractor shall verify the location of existing utilities prior to construction. The contractor shall verify the practicality of the location, elevation, and orientation of foundations for poles and pedestals prior to ordering materials.

Traffic control equipment to be salvaged shall be protected during removal and delivery to the specified location. Equipment not to be salvaged shall become the property of the contractor and shall be disposed of in accordance with Subsection 202.02.

The contractor shall use the existing equipment or provide traffic signal equipment during the period of construction for continuous operation of the signal system at no direct pay. Traffic control operations and construction shall be in accordance with the plans or these specifications. Operational differences shall be submitted in writing and approved in advance by the Traffic Engineer.

The contractor shall provide police supervision of traffic at any time the traffic signal system is not in operation at no direct pay.

Minimum clearances for traffic signal supports and apparatus shall be in accordance with the MUTCD. Poles shall be located a minimum of 2 feet outside the shoulder or a minimum of 10 feet outside the edge of the travelway whichever is greater.

The contractor shall provide the Traffic Services and Operations Engineer drawings and equipment submittals in accordance with Subsection 730.05. Shop drawings and submittals shall include cam breakout details and circuit identifications.

Upon completion of signal and controller work, each cabinet shall contain a plastic envelope with a completed copy of the Traffic Signal Inventory Form, LA. DOTD TSI-1 and a copy of the field wiring terminations pertaining to that intersection. The contractor shall submit to the District Traffic Engineer related documents including equipment manuals, traffic studies, copies of wiring diagrams, and manufacturer's certification letters, for each intersection prior to the new signals or signal modifications becoming operational.

736.05 ELECTRICAL SERVICE.

The contractor shall verify the location of the power source and arrange for electrical service in accordance with Subsection 730.09. Existing power service shall be used unless a new power source is indicated on the plans. The traffic signal control equipment shall be in the same quadrant as the power source. If the power source is not in the same quadrant, the contractor shall submit a detailed drawing of proposed changes for approval.

At each power source, a 1-inch diameter conduit with conductors shall be attached to the service pole and terminated with a threaded service entrance fitting (weatherhead) at a height designated by the power company. The wires shall extend a minimum of 2 feet beyond the weatherhead.

736.06 FOUNDATIONS.

Excavation for mast arm and strain pole foundations shall be drilled with an auger. Excavation for pedestal poles may be made with an

approved auger or by hand. When a cave-in occurs during excavation, the contractor may continue excavating using casing or sleeving. Cave-ins shall be repaired before the foundation is placed. When subsurface obstructions are encountered, the contractor shall remove the obstructions or replace the excavated material and relocate the foundation, as directed, at no direct pay. Forms and ground which will be in contact with concrete shall be thoroughly moistened before placing concrete.

Foundations shall be cast monolithically. The exposed portions shall be formed to present a neat appearance. The bottom and sides of concrete foundations shall rest on firm undisturbed ground. Pole foundations shall be placed with the bored hole as the form. Backfill around a cast-in-place foundation will not be allowed.

Tops of foundations for poles and signal supports, except special foundations, shall be finished at grade of curb top or sidewalk or as directed. Conduit ends and anchor bolts shall be placed in correct position and shall be held in place by a template.

Exposed surfaces of concrete shall receive a Class 1, Ordinary Surface Finish in accordance with Subsection 805.13 except when the edge of a concrete foundation is within 18 inches of a sidewalk, the sidewalk section shall be in accordance with Section 706.

The tops of mast arm foundations shall be level so the pole base will be in full contact and the pole will be vertical without the use of shims. Anchor bolts shall extend a minimum of 1/4 inch above the nut.

Conduits which terminate in anchor base type poles and pedestals shall extend approximately 3 inches above the foundation and shall be aligned toward the handhole opening.

An additional 2-inch diameter conduit stub-out shall be installed in foundations for future use. The foundation shall be marked as shown on the plans to indicate the location of the additional conduit and grounding conduit.

736.07 PEDESTAL POLES: The pedestal poles shall be installed plumb within 1 inch at the top. Pedestal poles not constructed within the 1-inch tolerance shall be removed and the foundation reconstructed at no direct pay. Shims will not be permitted on a new pedestal foundation. A total of 1/4 inch of shims will be permitted on existing foundations. When an existing pedestal pole cannot be shimmed within tolerance through no fault of the contractor, the existing foundation shall be replaced in accordance with Subsection 109.04.

736.08 MAST ARMS: After installation and loading, mast arm shaft shall be plumb within 1 inch at the top. The end of the mast arm shall be a minimum of 5 feet above the top of the shaft. The end of the mast arm shall be a minimum of 21 feet above the bottom of the transformer base. The mast arms shall be installed with compression grommet bushing (CGB) connectors in bosses utilized for cabling.

736.09 STRAIN POLES.

Strain poles for the attachment of support cables shall be the anchor base type. Support cable shall be attached in accordance with Subsection 736.12. Poles shall be plumb within 6 inches at the top after support cable tensioning in accordance with the plans.

736.10 TIMBER POLES.

Poles shall be set in holes drilled by an auger to a minimum depth of 6 feet. Auger diameter shall be approximately 4 inches greater than

the pole butt diameter. The poles shall be plumb within 6 inches at the top after support cable tensioning in accordance with the plans. Backfill material shall be provided and compacted as directed.

Holes for the attachment of support cables shall be fitted with 5/8-inch diameter thimble-eye through-bolts and 2 1/2-inch square curved washers.

Each pole shall have a continuous length of No. 8 AWG copper wire along the length of the pole. A minimum of 6 feet of the copper wire shall be coiled and attached to the bottom of the pole forming a coil ground. The copper wire shall extend a minimum of 6 inches above the top of the pole. The wire shall be stapled with galvanized 1 1/2-inch staples at approximately 6-inch intervals beginning at the butt, then at approximate 1-foot intervals beginning at 12 feet from the butt and continuing to the top of the pole.

The poles shall be embedded in the ground a minimum of 20 percent of the pole length.

Anchors shall be installed on new poles in accordance with the plans.

736.11 GUY WIRE ASSEMBLIES.

Guy wire shall be attached to the pole with a 5/8-inch diameter angle thimble-eye bolt of appropriate length through a lift plate fastened to the pole by two 3/8-inch diameter lag screws. The opposite side of the pole shall have a 2 1/2-inch square curved washer, a square nut, and a thimble-eye nut for termination of support cable. An additional square nut shall be used as a locking nut against the thimble-eye nut.

Hardware shall be tightened against the pole. Excess bolt length shall be sawn to within 1/4 inch of the nut and the galvanized coating repaired in accordance with Subsection 811.15.

The guy assembly shall have strain insulator, thimble eye anchor rod, service sleeves, and screw-type anchors as shown on the plans. Installed anchors shall develop holding strength and be properly aligned to provide permanent stability to the installation.

Guy assemblies shall be installed and tensioned before erection of signals so that they will resist the major portion of the horizontal loading.

736.12 SUPPORT CABLE.

Support cable with accessories shall be installed between two or more poles to provide support and attachment for traffic control equipment. Support cables shall be grounded. Accessories used with support cables shall include strain insulators and three-bolt clamps. Long strain insulators shall be used as needed for safety clearance and shall require approval when not shown on the plans. Attachments of the support cable shall be made with standard thimble-type hardware.

736.13 VEHICLE AND PEDESTRIAN SIGNAL HEADS.

Signals shall be vertical unless otherwise specified. Cable suspended heads shall be fitted with a universal hanger. Drop pipes will be allowed only when necessary to provide proper roadway clearance. Disconnect hangers shall be required for cable suspended heads.

Mast arm mounted signals shall be installed using an approved adjustable rigid bracket.

Each bulb in the signal head shall be connected to an individual wire from the controller. Lamp sockets shall be rotated to position the open portion of the lamp filament upward.

Each signal head shall be oriented to its lane or crosswalk and secured in place by a serrated or other locking device incorporated in signal housing and support hardware. Supporting brackets on trunnions shall be used at the top and bottom of the section assembly to rigidly support all faces. Openings not used for mounting purposes shall be closed with approved threaded weatherproof plugs.

A minimum of 8 feet between signal heads is required, measured between imaginary lines centered on each signal head parallel to the approach. The signal head shall be aimed within 3 degrees of parallel to the approach lane to which it applies, or as directed.

Vehicular signal heads shall be covered with a sturdy opaque material until placed in service.

736.14 VEHICLE LOOP DETECTOR INSTALLATION.

Slots shall be sawed in the pavement for installation of vehicle detector loop wire in the configuration, dimensions, and combinations as shown on the plans. An extension from the loop to the pavement edge shall be cut to permit wire routing to an adjacent pullbox or conduit.

Slots shall be cleaned of loose material. The engineer shall examine and approve the depth of each loop slot for conformance with the plans before the contractor places the loop wires in the slot. Wires shall be carefully placed in the slot. The number of turns of wire installed for each loop shall be as required. The wire shall be pushed carefully into the slots with a blunt tool to avoid damaging the insulation. No splices will be permitted in the loop installation except in the pull-box, conduit fittings or pole. Wires from the pavement to the controller box shall be installed inside a conduit as shown on the plans. Wire installed from the pavement edge to the splice shall be twisted uniformly at two to five turns per foot. The loop ends shall be spliced to a lead-in cable. The lead-in cable shall be connected inside the controller cabinet. The wires shall be spliced using an approved connector or by soldering, then encapsulated with an approved electrically insulating waterproof epoxy.

The slots shall be completely filled to within 1/8 inch of the pavement surface with an approved sealant.

736.15 PEDESTRIAN PUSHBUTTON.

Pushbuttons shall be installed on poles or pedestals at locations where the signal head is visible from the pushbutton location. Pushbuttons mounted on steel poles shall be serviced by wiring inside the poles. Wires shall be installed through a 3/4-inch diameter hole in the pole and through the back of housing and shall be installed with a rubber grommet. Unused conduit attachment holes shall be plugged. The housing shall be attached to the pole using machine or selftapping screws.

Pushbuttons mounted on wood poles shall be wired through conduit.

Pedestrian pushbutton signs shall be installed above the pushbutton.

736.16 ELECTRICAL.

Wires in cabinets shall be neatly laced into cables with nylon lacing or plastic straps.

Conductors shall be installed in conduit except where the run is inside poles or suspended from support cable.

After completion of field wiring, the conduit entering cabinets, pole bases, or junction boxes shall be sealed with a removable sealing material compatible with the cable jacket, insulation and conduit material.

Support cable, metallic cable sheaths, conduit, transformer cases, metal poles and pedestals shall be made mechanically and electrically secure and grounded. Bonding and grounding jumpers shall be No. 6 AWG copper wire. Equipment on wood poles shall be grounded.

Cable from the circuit breaker at the service to the controller shall consist of a minimum of three No. 6 AWG THWN stranded copper wires.

Six feet of spare signal, loop lead-in and communication cable shall be installed in each base-mounted cabinet. Field wiring shall be connected to terminals by one piece, screw-tightened lugs.

Aerial signal cable shall have a drip loop extending at least 6 inches below the entrance. The aerial signal cable and drip loop shall not chafe on the equipment.

Signal cable shall be installed between signal heads and controller cabinets. When specified, interconnect and/or communication cable shall be installed between controller cabinets of different intersections. Signal, interconnect, and/or communication cable may be lashed to support cable or installed in underground conduit as shown on the plans. Lashing material shall be stainless steel for interconnect and aluminum for signal cable.

736.17 CONDUIT INSTALLATION.

Underground wiring shall be enclosed in conduit. Conduit connections shall use threaded couplers and shall be sealed with a waterproof sealant. Coupling of new conduit to existing conduit shall be with a three-piece coupling.

Threads shall be clean cut, straight and true, and of sufficient length to permit full-depth coupling. Excessive threads will not be permitted. Ends of conduit installed for future connections shall be threaded, reamed and capped. Couplings shall be tightened until the conduit ends are together. Damaged coatings in exposed threads shall be repaired in accordance with Subsection 811.15. Exposed threaded ends of conduit shall be terminated with an insulated-throat, ground-type bushing.

Backfilling shall be with usable soil, placed and compacted to at least the density of the surrounding ground at no direct pay. After installation, conduits shall be tested for clearance with a 2-inch long mandrel having a diameter 1/4-inch smaller than the inside diameter of the conduit. Conduits not allowing passage of the mandrel will be rejected.

The contractor may install larger size conduit at no direct pay. No reducing couplings will be permitted in a conduit run.

Underground conduits shall be buried a minimum of 18 inches below the surface. Conduits for loop detectors shall be installed parallel to existing or proposed curbs and a maximum of 2 feet behind the back of curb or as directed. Conduit shall be jacked or bored under existing pavements and within the drip line of trees in accordance with Section 728.

736.18 CONTROL EQUIPMENT:

Field wiring in controller cabinets and bases shall be neatly arranged, lashed into cables, routed to the appropriate terminal blocks, and permanently identified near the terminal.

Controller equipment programming shall be provided by the contractor. When the information supplied by the Department is insufficient for functional operation of the installed equipment, the contractor shall notify the engineer in writing of the problem identifying discrepancies, and proposing specific remedies or corrections. After programming, controller equipment operations shall be tested with the signals off, using the signal shutdown switch.

736.19 JUNCTION BOXES.

Junction boxes are required a minimum of every 150 feet in a conduit run unless otherwise shown on the plans. Backfilling shall be with usable soil, shall conform to Subsection 701.08, and shall be placed and compacted to the density of the surrounding ground at no direct pay. All metal covers and conduits shall be bonded together.

Electrical conductors shall be installed clear of the metal frames and covers.

736.20 EQUIPMENT TESTING.

(a) Manufacturer's Tests: When design tests are specified herein, additional tests will not be required if documentation is provided indicating that such tests have been previously completed. Equipment shall be subject to factory demonstration tests and design approval tests at a location agreed upon by the contractor and the Department. The Department reserves the right to have its representative witness all factory demonstration tests and design approval tests.

Performance tests may be required on equipment not previously tested or approved. The Department will not be responsible for time lost or delays caused by sampling and testing prior to final approval of any item.

The contractor shall conduct special tests when equipment or systems are suspected of improper operation, or when additional data is necessary to determine proper operation or conformance with specifications.

A test shall be performed on the completely assembled equipment, cabinet, and control equipment by the manufacturer prior to shipment. Malfunctions or defects shall be corrected and the equipment retested. The complete log beginning with the first test, showing the results of the test shall be delivered with the equipment. The test shall require the operation of the equipment with each signal circuit connected to an incandescent load of a minimum of 600 watts. The equipment shall operate sequentially and continuously for a minimum of 48 hours as stated above in an environment having a minimum temperature of 140°F.

(b) Insulation Tests: Insulation tests shall be made between conductors and ground and between conductors. Tests shall be made after the conductors are installed and before connecting equipment that may be damaged by the tests. Readings below 50 megohms, when measured with a 1000 volt D.C. insulation tester, will be considered defective.

(c) Test Documentation: Documentation shall include a Certificate of Compliance, two sets of cabinet wiring drawings, and technical manuals for the control equipment. Cabinet drawings shall be DOTD standard blue line copies, with the manufacturer's name, equipment model number, project number, sheet number, date and revision block.

736.21 MEASUREMENT.

(a) Trenching and Backfilling: Trenching and backfilling will be measured by the linear foot of excavated trench backfilled and accepted.

(b) Conduit with Conductors: Conduit with conductors will be measured by the linear foot of conduit with conductors installed and accepted. Measurement will include conduit, conductors, clamps, fittings, above ground junction boxes, and miscellaneous hardware required for a complete conduit installation.

(c) Jacking or Boring Conduit: Jacking or boring conduit will be measured by the linear foot of conduit jacked or bored. Measurement will include fittings, excavation, backfilling and duct markers.

(d) Signal Support: Signal supports will be measured per each signal or strain pole installed and accepted. Measurement will include the pole, mast arm, base assembly, guy wires and hardware, signal support cables and hardware, traffic signal cables inside pole, concrete foundation, reinforcing steel, conduits in foundation, ground rod, ground wires, ground clamp, hardware, drilled excavation, backfill, grout, electrical oxide-inhibiting compound and disposal of excess excavated material.

(e) Signal Heads: Signal heads will be measured per each head installed and accepted. Measurement will include disconnect hangers, traffic signal wiring attached to overhead span, closure caps, mounting hardware, lamps, head programing, mounting connections and hardware.

(f) Signal Service: Signal service will be measured per each service assembly installed and accepted. Measurement will include pole, disconnect, ground rod, wire and conduit on service pole, conduit and conductors on utility company pole, and connections and hardware required.

(g) Traffic Signal System: Traffic signal systems will be measured on a lump sum basis, which will include furnishing and installing all equipment and apparatus, and performing work required for a complete system.

(h) Signal Controller: Signal controllers will be measured per each controller installed and accepted. Measurement will include all electronic control equipment specified, prewired cabinet, foundation, conduits in foundation, ground rod assembly, anchor bolts and hardware, connections, documentation, programming, and testing.

(i) Loop Detector: Detectors will be measured by the linear foot of sawn slot. Measurement will include sawing, installed wire and sealing. Measurement will be made from the edge of the pavement and once around each loop perimeter.

(j) Underground Junction Box: Underground junction boxes will be measured per each box installed and accepted. Measurement will include the box, cover, excavation, backfill and any concrete patching required.

736.22 PAYMENT: Payment for traffic signal work will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
736(01)	Trenching and Backfilling	Linear Foot
736(02)	Conduit with Conductors (Size & Type)	Linear Foot
736(03)	Jacking or Boring Conduit (Size & Type)	Linear Foot
736(04)	Signal Support (Size & Type)	Each
736(05)	Signal Heads (Type)	Each
736(06)	Signal Service	Each
736(07)	Traffic Signal System	Lump Sum
736(08)	Signal Controller	Each
736(09)	Loop Detector	Linear Foot
736(10)	Underground Junction Box	Each

Section 737
Painted Traffic Striping

737.01 DESCRIPTION. This work consists of furnishing and applying reflective white or yellow paint for pavement striping in accordance with plan details, the MUTCD and these specifications.

737.02 MATERIALS. Traffic paint shall be either quick dry alkyd or waterbased traffic paint conforming to Subsection 1015.12. Glass beads for drop-on application shall conform to Subsection 1015.13.

737.03 EQUIPMENT. Selection of proper equipment to produce satisfactory results within the following requirements shall be the responsibility of the contractor.

(a) Equipment shall permit traffic to pass safely within the limits of the roadway surface and shoulder while operating.

(b) Equipment shall be designed for placement of both solid and broken line stripes of the spacing shown on the plans with square, neat stripe ends.

(c) Equipment shall provide a method for cleaning the surface of dust immediately prior to placement of striping materials.

(d) Equipment shall provide for drop-on application of glass beads.

(e) The equipment shall provide accurate regulation of the application rate and shall have a tachometer or other approved device to ensure uniform paint application at the designated rate. The equipment shall be adjustable for applying one, two or three adjacent lines simultaneously at the specified spacing and be equipped with a device capable of following a control line. Operation of the unit shall be such that paint will not be spattered or blown on another stripe. The unit shall be designed to properly agitate the paint while in operation.

(f) The equipment shall be equipped with a heat exchanger to heat the paint to reduce drying time.

(g) The operation shall include a trailing vehicle equipped with a flashing arrow board.

737.04 SURFACE PREPARATION. Surfaces to be striped shall be cleaned of materials that may reduce adhesion of paint to pavement. Surfaces shall be kept clean and dry at the time of application of paint.

737.05 WEATHER LIMITATIONS. No paint striping shall be done when the pavement surface is not thoroughly dried, when the air is foggy or misty, when the air or surface temperature is below 50°F, or when wind or other condition causes a film of dust to be deposited on the surface after cleaning and before striping can be done or causes displacement of striping material.

737.06 APPLICATION. The longitudinal joint or existing centerline stripe shall be used in determining the location of the centerline of new

striping. In the absence of a longitudinal joint or existing stripe, the location of the centerline of new striping shall be located by the contractor with the approval of the engineer. Broken line individual intervals will not be marked. No striping material shall be applied over a guide stringline.

(a) Paint Preparation: Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned without approval.

(b) Application Rate: Paint shall be applied at the rate required to provide striping of the specified width at a thickness of 15 wet mils.

Glass beads shall be applied at the same time, but in a separate operation, at the rate of 6±1/2 pounds of beads per gallon of paint. Beads shall be applied to the paint before final set has occurred and accomplished in such manner as to provide uniform coverage of the stripe. Beads shall be applied to the paint immediately after it has been applied to the pavement. Beads shall be applied by compressed air of sufficient pressure to cause embedment of the beads throughout the thickness of the paint. Guns for bead application shall be of an approved type and care shall be taken to prevent loss of beads due to side spray or nonembedment.

Paint shall be heated in heat exchangers to accelerate drying, to a temperature between 110°F and 130°F for waterbased paint, and between 120°F and 150°F of solvent based paint.

737.07 TOLERANCES: A tolerance of +1/2 inch and -1/8 inch from the specified width will be allowed, provided the variation is gradual. Segments of broken line may vary ±6 inches from the specified length provided it is not consistently short. Segments shall be squared off at each end without mist or drip. Longitudinal painted lines shall not deviate from established alignment by more than 1 inch provided the variation does not increase or decrease at the rate of more than 1/2 inch in 25 feet. Lines not meeting these tolerances shall be removed by abrasive blasting or grinding and replaced at no direct pay.

737.08 PROTECTION OF MARKINGS. Traffic shall be prevented from crossing a wet stripe. The contractor shall use flaggers or other methods to prevent traffic from crossing the wet stripe or adjust the operation. Stripes which have been marred or picked up by traffic before they have dried shall be repaired by the contractor at no direct pay. The pavement shall be cleaned outside the stripe at no direct pay.

The contractor is not required to maintain striping which has been accepted and opened to traffic.

737.09 PROTECTION OF TRAFFIC. The contractor shall furnish and place all necessary temporary warning and directional signs to direct and protect the traveling public during striping operations.

The pavement striping equipment shall move in the direction of normal traffic flow. The trailing vehicle shall be equipped with an approved flashing arrowboard for directing traffic to the appropriate side during striping operation, when required. Temporary signs, cones and equipment shall be removed from the roadway when striping equipment is not in operation.

Protective and traffic marking devices shall conform to Section 713.

737.10 MEASUREMENT. Painted Traffic Striping will be measured by the mile or linear foot as specified.

(a) Mile: Measurement will be by the mile of single stripe per roadway. No deduction will be made for the standard 30-foot design gaps in broken-line striping; however, deductions will be made for the length of other omitted sections.

(b) Linear Foot: Measurement will be by the linear foot, exclusive of gaps.

737.11 PAYMENT. Payment for painted traffic striping will be made at the contract unit prices.

Payment will be made under.

Item No.	Pay Item	Pay Unit
737(01)	Painted Traffic Striping (Solid Line)	Mile
737(02)	Painted Traffic Striping (Broken Line)	Mile
737(03)	Painted Traffic Striping (Solid Line)	Linear Foot

Section 738
Mulch Sodding

738.01 DESCRIPTION: This work shall consist of furnishing, hauling, spreading, fertilizing and liming (if required), rolling, watering and maintaining live bermuda grass roots and topsoil at locations shown on the plans or as directed.

738.02 MATERIALS. Mulch sod shall consist of a combination of grass roots and topsoil. Mulch sod shall be predominately bermuda grass or other approved grass roots reasonably free of weeds and debris.

Topsoil shall conform to Subsection 715.02.

Fertilizer and agricultural lime shall conform to Section 718.

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

738.03 EQUIPMENT:

A single or double type soil roller or cultipacker weighing not less than 500 pounds and not more than 1500 pounds will be required.

Water wagons, tanks or sprinkling devices will be required.

738.04 CONSTRUCTION REQUIREMENTS:

(a) Digging: The source of mulch sod approved by the Roadside Development Specialist shall be mowed and raked when necessary. Mulch sod shall not be stockpiled for more than 48 hours.

Mulch sod shall be free of tree roots, tops, branches or other debris. Such foreign material shall be removed prior to the sod being stockpiled or delivered.

When agricultural lime is necessary to adjust the soil pH to between 5.5 and 8.0, it shall be done on sod field prior to stockpiling and delivery at no direct pay.

(b) Hauling: Mulch sod shall be loaded with suitable equipment, hauled and spread on the areas designated on the plans or as directed.

(c) Surface Preparation: Fertilizer shall be broadcast over the entire area to be mulch sodded before mulch sodding is placed and disked. When required, agricultural lime or other treatment to adjust pH to between 5.5 and 8.0 shall be applied to the area to be mulch sodded prior to scarifying. Areas to receive mulch sod shall be scarified and pulverized to a depth of approximately 3 inches and dressed to grade at no direct pay.

(d) Spreading: The mulch sod shall be spread to a depth of approximately 6 inches in such a manner that a minimum amount of roots are exposed. Spike tooth harrows or drags shall not be used to spread mulch sod. The mulch sod shall be dressed to grade.

(e) Rolling: The mulch sod shall be rolled with a cultipacker or soil pulverizer as directed. Locations inaccessible to rolling equipment shall be hand tamped.

(f) Watering: Mulch sod shall be watered and kept moist as directed until satisfactory growth is established.

738.05 MEASUREMENT. Mulch sod will be measured by the cubic yard in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01.

Fertilizer shall be paid for in accordance with Section 718.

Agricultural lime, when specified, will be paid for in accordance with Section 718.

738.06 PAYMENT: Payment for mulch sod will be made at the contract unit price. Payment for watering mulch sod will be made in accordance with Section 714.

Payment will be made under:

Item No.	Pay Item	Pay Unit
738(01)	Mulch Sodding	Cubic Yard

Part VIII — Structures

Section 801
General Requirements for Structures

801.01 DESCRIPTION. This section sets forth general requirements for construction of bridges and other structures and includes preparation and submittal of shop drawings and other data.

The contractor will be allowed to construct a bridge using any combination of compatible superstructure and substructure details shown on the plans. A precast superstructure may be combined with the compatible cast-in-place bent caps and a precast or cast-in-place concrete barrier rail may be used with the precast slab. A cast-in-place superstructure shall utilize a cast-in-place barrier rail.

Before beginning construction, the contractor shall notify the engineer in writing as to which alternates are to be used and any deviation will require approval of the engineer.

Any changes in the plans due to combining precast or cast-in-place superstructure with precast or cast-in-place substructure will be the responsibility of the contractor and shall be submitted to the engineer for approval.

Work within wetlands, navigable waters or adjacent areas shall conform to Subsection 107.09.

801.02 BORINGS. Soil borings and other soil investigations and soil analyses will be made by the Department for development of subsurface information for bridge foundations. This data will be included in the plans for informational purposes. Soil samples may not be available for inspection; bidders should make such additional investigations as they consider necessary to determine soil conditions. No additional compensation will be allowed the contractor if soil material is of a different character from that shown on the plans.

801.03 SHOP AND WORKING DRAWINGS. The contractor shall submit shop drawings, working drawings and other submittals for approval. No work shall be started until final approval of shop and working drawings has been obtained. No direct payment will be made for required shop and working drawings and other submittals.

Review and approval of these drawings and other required submittals will not relieve the contractor of responsibility under the contract.

(a) General: Two prints of required shop or working drawings shall be submitted to the Bridge Design Engineer for checking, one of which will be returned with either approval or required revisions noted thereon. For final approval and distribution, nine prints of each checked drawing shall be submitted to the Bridge Design Engineer. Sheets shall be assembled in sets and placed in numerical order prior to submittal.

Changes on drawings shall be noted and dated to show that a revision has been made. Tracings and subsequent reproductions shall have an outside measure of either 22-by-36 inches or 23-by-36 inches with

distance between margins measuring not more than 21-by-34 inches. Top, bottom and right margins shall be at least 1/2 inch, and the left margin shall be at least 1 1/2 inches. Each sheet shall have a title block in the lower right corner with the state project number, project name, parish, fabricator's plant location, sheet number, date, and revision block.

(1) Movable Bridges: The original tracings or photographic reproductions of original shop and working drawings shall be delivered to the Bridge Design Engineer upon completion of fabrication or erection, as follows:

a. Original Tracings: Original tracings shall be ink drawings on either tracing cloth or polyester translucent matte film 0.003-inch to 0.004-inch thick and having matte surfaces on both sides.

b. Reproductions: Photographic reproductions shall be on either cloth or 0.003-inch to 0.004-inch thick translucent polyester film having matte surfaces on both sides. Cloth or film shall have a silver halide emulsion image of a permanent type from which satisfactory prints can be made. Additions or changes shall be made with a permanent type waterproof black ink made for this purpose. Electrostatic processes will not be acceptable.

(2) Other Structures: One set of the final corrected shop and working drawings suitable for microfilming shall be delivered to the Bridge Design Engineer upon completion of fabrication or erection.

(b) Shop and Working Drawings Checked by Consulting Engineers: When specified, the contractor shall furnish the consulting engineer shop and working drawings for checking, approval and distribution.

Two prints of required shop or working drawings shall be submitted to the consulting engineer for checking. After all corrections required by the consulting engineer are made, nine prints of each checked drawing shall be submitted to the consulting engineer for final approval. Final checked prints shall be stamped "Approved" and dated by the consulting engineers; one print of each shall be retained by the consulting engineers; the remaining eight prints of each drawing shall be sent to the Bridge Design Engineer for distribution.

Upon completion of fabrication or erection, one set of prints of the final corrected shop and working drawings shall be delivered to the consulting engineer for transmittal to the Department.

During the process of approval, a copy of each transmittal letter from contractor to the consulting engineer shall be sent to the Department's Bridge Design Engineer and the consulting engineer shall send a copy of each letter of reply.

All other requirements of this Subsection shall apply.

(c) Falsework: The contractor shall prepare plans for falsework and submit them to the engineer for review. This requirement shall also apply to falsework required for changes in an existing structure for maintenance of traffic. These plans shall be stamped by an engineer currently licensed to practice Civil Engineering in the State of Louisiana.

(d) Form Drawings: When requested, the contractor shall prepare and submit to the engineer for review, plans for proposed forming system for cast-in-place concrete. The plans shall be sufficiently detailed to allow a complete evaluation of their adequacy. Plans for deck forms shall include details of the type screed to be used.

(e) Steel Fabrication and Erection: The type, size and procedures for submittal and approval of these drawings shall be as described in Headings (a) and (b) of this Subsection.

(1) Shop Drawings: The contractor shall furnish shop drawings for steel work for approval. No fabrication shall be started prior to final approval of these plans; however, when the project has separate structures or has been divided into parts to facilitate construction in accordance with the approved construction schedule, fabrication may be started for a separate structure or a particular part when the final shop details applying thereto have been approved and distributed. These details must conform to the general drawings, stress sheets and specifications. No deviations from the approved shop plans will be allowed without written approval. The contractor shall be responsible for correctness of drawings and for shop fits and field connections, even though drawings have been approved.

If the structural steel on the project consists only of expansion dams and bearing assemblies, the contractor will not be required to furnish a final set of corrected drawings.

(2) Erection Drawings: Before starting steel erection, the contractor shall inform the engineer of the method of erection and equipment the contractor proposes to use, which shall be subject to review and approval. The contractor shall prepare and submit for review and approval a key erection diagram and detail erection drawings for the work, all with dimensions and erection marks to properly coordinate erection drawings with shop drawings.

The contractor shall also submit erection drawings for all continuous span steel units, trusses and other metalwork requiring field splices to the Bridge Design Engineer for review and approval. Drawings shall outline the erection procedure and equipment to be used. These plans shall be stamped by an engineer currently licensed to practice Civil Engineering in the State of Louisiana.

(3) Shipping Statements and Shop Bills: The contractor shall furnish the engineer one copy of shipping statements or notices as each shipment of structural steel is made to the project. Weights of individual members shall be shown on shipping statements.

If payment for structural steel is per pound, the contractor shall also furnish the Bridge Design Engineer with three copies of final shop bills for the structural steel, showing the name, piece-mark, and calculated weight for each member. These bills shall include a summary of the weights of structural steel for the project by grades. Shop bills are not required when lump sum payment is to be made.

(f) Movable Bridge Equipment:

(1) Shop Drawings and Erection Drawings: The contractor shall furnish complete detailed working drawings of the machinery houses, operating house, counterweight, including calculations, and machinery and traffic barrier parts and assembly layouts of items to be furnished. Weights of machinery parts shall be shown on shop drawings and may be estimated initially; however, the final shop drawings shall show the correct weights as determined by weighing the fabricated parts. For commercial parts, the manufacturer's weights or certified dimension sheets will be acceptable. Certified dimension sheets of motors, brakes, generators, gasoline engines, limit switches, traffic gates and other such equipment shall be submitted to the Bridge Design Engineer for approval as soon as possible after award of the contract so that the engineer and fabricator will have the information necessary to determine the details of associated parts. Certified dimension sheets shall show complete specifications for equipment furnished.

The contractor shall submit nine copies of certified dimension sheets and detailed manufacturer's description of each piece of equipment and apparatus to the Bridge Design Engineer, one of which will be returned approved or with required revisions noted thereon. If revisions are required, the contractor shall submit nine corrected copies for final approval. The name of the project, project number and parish shall be shown on each sheet of every submittal, with indication of any changes noted on the drawings.

Drawings for counterweights shall show dimensions, method of construction and calculations.

A detailed list of commercial machinery and traffic barrier parts installed on the bridge shall be included in shop drawings. The list shall include item number as shown on drawings and the name, ratings, description, service manufacturer, type, model, catalog and serial number of each item.

The type, size and procedures for submittal and approval of shop and erection drawings shall be as described in Headings (a) and (b) of this Subsection.

If any part of the work not requiring fabrication is so completely detailed that design drawings may serve as working drawings, the contractor will not be required to submit shop drawings for that part of the work, provided the contractor notifies the Bridge Design Engineer in writing that the work is to be performed as shown on design drawings. The contractor shall be responsible for any errors which may be on the plans, and will not be relieved of any responsibility placed upon the contractor by the contract. Shop drawings will be required for fabricated items.

(2) Maintenance and Operation Instruction Booklets: The contractor shall furnish the Bridge Design Engineer six bound copies of a booklet, 8 1/2-by-11 inches in size, containing descriptive leaflets and drawings covering items of the electrical equipment. This booklet shall include catalog numbers indicated, printed or typewritten statements prepared by the equipment manufacturer covering the proper method of adjusting, lubricating and otherwise maintaining each item, a concise statement of the necessary operating functions in proper sequence, a detailed description of the functions of each item in connection with the various operating steps, reduced copies of conduit and wiring diagrams and drawings of control desk and switchboard. The booklet shall designate each wire and item of equipment by the numbers and symbols used on the drawings.

The contractor shall also furnish the Bridge Design Engineer six bound copies of a similar booklet for mechanical and traffic barrier equipment which shall include lubricating charts showing locations of lubricating fittings and other points of lubrication, recommended types of lubricant, frequency of application and changing of lubricants and reduced prints of the machinery and traffic barrier shop drawings.

Each booklet shall contain the following:

a. Front Matter: Cover, instructions for normal operation, operation under emergency or adverse conditions, and shutdown; table of contents, list of illustrations; introduction; and safety precautions.

b. Theory of Operation: Theory of operation to the extent necessary for understanding by operation and maintenance personnel.

c. Maintenance Instructions: Cleaning, lubrication, troubleshooting, inspection, performance verification, disassembly, repair, replacement, and reassembly.

d. Parts Lists.

e. List of Special Tools: Name and size of nonstandard tools necessary for proper maintenance and adjustment of equipment, location requiring the special tools, and the proper adjustment.

f. Illustrations and diagrams.

g. Warning Notes: Cautions and warning notes indicating any condition or practice which could result in personal injury or loss of life.

(g) Precast-Prestressed Concrete Girder Spans: The contractor shall furnish complete fabrication and erection drawings. No girders shall be cast prior to approval of these drawings. When precast stay-in-place concrete panels are used, the following requirements will also apply to fabrication drawings. Precast panels shall conform to Subsection 805.14(k).

Fabrication drawings shall include complete details and dimensions of girders, details of proposed casting bed layout and stressing data and, in pretensioned members, method of holding draped strands in place and method and schedule of release of hold-downs and cable strands.

If girders are detailed so completely that design drawings may serve as working drawings, the contractor will not be required to submit drawings for that part of the work, provided he notifies the Bridge Design Engineer in writing that the work is to be done as shown on design drawings; however, the contractor shall submit corrections to plan dimensions due to elastic shortening, shrinkage, girder slope and other causes. The use of such design drawings will not relieve the contractor of any responsibility placed on the contractor by the contract.

Erection drawings shall show the location of each girder in each span and shall be coordinated with identifying marks on the girders. Identifying girder marks showing the location and span for which the girder is cast. The date of casting shall be shown on one end of each girder.

The type, size and procedures for submittal and approval of fabrication and erection drawings shall be as described in Headings (a) and (b) of this Subsection.

(h) Illumination Systems: Detail drawings for lighting standards or high mast towers including all connections, bases, welds, anchor bolts, handhole reinforcement, and erection procedures shall be furnished by the contractor for approval.

Electrical system components shall be in accordance with Section 730.

(i) Traffic Signs and Devices: Detail drawings for overhead or structure mounted signs and devices shall be furnished by the contractor for approval. Fabrication or construction shall not be started until drawings have been approved and distributed.

(1) Fabrication and Erection of Overhead and Structure-Mounted Sign Structures: The type, size and procedures for submittal and approval of these drawings shall be as described in Headings (a) and (b) of this Subsection.

Detailed drawings for fabrication and erection of aluminum and steel parts for overhead or structure-mounted sign structures shall include details of all parts of the sign structure and mounting brackets.

Required dampers for aluminum overhead sign trusses shall be shown on the shop drawings.

Backing details to be used that are not covered by typical details and notes shown on the plans shall be submitted.

(2) Sign Face Details: Sign face details shall be submitted to the Traffic and Geometric Design Engineer for approval. Details shall be submitted on legal size sheets of acceptable quality for sign faces not completely detailed on the plans. Two prints of required sign face details shall be submitted for checking, one of which will be returned with either approval or required revisions noted thereon. Nine copies of prints shall then be submitted and, if approved, shall be distributed. Approval and distribution of these prints shall be required prior to submittal of drawings for fabrication and erection of the corresponding sign structures.

(j) Buildings: Detail drawings, brochures and samples for architectural and mechanical work shall be furnished by the contractor for approval by the Bridge Design Engineer in accordance with the following requirements.

The type, size and procedures for submittal and approval of shop and working drawings shall be as described in Headings (a) and (b) of this Subsection. No fabrication or erection work shall begin until these drawings have been approved. Brochures and samples shall be furnished in accordance with the project specifications.

Maintenance and operation instruction booklets shall be furnished in accordance with the project specifications.

Section 802
Structural Excavation and Backfill

802.01 DESCRIPTION. This work consists of removal of all materials necessary for construction of retaining walls, foundations and substructures. It shall include furnishing all necessary equipment, dewatering and the construction of all cribs, cofferdams, caissons, etc. necessary for execution of the work. It shall also include subsequent removal of cofferdams and cribs, and placement and compaction of necessary backfill. It shall also include wasting of excess excavated material, in a manner and in locations so as not to affect the carrying capacity of the channel and not be unsightly.

802.02 GENERAL CONSTRUCTION REQUIREMENTS. Excavations for substructures shall be shored, braced or protected by cofferdams where necessary. When footings can be placed in the dry without cribs or cofferdams, backforms may be omitted, with approval, and the excavation filled with concrete to the required elevation of the top of footing. Additional concrete required shall be placed at no direct pay.

Foundations for reinforced concrete box culverts shall be prepared in accordance with Subsection 701.04.

802.03 PRESERVATION OF CHANNEL. Unless otherwise directed, no excavation shall be made outside of caissons, cribs, cofferdams or sheeting. The natural stream bed adjacent to the structure shall not be disturbed. If excavation or dredging is made at the site of the structure before caissons, cribs or cofferdams are sunk or in place, the contractor shall, at no direct pay, after the foundation base is in place, backfill such excavation to the original ground surface or river bed with satisfactory material. Material deposited within the stream area shall be removed and the stream area freed from obstruction.

802.04 DEPTH OF FOOTINGS. Elevations of the bottoms of footings as shown on the plans are approximate. The engineer may order, in writing, such changes in dimensions or elevation of footings as necessary to secure a satisfactory foundation.

802.05 PREPARATION OF FOUNDATIONS FOR FOOTINGS. Rock or other hard foundation material shall be cleaned of loose material and cut to a firm surface, either level, stepped or roughened, as directed. Seams shall be cleaned and filled with concrete, mortar or grout to a suitable depth.

When concrete is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation. Final removal of foundation material to grade shall not be made until just before concrete is placed.

802.06 COFFERDAMS AND CRIBS.

(a) General: Cofferdams and cribs for foundation construction shall be carried to adequate depths and heights, safely designed and

constructed and made as watertight as necessary for proper performance of the work which must be done inside them. Interior dimensions of cofferdams and cribs shall be such as to give sufficient clearance for construction of forms and inspection of their exteriors and to permit pumping outside of forms. Cofferdams or cribs which tilt or move laterally during sinking shall be righted, reset or enlarged to provide the necessary clearance at no direct pay.

When it is impractical to dewater the foundation before placing concrete, the engineer may require construction of a concrete foundation seal of such dimensions as necessary. The foundation shall be dewatered and the balance of concrete placed in the dry. When weighted cribs are used to partially overcome hydrostatic pressure acting against the bottom of the foundation seal, special anchorages such as dowels or keys shall be provided to transfer the weight of the crib to the foundation seal. During placing of a foundation seal, elevation of water inside the cofferdam shall be controlled to prevent flow through the seal. If the cofferdam is to remain in place, it shall be vented or ported at low water level.

(b) Protection of Concrete: Cofferdams or cribs shall be constructed so as to protect foundations from damage caused by a sudden stream rise.

(c) Drawings: Drawings for substructure work shall be furnished in accordance with Subsection 801.03.

(d) Removal: Cofferdams or cribs with all sheeting and bracing shall be removed after completion of the substructure, care being taken not to damage concrete. No sheet piling used as forms shall be removed prior to 7 days after placement of concrete. Timber from cofferdams or cribs shall not be left embedded in substructure concrete.

802.07 DEWATERING. Pumping from the interior of a foundation enclosure shall be done in such manner as to preclude the possibility of movement of water through fresh concrete. No pumping will be permitted during placing of concrete or for at least 24 hours thereafter unless done from a suitable sump separated from the concrete work by a watertight wall or other effective means.

Pumping to dewater a sealed cofferdam shall not begin until 72 hours after placement of concrete seal unless otherwise directed.

802.08 EXCAVATION OF FOUNDATION. After each excavation is completed, the contractor shall notify the engineer. No concrete shall be placed until the engineer has approved the depth of excavation and character of foundation material.

802.09 BACKFILL. Backfill material shall be of acceptable quality, free from large or frozen lumps, wood or other foreign material.

(a) For backfilling cofferdams and cribs, all spaces excavated and not occupied by piers or other permanent work shall be backfilled with soil to the surface elevation of surrounding ground in such manner as to maintain approximately the same elevation on each side.

(b) Backfilling of Reinforced Concrete Box Culverts: Material and backfilling requirements for reinforced concrete box culverts and attached headwalls shall be in accordance with Subsection 701.08.

Adequate cover shall be provided over reinforced concrete box culverts before heavy construction equipment may cross the installation to prevent damage to the box culvert.

(c) Backfill material for footings shall be placed in horizontal lifts and compacted to the satisfaction of the engineer. The excavation shall be pumped as dry as possible before backfill material is placed.

(d) Backfill for structures other than in Headings (a), (b) and (c) above shall be placed in horizontal layers not exceeding 9 inches loose thickness and uniformly compacted by approved methods to the satisfaction of the engineer. Jetting of backfill behind abutments and wingwalls will not be permitted. The excavation shall be pumped as dry as possible before beginning backfilling.

(e) No backfill shall be placed against a concrete abutment, wing wall or reinforced concrete box culvert until concrete has been in place a minimum of 14 calendar days, or until test cylinders made in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230 have obtained a minimum compressive strength of 3000 psi.

802.10 MEASUREMENT. The quantity of structural excavation for payment shall be the number of cubic yards, measured in its original position, of material acceptably excavated in conformity with the plans or as directed. No yardage shall be included in the measurement outside of a volume bounded by vertical planes 18 inches outside of and parallel to neat lines of footings. The cross-sectional area measured shall not include water or other liquids but shall include mud, muck and other similar semi-solids. No measurement will be made of excavation required for construction of abutment bents or abutment footings. Measurements for intermediate bents or pier footings will be made on the basis of the depth taken from the elevation of the completed sections or natural ground line, whichever is lower, to the bottom of footing; however, no measurement will be made for material not excavated.

(a) Reinforced Concrete Box Culverts: Excavation and backfill required for box culvert construction will not be measured for payment, except as specified in Subsection 203.15.

(b) Cofferdams: When the contract does not contain an item for "Cofferdams", the cofferdams and cribs will not be measured for payment.

When an item for "Cofferdams" is included in the contract, the cofferdams will be measured on a lump sum basis.

802.11 PAYMENT. Payment for structural excavation will be made at the contract unit price per cubic yard, which includes constructing and removing cribs and cofferdams, required excavation and backfill, and disposing of excess excavated material.

If the engineer orders foundations to be lower than the specified elevation, payment for the additional excavation required will be made in accordance with the following table:

Depth of Foundation Below Specified Elevation (Feet)	Percent of Contract Unit Price for the Excavation Item
0 to 2.0	100
2.1 to 4.0	125
4.1 to 6.0	150
6.1 to 8.0	175
8.1 to 10.0	200
Over 10.0	Extra Work

When an item for "Cofferdams" is included in the contract, payment for cofferdams will be made at the contract lump sum price, which includes furnishing and installing all materials, backfilling, dewatering, maintenance, removal, and satisfactory clean-up of the areas.

Payment will be made under:

Item No.	Pay Item	Pay Unit
802(01)	Structural Excavation	Cubic Yard
802(02)	Structural Excavation for Intermediate Bents	Cubic Yard
802(03)	Structural Excavation for Piers (Dry)	Cubic Yard
802(04)	Structural Excavation for Piers (Wet)	Cubic Yard
802(05)	Cofferdams	Lump Sum

Section 803
Sheet Piles

803.01 DESCRIPTION. This work consists of furnishing and driving sheet piling of the specified type in accordance with the plan details and these specifications.

803.02 MATERIALS. Materials shall conform to the following Sections and Subsections.

Concrete	901
Coal Tar Epoxy-Polyamide Paint	1008.04
Reinforcing Steel	1009
Sheet Piles	1013.10
Timber and Preservatives	1014
Hardware	1018.08

(a) Concrete Sheet Piles: Concrete sheet piles shall be precast-prestressed piles fabricated in accordance with Subsection 805.14.

(b) Metal Sheet Piles:

(1) Steel Sheet Piles: Steel sheet piles shall be fabricated in accordance with Section 807.

(2) Aluminum Sheet Piles: Aluminum sheet piles shall have a depth of 2 1/2 inches to 6 inches, a width of 1.00 foot to 1.67 feet, a nominal thickness of at least 0.125 inch. Sheet piles shall have sand-tight interlocking joints.

(c) Timber Sheet Piles:

(1) General: Piles shall be provided with tongues and grooves of suitable proportions, either cut from the solid material or made by building up the piles with three planks fastened together. Piles shall be drift-sharpened at their lower ends to wedge adjacent piles tightly together during driving. Hardware shall be galvanized.

(2) Untreated Timber: Timber shall conform to Section 812, but may consist of any species which will satisfactorily withstand driving. It shall be sawn or hewn with square corners and shall be free from work holes, loose knots, wind shakes, decayed or unsound portions, or other defects which might impair its strength or tightness.

(3) Treated Timber: Treated timber shall be either Southern Pine or Douglas Fir conforming to Section 812.

803.03 DRIVING SHEET PILES. Sheet piles shall be driven with hammers adequate to drive the piles to required depth in satisfactory condition. To maintain satisfactory alignment, sheet piles shall be driven in increments of penetration necessary to prevent distortion, twisting out of position or pulling apart at interlocks. To facilitate closure, it may be advantageous to set up piles for a complete length of wall before initial driving; piles thus set up can be progressively driven in short increments of penetration.

803.04 JETTING SHEET PILES.

(a) Use of jets will not be permitted at locations where stability of embankments or other improvements may be endangered.

(b) The contractor may use high pressure water jetting systems to erode material adjacent to the pile when needed and permitted to facilitate driving sheet piles to desired penetration.

(c) Jetting may be done either ahead of or simultaneously with driving operations. If jets and hammer are used simultaneously, jets shall be withdrawn and final penetration of sheet piles obtained by driving with the hammer alone for at least the last foot of penetration.

(d) Jetting sheet piles will be at no direct pay.

803.05 CUTOFFS.

(a) Tops of sheet piling shall be cut off or driven down to a straight line at the elevation indicated on the plans or as directed.

(b) If heads of sheet piles are appreciably distorted or otherwise damaged below cut-off level, damaged portions shall be removed and replaced at no direct pay.

(c) Tops of timber sheet piles after cut-off shall be treated in accordance with Subsection 812.06, except that galvanized metal coverings shall be bent down at least 3 inches on each side and nailed to the vertical surface of sheet piles with large-headed galvanized roofing nails.

(d) Sheet piles damaged during driving, or driven out of proper position or below cut-off elevation, shall be withdrawn and replaced with new piles at no direct pay.

803.06 PAINTING. Before driving, surfaces of steel sheet piling shall be cleaned and painted with a 2-coat coal tar epoxy-polyamide paint system in accordance with Section 811.

803.07 MEASUREMENT. Quantities of sheet pile wall for payment will be the design wall area as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made.

803.08 PAYMENT. Payment for Sheet pile wall will be made at the contract unit prices under:

Item No.	Pay Item	Pay Unit
803(01)	Untreated Timber Sheet Pile Wall	Square Foot
803(02)	Treated Timber Sheet Pile Wall	Square Foot
803(03)	Concrete Sheet Pile Wall	Square Foot
803(04)	Steel Sheet Pile Wall	Square Foot
803(05)	Aluminum Sheet Pile Wall	Square Foot

Section 804
Bearing Piles

804.01 DESCRIPTION. This work consists of furnishing and driving piles of the kind and size designated to the required penetration.

Piling furnished under items for "Concrete Piles" and "Unloaded Concrete Test Piles" shall be either precast concrete piles or cast-in-place concrete piles, at the contractor's option; however, the same type pile shall be furnished under both these items for a project. Extensions of piles will not be permitted without approval.

804.02 MATERIALS. Materials shall conform to the following Sections and Subsections.

Precast Concrete Piles	805.14
Concrete	901
Coal Tar Epoxy-Polyamide Paint	1008.04
Reinforcing Steel	1009
Steel Bearing Piles	1013.09
Steel Pipe Piles	1013.11
Timber Piles	1014

804.03 ORDER LISTS. The contractor shall furnish piles in accordance with an itemized list furnished by the engineer showing the number, size, length and location of all permanent piles. No permanent piles shall be driven prior to receipt of this order list. When test piles are driven to determine the lengths of piling, the order list will not be furnished the contractor until loading is completed and order lengths approved. In determining lengths of piles for ordering, the lengths given in the order list will be based on the lengths which are assumed to remain in the completed structure. The contractor shall, at no direct pay, increase the lengths given to provide such additional length as necessary to suit the contractor's method of operation. The order length may be revised by the engineer when driving conditions deviate from test pile results.

804.04 PREPARATION FOR DRIVING. If, in the opinion of the engineer, pile driving operations may cause damage to recently placed concrete, the contractor will be required to alter operations to prevent such damage.

(a) Excavation: Piles shall not be driven until after excavation is complete. Any material forced up between piles shall be removed to correct elevation at no direct pay before foundation concrete is placed.

(b) Embankment: The full height of the embankment at bridge ends shall be constructed in accordance with Subsection 813.03 before driving affected piles.

(c) Equipment for Driving Piles:

(1) Steam and Air Hammers: The plant and equipment furnished for steam and air hammers shall have sufficient capacity to maintain at the hammer, under working conditions, the volume and pressure specified

by the manufacturer. The plant and equipment shall be equipped with accurate pressure gauges which are easily accessible for viewing by the engineer. The weight of the striking parts of air and steam hammers shall not be less than 1/3 the weight of drive head and pile being driven, and in no case shall the striking parts weigh less than 2,750 pounds.

(2) Diesel Hammers: Open-end (single acting) diesel hammers shall be equipped with a device such as rings on the ram or a scale (jump stick) extending above the ram cylinder, to permit the engineer to visually determine height of fall of the ram at all times during pile driving operations. The contractor shall provide the engineer with a chart from the hammer manufacturer equating stroke and blows per minute for the open-end diesel hammer to be used. Closed-end (double acting) diesel hammers shall be equipped with a bounce chamber pressure gauge, in good working order, mounted near ground level so as to be easily read by the engineer. Also, the contractor shall provide the engineer a chart, calibrated to actual hammer performance equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used. This chart shall be provided within 90 calendar days before driving.

(d) Collars: Collars, bands or other approved devices to protect timber piles against splitting or brooming shall be provided where necessary or as required by the engineer.

(e) Splicing Piles:

(1) Precast concrete piles shall be furnished and driven in full lengths, unless otherwise specified. When splicing of piling is specified, there will be no direct payment for splicing.

(2) Cast-in-place concrete pile shells may be field spliced, but sections which, in the opinion of the engineer, are too short shall not be used. Field splices of shell sections shall be made in accordance with the manufacturer's recommendations and to the satisfaction of the engineer. Welding shall conform to Section 815, except that the prequalification test for field welders will not be required unless directed.

(3) Steel bearing piles shall be furnished and driven in full lengths unless splices are authorized. When authorized, splices shall be limited to two per pile. Splicing of steel bearing piles shall be made by welding with full penetration welds in accordance with Section 815.

(4) Timber piles shall be furnished and driven full length where possible. Splicing of timber piles may be made only by written permission and in accordance with the splicing detail approved by the engineer.

(f) Painting of Piling: Foundation piling need not be painted. When specified, that area of steel piles, or the exterior surface of the steel shell of cast-in-place concrete piles, above the ground line or stream bed shall be cleaned and painted with a coal tar epoxy-polyamide paint system in accordance with Section 811.

(g) Transporting Precast Concrete Piling: Precast concrete piles shall be transported with supports at each of the pick-up points shown on the plans. Supports shall not be more than 1 foot from the theoretical position of each support, nor shall the distance between supports be more than one foot from the theoretical required distance between supports, unless otherwise approved.

(h) Supporting Holes for Piles: When approved, piles may be set in supporting holes, but in no case shall the depth of the holes be more than 10 feet for piles up to 50 feet long, or more than 20 percent of the

designated penetration of the piles for piles over 50 feet long. If additional support is required, templates or falsework above ground shall be furnished. After piles are driven, supporting holes shall be backfilled to finished ground or base of footing with granular-type material acceptable to the engineer.

804.05 METHODS OF DRIVING.

(a) Description: Pile driving equipment furnished by the contractor shall be approved by the DOTD Construction Engineer Administrator. Equipment shall be such that piles will obtain required penetration without damage. Gravity hammers will be permitted only when driving timber piles. In no case shall the driving equipment be transported to the project site until approval is received in writing. As a prerequisite to such approval, the contractor shall submit the necessary pile driving equipment information at least 30 calendar days prior to driving piles. A form which the contractor shall complete with the above information shall be supplied by the Department. The minimum energy developed by the hammer shall be specified herein for the various type piles. The adequacy of diesel hammers in meeting the 1 foot-pound of energy for each pound of pile criteria will be determined by rating the diesel hammer at 85 percent of the maximum rating specified by the manufacturer. During pile driving operations, the contractor shall use the approved system. No variations in the driving system will be permitted without the DOTD Construction Engineer Administrator's written approval. In the event the pile driving hammer is causing damage to the pile, the contractor shall supply additional hammers to drive the pile without damage.

(b) Hammers for Timber Piles: Gravity hammers for driving timber piles shall weigh not less than 2,000 pounds, but in no case shall the weight of the hammer be less than the combined weight of the driving head and pile. The fall shall be so regulated as to avoid damaging piles and in no case shall it exceed 10 feet. When timber piles are driven with steam, air or diesel hammers, either single or double acting, the total energy developed by the hammer shall not be less than 7,200 nor more than 20,000 foot-pounds per blow.

(c) Hammers for Concrete Piles: Precast concrete piles or shells for cast-in-place concrete piles shall be driven with an approved hammer which shall develop at each full stroke of the piston not less than 1 foot-pound of energy for each pound of weight driven. The minimum required hammer energy will be rated at 15,000 foot-pounds and the maximum required hammer energy will be rated at 60,000 foot-pounds. When resistance to driving is small, a hammer of less energy than specified above may be required to prevent damage to piling. If the contractor desires to use a diesel hammer, he shall obtain approval from the DOTD Construction Engineer Administrator, along with approval of a specific procedure to prevent pile damage, prior to driving test piles and permanent piles.

(d) Hammers for Steel Piles: Steel piles shall be driven with an approved hammer developing an energy of not less than 1 foot-pound for each pound of weight driven. The minimum energy shall be developed at each full stroke of the piston. The minimum allowed hammer energy shall be no less than 15,000 foot-pounds per blow.

(e) Hammer Cushion: All impact pile driving equipment except gravity hammers shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to ensure

uniform driving behavior. Hammer cushions shall be made of durable, manufactured materials, provided in accordance with the hammer manufacturer's guidelines except that wood, wire rope, and asbestos hammer cushions shall not be used. A striker plate as recommended by the hammer manufacturer shall be placed on the hammer cushion to insure uniform compression of the cushion material. The hammer cushion shall be inspected in the presence of the engineer when beginning pile driving at each structure and periodically during the pile driving. The contractor shall replace the cushion when the reduction in thickness exceeds 25 percent of the original thickness.

(f) Driving Caps: When the nature of driving requires protection for heads of concrete and timber piles, pile driving heads shall be cushioned by an approved cap. The cap shall have a suitable cushion next to the pile head. When the area of the head of a timber pile is greater than that of the face of the hammer, a suitable cap shall be provided to distribute the blow of the hammer throughout the cross section of the pile.

Special driving heads, mandrels or other devices shall be provided as recommended by the manufacturer for special types of piling so the pile may be driven without damage.

Heads for steel piling shall be cut squarely. For precast concrete and prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile. A driving cap shall be provided during driving to hold the axis of the pile in line with the axis of the hammer.

(g) Pile Cushion: The heads of concrete piles shall be protected by a pile cushion made of suitable wood. The pile cushion dimensions shall match the cross sectional area of the pile top.

(h) Additional Equipment: If required penetration of the pile is not obtained by the use of a hammer complying with the above requirements, the contractor shall, with approval, use pilot holes or water jets or both with the hammer.

(i) Leads and Templates: Equipment shall be constructed in such manner as to afford freedom of movement of the hammer and to drive piles to the tolerances specified without damaging piles. Either fixed leads or swinging leads may be used. Swinging leads shall be used in combination with a rigid template providing pile support meeting the approval of the engineer. Inclined leads shall be used in driving batter piles.

(j) Followers and Underwater Hammers: The use of followers or underwater hammers for driving piling will only be permitted by written approval. When a follower or underwater hammer is used, one pile in each group of ten shall be furnished sufficiently long to permit being driven without a follower or underwater hammer and shall be used to determine the average bearing capacity of the group. The safe bearing capacity of piles will be determined by blow count in accordance with Subsection 804.08(c). Payment for any required loading of piles will be made under Item 804(15). No direct payment will be made for cut-off of these piles.

(k) Pilot Holes: Pilot holes will be required when piles are driven in compacted embankments and when bridge borings indicate impenetrable material above minimum tip elevation. Maximum diameter of pilot holes will be the dimension of the pile diagonal. Depth of pilot holes in embankment shall be equivalent to the embankment height. Depth of pilot holes in impenetrable soils will be that dimension necessary to obtain required penetration with the pilot holes a minimum of 2 feet

above pile tip elevation, unless otherwise directed. Pilot holes for timber or tapered piles shall be no larger than the diameter of the pile tip. The annular space around piles shall be filled with granular-type material acceptable to the engineer.

(l) Water Jets: When water jets are required or allowed, the number and size of jets and the volume and pressure of water at jet nozzles shall be sufficient to erode material adjacent to the pile. Before desired penetration is reached, jets shall be withdrawn and the piles shall be driven with the hammer to final penetration. Jetting will not be permitted within 5 feet of pile tip elevation unless authorized. The use of jets in footings, header banks, or where stability of embankments or other improvements would be endangered will not be permitted.

(m) Accuracy of Driving: Piles shall be driven at locations shown on the plans or as ordered in writing. In pile bents, the centroid of a pile at cut-off elevation shall not vary from plan location by more than 3 inches measured perpendicular to the bent, nor more than 6 inches measured along the centerline of the bent. Piles shall be driven with a variation of not more than 1/4 inch per foot from vertical or from the batter shown on the plans. For foundation piling, the centroid of a pile at cut-off shall be within a 12-inch diameter circle having the plan location as its center.

(n) Interrupted Driving: When driving is interrupted before the pile reaches final penetration, the record for resistance shall not be taken until after at least 12 inches of penetration have been obtained after driving is resumed.

(o) Extent of Driving: Driving shall be continued until plan cut-off is reached or until satisfactory penetration and resistance are obtained. If desired resistance to driving is not obtained at plan cut-off, the engineer has the option of either loading a permanent pile to determine its capacity or continuing to drive the pile until satisfactory resistance is obtained. The additional length of pile required shall be supplied by splicing. Precast concrete piles shall be extended in accordance with Subsection 804.11.

(p) Loading Permanent Piles: A permanent pile which does not attain the desired resistance to driving shall be loaded when directed. The loading procedure shall be in accordance with Subsection 804.10(b).

(q) Heaved Piles: Level readings to check on pile heave after driving shall be made at the start of pile driving operations and shall continue until the engineer determines that such checking is no longer required. Level readings shall be taken immediately after the pile has been driven and again after piles within a radius of 15 feet have been driven. If pile heave is observed, accurate level readings referenced to a fixed datum shall be taken on all piles immediately after installation and periodically thereafter as adjacent piles are driven to determine the pile heave range. All end bearing piles that have been heaved more than 0.50 inch shall be redriven, to the required resistance or penetration at no direct pay. Concrete shall not be placed in pile casings until all piles in a footing have been driven.

804.06 CAST-IN-PLACE CONCRETE PILES. Cast-in-place concrete piles shall be steel encased. Steel shells shall be of the specified diameter and type. After shells are driven to required penetration and any required reinforcing steel is placed, shells shall be filled with concrete subsequent to their inspection and approval. The contractor shall provide

suitable light for inspection of each shell after it has been driven to required penetration. The shell shall be cleaned of debris and pumped dry before placing concrete.

The shell shall be filled with Class A concrete placed in accordance with Section 805. Use of concrete other than Class A shall be approved by the DOTD Construction Engineer Administrator. Reinforcing steel conforming to Section 806 shall be securely fastened together to form a rigid cage. Care shall be taken to hold reinforcement in position during filling of piles. Concrete blocks or suitable devices may be used to prevent displacement of the reinforcement cage. Piles shall be filled with concrete to the cut-off elevation. Concrete in the shell shall be vibrated from the lower end of the reinforcing cage to the top of pile. When reinforcing steel is not required, concrete in the top 10 feet of the shell shall be vibrated. Driving of additional piles within a radius of 10 feet of the completed pile will not be permitted until concrete has been allowed to set for at least 36 hours.

Shells for cast-in-place concrete piles shall be of sufficient thickness and strength so that the shell will hold its original form and show no harmful distortion after it has been driven and the driving mandrel withdrawn. It shall be the contractor's responsibility to determine the wall thickness of shell required.

804.07 DEFECTIVE PILES. The procedure used in driving piles shall not subject them to excessive abuse which produces cracking, crushing or spalling of concrete, splitting, splintering and brooming of timber or deformation of steel. Manipulation of concrete piles to force them into proper position will not be permitted. Any pile found to be unacceptable due to internal defects, by improper driving, driven out of proper location, or driven below required elevation shall be corrected at no direct pay by one of the following methods approved by the engineer:

1. The pile shall be withdrawn and replaced by a new and, if necessary, a longer pile.
2. A second pile shall be driven adjacent to the defective pile.
3. The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the footing extended to embed the pile. Timber piles shall not be spliced without approval. Heaved piles shall be redriven to desired elevation.
4. The cap or footing shall be redesigned at no direct pay and shall be approved by the engineer. The contractor will not be allowed additional compensation for increased quantities in a bent or footing due to driving additional piles to correct defective piles.

804.08 DETERMINING PILE BEARING CAPACITY.

(a) General: A pile's bearing capacity will normally be determined by comparing penetration, theoretical bearing values, loading conditions and soil borings with similar conditions known from a previously driven representative test pile. When the pile bearing capacity is questionable or does not offer a ready comparison to available information, test loading may be required. The test shall consist of applying a static test load placed on a suitable platform supported by the pile. The platform shall be equipped to accurately measure the test load and settlement of the pile under each increment of load. In lieu thereof, hydraulic jacks with suitable yokes and pressure gauges may be used.

The test load shall be applied in the various increments as specified. If hydraulic jacks are used to apply the load, the entire hydraulic system will be calibrated by an approved independent calibration service. Certified laboratory reports of calibration tests shall be furnished to the Materials and Testing Section. After the system is calibrated, no replacement parts will be permitted (except the pump) without recalibration of the system. When two or more hydraulic jacks are used, they shall be calibrated as one system connected in parallel by a manifold or other device used to direct the flow of fluid to the jacks. The gauge shall be calibrated to give a direct reading in tons of the total load placed on the test pile.

(b) When required, the contractor shall make load tests to determine the bearing capacity of piling. Anchor piles shall be at least 5 feet from the test pile.

The contractor shall submit to the engineer for approval a proposed method to test load the required piles.

(c) Pile Formulas: If the safe bearing capacity of permanent piles is to be determined by formulas, the following shall be used as a guide and shall be correlated with test pile driving and loading data.

$$P = \frac{2WH}{S + 1.0}$$ for gravity hammer,

$$P = \frac{2WH}{S + 0.1}$$ for single-acting steam, air, or diesel hammers,

where P = capacity in pounds,
W = weight in pounds of striking parts of hammer,
H = height of fall in feet,
S = the average penetration in inches per blow for the foot involved.

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 appreciable bounce after the blow.
(5) A follower is not used.

Twice the height of the bounce shall be deducted from "H" to determine its value in the formula. The safe bearing capacity of permanent piles is 1/2 of that value at which the test pile was loaded before failure, or 1/2 of the bearing obtained under the hammer by the foregoing formula for test piles which were not required to be loaded. Diesel hammers will be permitted. The hammer shall be equipped with an attached measuring rod calibrated in 0.5 foot increments to determine the height of fall of the ram. The safe bearing capacity will be calculated by the formula above for single-acting steam or air hammers.

804.09 TEST PILES.

(a) When required, the contractor shall drive test piles of the length, number, size and type specified at the location and penetration shown on the plans or as directed.

If water jets are used in connection with driving, the bearing capacity will be determined by the applicable formulas from the results obtained by driving after jets have been withdrawn or by static load testing in accordance with Subsection 804.10(a).

Test piles shall be driven using the same type of hammer, the same energy, methods and procedures as intended for permanent piles.

(b) When test piles are driven to determine the length of foundation piles or when the test pile is being driven on a stream bank where the most critical pile is in the middle of the stream, the test pile shall model the subsurface conditions of the permanent piles as directed. The contractor will be required to excavate the test pile location to the elevation of the bottom of the footing or stream bottom and to keep this excavation open during driving and loading of test piles. In lieu of the above, the contractor will be permitted to drive the test pile within an approved casing. The casing shall extend to the elevation of the bottom of footing, the elevation shown on the plans or the stream bottom. The contractor shall, at no direct pay, provide any bracing or strengthening of the test pile required during loading or driving operations.

(c) Cast-in-place concrete test piles shall be filled with concrete in accordance with Subsection 804.06 and the concrete allowed to set for at least 48 hours before the first increment of test load is applied.

(d) The plans or project specifications will designate whether or not permanent piles are to serve as test piles. Should a permanent pile so designated fail under the test load, and should redriving be required, the following requirements shall apply:

1. Precast concrete piles shall not be spliced and redriven. If directed, the contractor shall remove the failing pile and drive a new test pile to the designated depth at an approved location.
2. Steel bearing piles shall be extended by splicing if necessary, and redriven as directed.
3. Timber piles shall not be spliced and redriven. If directed, the contractor shall remove the failing pile and drive a new test pile to the designated depth at an approved location.
4. Cast-in-place concrete piles shall not be redriven. If ordered, the contractor shall drive a new test pile to the designated depth and an approved location.

(e) If test piles are not to be utilized as permanent piles, they shall be removed to a minimum of 5 feet below natural ground or stream bed and disposed of as directed.

(f) If permanent piles are used for anchor piles, permanent piles will be no lower than the tip elevation of the test pile and, after completion of test pile installation, permanent piles shall be reseated. Concrete piles shall not be used as anchor piles.

804.10 LOADING PILES.

(a) Loading Test Piles: A test pile will be loaded when the bearing capacity of the pile is less than two times the design load as determined in Subsection 804.08 or when directed. Test piles shall remain undisturbed for at least 14 calendar days after driving to required penetration before beginning loading operations. The load shall be applied in increments of 10 to 15 percent of the design load as directed. Each load increment shall be held for an interval of 5 minutes. Gross settlement readings, loads and other data shall be recorded by the engineer before and after the application of each load increment.

Test piles shall be loaded to failure or until three times the design load is reached. The test pile will be considered to have failed when continuous jacking is required to maintain the load and the pile is being driven into the ground. Unless otherwise directed, pumping shall cease on a plunging pile when the gross settlement has reached 10 percent of the average pile diameter or diagonal dimension. Gross settlement readings, loads and other data shall be recorded immediately after pumping has stopped and again after an interval of 5 minutes. All loads shall then be removed with gross settlement readings taken immediately and again after 5 minutes. The final rebound readings shall be recorded after the test pile has remained at zero load for 1 hour.

The safe allowable load of any pile so tested shall be considered equal to 1/2 the ultimate load determined by the engineer through analysis of the load settlement curve.

(b) Loading Permanent Piles: When the driving resistance of a permanent pile is less than that of the test pile and will not correlate with the test pile data, the engineer may direct the contractor to either drive permanent piles to a greater depth, retap the pile after a specified waiting period, or load a permanent pile at the driven tip elevation. When loading a permanent pile is directed, the loading shall be conducted in accordance with the procedure given in Heading (a) amended as follows. Permanent piles shall be loaded to failure or until a load equal to two times the design load is reached.

804.11 EXTENSION OF PRECAST CONCRETE PILES BY CASTING IN PLACE. When permitted or shown on the plans, a precast pile may be extended as shown on the plans. The plans show the length of reinforcing steel to be exposed and the additional size and number of reinforcing bars to be spliced where pile extensions are required. The final cut of the concrete shall be perpendicular to the axis of the pile. Concrete shall be as shown on the plans. Just prior to placing concrete, the top of the pile shall be thoroughly wetted and covered with a thin coating of neat cement or other suitable bonding material.

804.12 CUT-OFFS.

(a) Precast Concrete Piles: Cut-offs for precast concrete piles shall be made perpendicular to the axis of the pile at the elevation shown on the plans or as directed. Care shall be exercised to minimize spalling of concrete below the cut-off elevation.

(b) Steel Bearing Piles: Steel bearing piles shall be cut off perpendicular to the axis of the pile and to the elevation shown on the plans or as directed. Cuts shall be made in clean straight lines and any irregularity due to cutting or burning shall be corrected by deposits of weld material prior to placing caps.

(c) Timber Piles:

(1) Tops of timber piling which support concrete footings or caps shall be sawed off perpendicular to their axis at the required elevation.

(2) Piles which support timber caps shall be sawed to a horizontal plane, or to the slope specified, in such manner as to fit the cap.

(3) Shimming on tops of piles will not be permitted.

(4) Treatment of pile heads shall conform to Subsection 812.06.

(d) Cast-in-Place Concrete Piles: After pile shells are fully driven, inspected and approved, they shall be cut off perpendicular to the axis of the pile at the required elevation.

804.13 MEASUREMENT.

(a) Pilings: Piling will be measured by the linear foot of pile below pile cut-off elevation. Redriving of permanent piles used for anchor piles in accordance with Subsection 804.09 will not be measured for payment.

(b) Cut-offs: Cut-offs made as directed will be measured by the linear foot. Payment will not be made for cut-off of a pile unless the length of such cut-off is in excess of 1 foot, nor will payment for cut-offs be made where they have been necessitated by crushing, brooming, splitting or other damage resulting from driving. No payment will be made for required cut-offs of steel bearing piles and cast-in-place concrete pile shells. Such cut-offs will remain the property of the contractor.

(c) Concrete Pile Extensions: Measurement of extensions on precast concrete piles including test piles will be made by the linear foot. The length of cut-back on the ordered length of pile will be added to the net length of extension to obtain the gross length of extension. The gross length of extension will be multiplied by four to determine the quantity for payment, which includes any additional driving required. No deduction will be made from the ordered length of pile driven due to cut-back for splicing.

Measurement of extensions on other type piles will be made by the linear foot for that portion of the pile added to the original length of pile driven, which includes any additional driving required.

No measurement will be made for extensions necessitated by damage to the pile during driving.

(d) Redriving Test Piles: Redriving of test piles will be measured for each test pile for which redriving is required.

(e) Splices:

(1) Concrete Piles: Splices for precast concrete piles will not be measured.

(2) Timber Piles: Measurement of splices on timber piles will be by the linear foot. The total number of linear feet of piling driven will be determined by adding 10 feet to the net length of piling for each splice in place in the finished structure. No measurement will be made for splices except those made as directed.

(3) Steel Bearing Piles: Measurement of splices on steel bearing piles will be made by the linear foot. The total number of linear feet of piling driven will be determined by adding 2 feet to the net length of piling for each splice in place in the finished structure. No measurement will be made for splices except those made as directed.

(4) Cast-in-Place Concrete Piles: Splices for cast-in-place concrete piles will not be measured.

(f) Test Piles: The number of test piles to be paid for will be the number of piles of each type furnished and driven as directed. Cut-offs of test piles will not be included in any pay footage. Test piles pulled and reused as permanent piles will be measured as provided under Heading (a) of this Subsection.

(g) Loading Test Piles: The number of load tests to be paid for will be the number of load tests ordered and completed.

(h) Reloading Test Piles: The number of reload tests to be paid for will be the number of reload tests ordered and completed.

(i) Loading Permanent Piles: The number of load tests to be paid for will be the number of load tests made as directed.

(j) Pilot holes and jetting will not be measured for payment.

804.14 PAYMENT.

(a) Piling: Payment for piling will be made at the contract unit price per linear foot, which includes all bolting, wrapping or fastening timber fender piles, driving batter piles, concrete and reinforcing steel, jetting or pilot holes and redriving permanent piles used for anchor piles.

(b) Cut-offs: Payment for cut-offs will be made at 2/3 the contract unit price when the cutoff is up to 5 feet in length. Payment for cutoffs greater than 5 feet will be made at the contract unit price per linear foot.

(c) Extensions: Payment for cast-in-place extensions will be made at the contract unit price per linear foot for the type and size of pile extended.

(d) Splices: Payment for splices will be made at the contract unit price per linear foot for the type of pile splices.

(e) Test Piles: Payment for test piles will be made at the contract unit price per each.

(f) Loading Test Piles: Payment for loading test piles will be made at the contract unit price per each.

(g) Reloading Test Piles: Payment for reloading test piles will be made at the contract unit price per each.

(h) Loading Permanent Piles: Payment for loading permanent piles will be made at the contract unit price per each.

(i) Redriving Test Piles: Payment for redriving test piles will be made at the contract unit price per each.

(j) Payment will be made under:

Item No.	Pay Item	Pay Unit
804(01)	Precast Concrete Piles (Size)	Linear Foot
804(02)	Untreated Timber Piles	Linear Foot
804(03)	Treated Timber Piles	Linear Foot
804(04)	Steel Bearing Piles (Size)	Linear Foot
804(05)	Cast-in-Place Concrete Piles (Size)	Linear Foot
804(06)	Concrete Piles (Size)	Linear Foot
804(07)	Precast Concrete Test Piles	Each
804(08)	Timber Test Piles	Each
804(09)	Steel Bearing Test Piles	Each
804(10)	Cast-in-Place Concrete Test Piles	Each
804(11)	Concrete Test Piles	Each
804(12)	Loading Test Piles	Each
804(13)	Reloading Test Piles	Each
804(14)	Redriving Test Piles	Each
804(15)	Loading Permanent Piles	Each

Section 805
Structural Concrete

805.01 DESCRIPTION. This work consists of furnishing, placing, finishing and curing portland cement concrete in bridges, culverts and other structures.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures" or "Application of Quality Assurance Specifications for Precast-Prestressed Concrete Plants".

Structural excavation and backfill shall conform to Section 802.

805.02 MATERIALS. Materials shall conform to the following Sections or Subsections:

Mortar	702.02
Steel Joints	807
Portland Cement Concrete	901
Joint Fillers	1005.01
Joint Sealants	1005.02-1005.06
Preformed Elastomeric Compression Joint Seals	1005.03(b)
Strip Seal Joints	1005.05
Waterstops	1005.08
Flexible Plastic Gasket Material	1006.06(b)
Reinforcing Steel	1009
Epoxy Coated Reinforcing Steel and Repair Material	1009.01(f)
Curing Materials	1011.01
Special Surface Finish for Concrete	1011.03
Precast Box Culvert Units	1016
Epoxy Resin Systems	1017.02
Prefabricated Masonry Pads	1018.06
Elastomeric Bridge Bearing Pads	1018.14
Form Release Agents	1018.25
Geotextile Fabric	1019

Classes of concrete furnished shall be as follows:

Concrete Class	Use
A or A(M)	Concrete exposed to sea water, and all other concrete except as listed herein.
AA or AA(M)	Cast-in-place bridge superstructure
D	Pier footings
F	Dams and flood control structures
P or P(M)	Precast bridge members
R	Nonreinforced sections
S	Underwater sections
X	When specified

805.03 HANDLING AND PLACING CONCRETE AND PRECAST UNITS.

(a) General: In preparation for placing concrete, all sawdust, chips and other debris shall be removed from the interior of forms. Struts, stays and braces serving to hold forms in correct shape and alignment shall be removed from the forms when concrete placing has reached an elevation rendering their use unnecessary.

Traffic shall not be permitted on bridge decks until concrete has been in place for 14 calendar days or has attained 3,200 psi compressive strength.

Precast nonprestressed bridge unit shall be held at the plant a minimum of 10 calendar days after casting. After 10 calendar days, the units may be shipped, provided the required 28-day compressive strength has been attained.

Concrete shall be placed to avoid segregation of materials and displacement of reinforcement. The use of long troughs, chutes and pipes for conveying concrete from mixer to forms will be permitted only with written authorization. If these devices cause segregation, impede workability, or produce detrimental effects, their use shall be discontinued.

Open troughs and chutes shall be metal or metal-lined. Where steep slopes are required, chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement of concrete.

Chutes, troughs and pipes shall be kept free from coatings of hardened concrete by thoroughly flushing with water after each pour. Water for flushing shall not be discharged within the structure. No aluminum alloy material will be allowed.

When placing operations involve dropping concrete more than 5 feet, it shall be deposited through a sheet metal or other approved tremie. After initial set of the concrete, forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars which project from the concrete.

Concrete, during and immediately after depositing, shall be thoroughly consolidated. Consolidation shall be done by mechanical vibration subject to the following provisions.

(1) Vibration shall be internal unless authorization for other methods is obtained or as provided herein.

(2) Vibrators shall be of an approved type and design, capable of transmitting vibration to concrete at frequencies of at least 4,500 impulses per minute.

(3) Intensity of vibration shall be such as to visibly affect concrete over a radius of at least 18 inches.

(4) The contractor shall provide a sufficient number of vibrators to properly consolidate each concrete batch immediately after it is placed.

(5) Vibrators shall be manipulated so as to thoroughly work concrete around reinforcement and imbedded fixtures and into corners and angles of forms.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. Vibrators shall be inserted and withdrawn from the concrete slowly. Vibration shall be of sufficient duration and intensity to thoroughly compact concrete, but shall not 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 vibration is visibly effective.

(6) Vibration shall not be applied directly to or through reinforcement to sections or layers of concrete which have hardened to the degree that concrete ceases to be plastic under the vibration. It shall not be used to make concrete flow over distances so great as to cause segregation. Vibrators shall not be used to transport concrete in forms.

(7) Vibration shall be supplemented by such spading as necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations inaccessible to vibrators.

(8) These provisions for vibration shall apply to filler concrete for steel grid floor except that the vibrator shall be applied to the steel.

(9) These provisions for vibration shall also apply to precast concrete except that, if approved, the manufacturer's methods of vibration may be used.

Concrete shall be placed in horizontal layers not more than 12 inches thick unless otherwise permitted. When less than a complete layer is placed in one operation, it shall be terminated at a vertical bulkhead. Each layer shall be placed and consolidated before the preceding batch has taken initial set to prevent damage to green concrete and avoid surfaces of separation between batches. The top surface of concrete adjacent to forms shall be finished to a suitable grade strip.

When 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.

Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wingwall, an inset form shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Placement of concrete shall not be discontinued within 18 inches of the top of any face, unless provision has been made for a coping less than 18 inches thick, in which case, if permitted, the construction joint may be made at the underside of the coping.

Following discontinuance of placing concrete, accumulations of mortar splashed on reinforcement steel and forms shall be removed. Dried mortar chips and dust shall not be mixed in fresh concrete.

(b) Reinforced Concrete Box Culvert: The contractor may furnish structures of either cast-in-place concrete or precast concrete units; however, design and installation procedures for precast units will be subject to approval. For the cast-in-place option, the base slab or footings of a box culvert shall be placed and allowed to set before the remainder of the culvert is constructed.

Before concrete is placed in sidewalls, culvert footings shall be cleaned of shavings, sticks, sawdust and other debris and the surface carefully chipped or roughened in accordance with the method of bonding construction joints specified in Subsection 805.06.

For culverts 4 feet or less in height, walls and top slab may be constructed monolithically. When this method of construction is used, necessary construction joints shall be vertical and perpendicular to the axis of the culvert.

In construction of box culverts more than 4 feet in height, concrete in walls shall be placed and allowed to set in accordance with strength or curing time requirements of Subsection 805.11 before the top slab is placed.

If possible, each wingwall shall be constructed monolithally. Construction joints shall be horizontal and located so that no joint will be visible in the exposed face of the wingwall above the ground line.

Precast units shall be cast and placed as shown on the plans. Joints for sectional precast units shall be sealed with an approved flexible plastic gasket material installed as to form a watertight seal. Joints shall be wrapped with an approved geotextile fabric for a minimum of 12 inches on each side of the joint. Ends of cloth shall be lapped at least 10 inches, with the edges and ends suitably secured.

(c) Girders, Slabs and Columns: Concrete in girders shall be deposited uniformly for the full length of girder and brought up evenly in horizontal layers.

Concrete in girder haunches less than 3 feet high shall be placed at the same time as that in the girder web; the column or abutment tops shall be cut back to form seats for the haunches. Whenever a haunch or fillet has a vertical height of 3 feet or more, the abutment or columns, haunch and girder shall be placed in three stages: up to the lower side of haunch, to the lower side of girder, and to completion. For haunched continuous girders, the girder web (including haunch) shall be placed to the top of web. Where the size of pour is such that it cannot be made in a continuous operation, vertical construction joints shall be located within the area of contraflexure.

Concrete in slab spans shall be placed in one continuous operation for each span.

Concrete T-beam or deck girder spans may be placed in a continuous operation, or in two separate operations, each of which shall be continuous: to the top of girder webs, and to completion. In the latter case, the bond between stem and slab shall be positive and mechanical and may be secured by suitable shear keys or roughening the top of girder stem. Keys are formed by using timber blocks approximately 2 inches by 4 inches in cross section and having a length 4 inches less than the width of girder stem, spaced along girder stems as required, but not greater than 1-foot center to center. Blocks shall be beveled and oiled to facilitate their removal, and shall be removed as soon as concrete has set sufficiently to retain its shape.

Concrete columns shall be placed in a continuous operation. Concrete shall be allowed to set at least 24 hours before caps are placed. When friction collars are used to support cap forms, concrete columns shall have been poured at least 7 days or shall have at least 3,000 psi compressive strength before caps are placed. Compressive strength cylinders shall be made in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230.

No concrete shall be placed in the superstructure until column forms have been stripped sufficiently to determine the character of concrete in the columns. The load of the superstructure shall not be allowed to come upon the bents until compressive strength cylinders representing the bents have attained at least 3,000 psi compressive strength but in no case in less than 7 curing days. Compressive strength cylinders shall be made in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230.

(d) Minimum Placement Rate for Bridge Decks: The contractor shall provide sufficient supervision, manpower, equipment, tools and materials to assure proper production, placement and finish of concrete for each pour in accordance with minimum placement rates specified herein. If the

contractor fails to meet the minimum placement rate, the engineer may reject the pour; further placement of similar nature and size will not be permitted until corrective measures have been taken to assure that the minimum placement rate can be met.

Pour Size Cubic Yards	Minimum Placement Rate Cubic Yards Per Hour
0-25	15
26-50	20
51-75	25
76-125	30
Over 125	40

805.04 PUMPING. Pumping equipment shall be so arranged that no vibrations result which might damage freshly placed concrete. Pipes carrying concrete to placing area shall be laid out with a minimum of bends and no unauthorized change in size. Where concrete is conveyed and placed by mechanically applied pressure, suitable equipment of adequate capacity shall be used. Aluminum piping will not be permitted.

A grout mortar, or concrete with coarse aggregate omitted, shall be pumped through the equipment ahead of the regular concrete to provide lubrication to start pumping operations. This material shall not be used in placement. The lubrication process need not be repeated as long as pumping operations are continuous.

Operation of the pump shall be such as to provide a continuous stream of concrete without air pockets. When pumping is completed, concrete remaining in the pipes, if it is to be used, shall be ejected in such manner that there will be no contamination of concrete or separation of ingredients.

805.05 DEPOSITING CONCRETE UNDERWATER. Concrete shall not be deposited in water except on approval. The method of placing shall be approved by the engineer and conform to the following:

To prevent segregation, concrete shall be placed in its final position by means of a tremie and shall not be disturbed after being deposited. Concrete shall be placed in caissons, cofferdams or watertight forms.

For underwater parts of structures, concrete seals shall be placed in one continuous operation. The surface of the concrete shall be kept as nearly horizontal as possible; still water shall be maintained at the point of deposit.

A tremie shall consist of a tube at least 10 inches in diameter; if constructed in sections, the couplings shall be watertight. Tremies shall be supported so as to permit positioning anywhere over the top surface of the work and for rapid lowering when necessary to retard or stop the flow of concrete.

When concrete is dumped into the hopper, flow may have to be induced by slightly raising the discharge end of the tremie, but always keeping it in deposited concrete. Flow shall be continual until the work is completed. Aluminum tremies will not be permitted.

Dewatering may proceed when the concrete is sufficiently hard, but not for at least 72 hours after concrete placement is completed. Prior to constructing succeeding portions of the structure, laitance or other unsatisfactory material shall be removed from the surface by scraping, chipping or other means which will not damage the concrete.

805.06 CONSTRUCTION JOINTS.

(a) General: Construction joints shall be made only where located on the plans or shown on the pouring schedule, unless otherwise approved. When not detailed on the plans, construction joints shall be placed as directed. Raised shear keys or reinforcing steel shall be used where necessary to transmit shear or bond sections together.

(b) Bonding: Forms shall be retightened before placing new concrete on or against hardened concrete.

(1) Neat Cement Slurry Joints: The surface of hardened concrete shall be roughened as required in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall then be thoroughly cleaned of foreign matter and laitance, and saturated with water. To ensure an excess of mortar at the juncture of hardened and newly deposited concrete, the surfaces, including vertical and inclined surfaces, shall be thoroughly coated with a neat cement slurry. New concrete shall be placed before the grout has attained its initial set. Placing of concrete shall be carried continuously from joint to joint. Edges of joints which are exposed to view shall be finished true to line and elevation.

(2) Epoxy Resin Joints: Vertical surfaces of bridge deck construction joints and other construction joints shall be coated prior to each succeeding pour with an approved Type II, Grade B or Grade C epoxy resin applied according to the manufacturer's recommendations. Surfaces of hardened concrete to which new concrete is to be bonded shall be cleaned of foreign material, loose or unsound concrete by sandblasting, hammers or wire brushes. Grease or oil shall be removed with a detergent wash such as trisodium phosphate, and the entire area washed with fresh water and brushed with a stiff brush. If a detergent is not required, dust and small particles not removed by other cleaning methods shall be removed by washing.

805.07 CONCRETE EXPOSED TO SALT WATER. Concrete shall be thoroughly consolidated and stone pockets shall be avoided. No construction joints shall be formed between levels of extreme low water and extreme high water. Salt water shall not come in contact with concrete for at least 30 calendar days.

805.08 FALSEWORK. Detailed plans for falsework shall be furnished in accordance with Section 801.

For designing falsework, a weight of 150 pounds per cubic foot shall be assumed for green concrete and a minimum of 30 pounds per square foot for construction load. Falsework shall be designed and constructed to provide necessary rigidity and support loads without appreciable settlement or deformation and shall provide a means to determine settlement along the structure. The engineer may require the contractor to employ screw jacks, hardwood wedges or other approved methods to take up settlement in formwork before or during placing of concrete.

Falsework which cannot be founded on a satisfactory footing shall be supported on piling spaced, driven and removed in an approved manner. Falsework shall be set to give the finished structure the specified camber.

805.09 FORMS.

(a) Construction: Forms shall be of wood, metal or other approved material, built mortartight and of sufficient rigidity to prevent

distortion due to pressure of concrete and other loads incident to construction operations.

Forms shall be constructed and maintained to prevent warping and opening of joints due to shrinkage of lumber. Forms shall be substantial and unyielding and so designed that finished concrete will conform to proper dimensions and contours. Design of forms shall take into account the effect of vibration of concrete as it is placed.

(b) Form Surface: Forms for exposed surfaces shall not adhere to or discolor concrete. Forms shall be made of either metal or dressed lumber of uniform thickness with or without approved form liner and shall be mortartight. Forms for reentrant angles shall be chamfered and forms shall be filleted at sharp corners. Forms for projections, such as girders or copings, shall be given a bevel or draft to ensure easy removal.

When possible, forms shall be daylighted at intervals not greater than 10 feet vertically, the openings being sufficient to permit free access for inspecting, working and spading the concrete.

(c) Metal Ties: Metal ties or anchorages within forms shall be constructed to permit their removal to a depth of at least 1/2 inch from the face without damage to concrete. If wire ties are permitted, upon removal of the forms, wires shall be cut back at least 1/4 inside from the face of concrete with chisels or nippers. Fittings for metal ties shall be of such design that, upon their removal, cavities left will be of the smallest possible size. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in color.

(d) Setting and Maintaining: Forms shall be set and maintained reasonably true to required line and grade until concrete is sufficiently hardened. When forms are deemed to be unsatisfactory, either before or during placing of concrete, the work shall be stopped until defects have been corrected. Forms shall be so designed that portions where finishing is required may be removed without disturbing portions of forms to be removed later and, as far as practical, so that form marks will conform to general lines of the structure. For narrow walls and columns, where the bottom of the form is inaccessible, lower form boards shall be left loose so that they may be removed for cleaning out immediately before placing concrete.

(e) Re-Used Forms: Shape, strength, rigidity, mortar-tightness and surface smoothness of re-used forms shall be maintained. Warped or bulged lumber shall be resized before being reused. Unsatisfactory forms shall not be re-used.

(f) Surface Treatment: Forms shall be treated with an approved form release agent. Release agents which will adhere to or discolor concrete shall not be used.

Prior to placing concrete, the interior of forms shall be cleaned of dirt, sawdust, shavings or other debris. Forms shall be inspected then saturated with water immediately prior to placing concrete.

805.10 CURING. Concrete in substructures for grade separation structures, superstructures of major structures, and railroad underpasses shall be cured with wet burlap or other approved material. Precast concrete shall be cured in accordance with Subsection 805.14(e).

A Type 1-D curing compound conforming to Subsection 1011.01 may be used for curing concrete in minor drainage structures and bridge substructures and diaphragms when surfaces do not require a Class 2A

finish. When membrane curing is used, exposed reinforcing steel and construction joint surfaces shall be covered or shielded to prevent coating with curing compound. Construction joint surfaces shall be wet cured by approved methods as soon as possible after concrete placement. Concrete surfaces in contact with forms shall be sealed immediately after completion of form removal and surface finishing. Membrane curing shall be applied as soon as surface moisture has evaporated. Method and application rate of curing compound shall be in accordance with the manufacturer's recommendations, but in no case shall the application rate be less than one gallon per 100 square feet of surface area. The compound shall be applied in one or two applications. If the compound is applied in two increments, the second application shall follow the first application within 30 minutes. Satisfactory equipment shall be provided, with means to properly control and direct application of curing compound on concrete surfaces to result in uniform coverage.

If rain falls on newly coated concrete before the film has dried sufficiently to resist damage, or if the film is damaged, a new coat of compound shall be applied to affected portions.

When curing with burlap, the exposed concrete immediately after finishing shall be covered with two thicknesses of wet burlap. Burlap shall be fixed so that it is in contact with the concrete at all times and shall be kept continuously wet for at least 5 curing days as defined in Subsection 805.11 after concrete is placed.

In bridge deck construction, exposed surface of decks shall be sprayed uniformly with a Type 2 curing compound immediately after final texturing as an interim curing measure in accordance with Subsection 601.10(a). Exposed reinforcing steel and joints shall be covered or shielded to prevent contact with curing compound. Moist curing methods stated herein shall then be used on the deck when concrete has set sufficiently to support burlap without marring the surface.

805.11 REMOVAL OF FALSEWORK AND FORMS. Except as otherwise specified herein, face form for barrier curbs or rails and side forms for caps requiring a Class 2A finish shall be removed not less than 1/2 nor more than 2 curing days after concrete is placed to permit finishing.

Forms for surfaces not requiring a Class 2A finish, and supporting forms and falsework for structure members such as bent caps, beams and slabs, shall be removed in accordance with one of the following methods.

Method 1: Forms and falsework may be removed as soon as concrete has attained a compressive strength, as determined by cylinder tests, indicated in the following table:

REMOVAL OF FORMS AND FALSEWORK

Concrete Class	Compressive Strength (psi)
A	3,000
A(M)	3,600
AA	3,200
AA(M)	3,600
D	2,500
P (nonprestressed)	3,000
P(M) (nonprestressed)	3,600
X (nonprestressed)	2,500
Precast Minor Structure Units (nonprestressed)	2,500

Test specimens will be made in accordance with DOTD TR 226 from the same concrete and cured under the same conditions as the portion of the structure involved. Specimens will be tested in accordance with DOTD TR 230.

Method 2: Forms and falsework may be removed when concrete has aged for the minimum number of curing days in the following table:

Under slabs, beams or pile caps with span lengths less than 10 feet	7 days
Under slabs, beams or pile caps with span lengths of 10 to 17 feet	7 days plus 1 day for each foot of span over 10 feet
Under slabs, beams or pile caps with span lengths over 17 feet	14 days
Under portion of slabs that cantilever more than 1 foot	7 days
Walls, columns, side forms for beams, pile caps and slabs that cantilever less than 1 foot	1 day
Caissons	1 day
Precast nonprestressed bridge units (side forms)	1 day
Precast nonprestressed minor structure units	7 days

The term "curing day" will be interpreted as a calendar day on which the temperature is above 50°F for at least 19 hours. Colder days may be counted if approved methods are used to maintain air temperature adjacent to concrete above 50°F throughout the day.

During continued cold weather, when artificial heat is not provided, the engineer may permit removal of forms and falsework at the end of a period of calendar days equal to two times the number of curing days stated above.

The foregoing provisions for form and falsework removal shall apply only to forms or parts of forms so constructed as to permit removal without disturbing forms or falsework which are required to be left in place for a longer period on other portions of the structure.

Methods of form removal likely to cause overstressing of concrete shall not be used. Forms and their supports shall not be removed without approval. Supports shall be removed in such manner as to permit concrete to uniformly and gradually take stresses due to its own weight.

805.12 EXPANSION AND FIXED JOINTS, AND BEARINGS.

(a) Open Joints: Open joints shall be constructed by insertion and subsequent removal of a wood strip, metal plate or other approved

material. Insertion and removal of the template shall be accomplished without chipping or breaking corners of concrete. Reinforcement shall not extend across an open joint.

(b) Filled Joints: Joints to be sealed with poured or preformed compression seals shall be formed and constructed similar to open joints. For joints with preformed filler, the filler shall be in correct position when concrete is placed.

(c) Joint Seals: Joints shall be sealed full width, including curbs and sidewalks.

(1) Liquid Poured: Before application of the sealant, joint faces shall be sandblasted. Joints shall be thoroughly dry at the time of installation. Sealants shall be installed in accordance with the manufacturer's recommendations. The material's shelf life shall not be exceeded. The ambient air temperature at the time of application shall be at 70°F or greater. Application shall be done by a machine with a powered mixing device with an accurate method of proportioning and mixing the components.

Primers, when required, shall be applied as directed by the manufacturer; however, it shall be applied the same day as installation and shall be tackfree prior to installation of sealants.

Joints shall be backed with an approved backer material. The backer material may be cast into the joint or compressed into the joint such that it adheres tightly to sides of the joint.

(2) Preformed Elastomeric Compression Joint Seal: Joints shall be thoroughly cleaned and free of loose rust. Where armored joints are welded for alignment during construction, weld spots shall be ground smooth and spot primed prior to seal placement. Joints shall be smooth-faced and thoroughly clean and dry at the time of installation. Joint seals shall be installed in accordance with the manufacturer's recommendations.

The adhesive-lubricant shall be applied just prior to installation and shall be sufficient to completely cover the seal's sidewalls. Installation shall be done in a manner that least disturbs the adhesive-lubricant on joint walls. Dilution of the adhesive-lubricant will not be allowed.

Stretching of the seal shall be minimal. When installation procedures appear to cause stretching, random inspections shall be made. Frequency and thoroughness of inspections shall be as directed. Maximum allowable longitudinal stretch of the compression seal is 5 percent. When maximum limits are exceeded, and the adhesive lubricant has chemically set, the seal shall be removed and cleaned, the joint recleaned and reinstallation made at no direct pay.

One manufacturer's shop splice per 48-foot length will be allowed provided field performance and laboratory tests indicate satisfactory performance. Field splicing will not be allowed.

(d) Strip Seal Joints: Joints shall be free of loose rust, and thoroughly clean and dry at the time of installation. Joint seal glands shall be installed in accordance with the manufacturer's recommendations.

Stretching of the seal gland shall be minimal. When installation procedures appear to cause stretching, random inspection will be made. Frequency and thoroughness of inspections shall be as directed. Maximum allowable stretch shall be 5 percent. When maximum limits are exceeded, and the adhesive-lubricant has chemically set, the seal shall be

completely removed and cleaned, the joint recleaned and reinstallation made at no direct pay.

The adhesive-lubricant shall be applied just prior to installation of the gland and shall be sufficient to completely cover the contact surfaces of the steel extrusion and the seal glands. Installation shall be done in a manner that least disturbs the adhesive-lubricant. Dilution of the adhesive-lubricant will not be allowed.

The joint manufacturer shall submit shop drawings in accordance with Subsection 801.03 and shall supervise the installation and provide the necessary technical expertise.

Welding shall be in accordance with Section 815. Shop fabrication and fabrication inspection shall conform to Section 807.

(e) Preformed Polyurethane Expansion Joint Filler: Joint fillers shall be installed as directed.

(f) Steel Joints: Plates, plans, and angles or other structural shapes shall be fabricated to conform to the plans and section of the concrete floor. The surface in the finished plane shall be true and free of warping. Positive methods shall be employed in placing joints to keep them in correct position during placing of concrete. The opening at expansion joints shall be designated on the plans at the prescribed temperature. The required clearance shall be accurate considering temperature effects and stage of construction at the time of installation.

Temporary restraints placed in joints shall be removed as soon as possible after placing concrete adjacent to the joint.

(g) Waterstops: Adequate waterstops of metal, rubber or plastic shall be placed as shown on the plans. Where joint movement is to be provided, waterstops shall be of a type permitting such movement without damage. They shall be spliced, welded or soldered to form continuous watertight joints.

(h) Bearing Surfaces: Masonry surfaces on which bearings are to be set shall be finished to ensure uniform bearing at required grade and elevation.

(i) Elastomeric Bridge Bearing Pads: Bearings shall be specified by durometer hardness, size and configuration and, in the case of laminated bearings, by thickness of individual layers of elastomer and the size and position of special connection members required to be vulcanized with the bearing.

(j) Expansion Devices: Rockers or other expansion devices shall be accurately set considering temperature effects and stage of construction at the time of installation.

805.13 CONCRETE SURFACE FINISHES. Surface finishes shall be classified as follows:

Class 1	Ordinary Surface Finish
Class 2A	Special Surface Finish
Class 4	Sandblast Finish
Class 6	Bridge Deck Finish
Class 7	Sidewalk Finish
Class 8	Precast-Prestressed Concrete Finish

All concrete shall be given Class 1, Ordinary Surface Finish, in addition to any other type of finish specified. The following surfaces shall be given a Class 2A, Special Surface Finish: visually exposed faces

of wingwalls, retaining walls, railings and parapets; outside faces of girders, slabs, brackets, curbs, headwalls, parapets, and vertical faces of caps and columns. Wingwalls shall be finished from the top to 1 foot below finish slope lines on the exposed face and shall be finished on top for a depth of one foot below the top on backfill sides.

Bridge deck surfaces shall be given a Class 6, Bridge Deck Finish.

(a) Class 1, Ordinary Surface Finish: Immediately following the removal of forms, fins and irregular projections shall be removed from all surfaces except from those which will not be exposed to view after construction or are not to be waterproofed. Cavities produced by form ties and other holes, honeycombed spots, broken corners or edges and other defects shall be cleaned and, after having been kept saturated with water, shall be pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the concrete being finished.

Mortar used in pointing shall be not more than 1 hour old. Water shall be added to a workable consistency. Concrete shall then be cured as specified under Subsection 805.10. Construction and expansion joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

Surfaces shall be true and uniform. Surfaces which cannot be satisfactorily repaired shall be coated as specified for Class 2A, Special Surface Finish.

Exposed surfaces not protected by forms shall be struck off with a straightedge and finished with a wood float to a true, even surface. Use of additional mortar to provide a grout finish will not be permitted.

(b) Class 2, Rubbed Finish: Whenever a Class 2 Rubbed Finish is specified a Class 2A Special Surface Finish shall be used.

(c) Class 2A, Special Surface Finish: The Class 2A Special Surface Finish will be used as required by the plans and as specified elsewhere herein. When the Special Surface Finish is used, it shall be used throughout the structure.

Application of the Special Surface Finish shall not be started until other work which might mar the surface finish is complete and finishing operations can be carried out continuously on a structure.

The same materials and methods shall be used for all surfaces on the project given this Special Surface Finish.

(d) Class 4, Sandblasted Finish: After 28 curing days, the concrete surface shall be sandblasted with hard, sharp sand to produce an even fine grained surface in which mortar has been cut away, leaving aggregate exposed.

(e) Class 6, Bridge Deck Finish:

(1) Striking Off: After concrete is placed and consolidated according to Subsection 805.03, bridge decks or top slabs of structures serving as finished pavements shall be finished either by hand methods or approved mechanical machines. Continuous span units shall be struck off with approved mechanical equipment.

When hand methods are used, bridge decks shall be struck off with a screed parallel to the centerline of roadway, resting on bulkheads or screed strips cut or set to required roadway cross section. This screed shall be constructed to have sufficient strength to retain its shape, and the cutting edge shall be adjusted to conform to roadway profile. Screeds shall be of sufficient length to finish the full length of spans 50 feet or less in length. These screeds shall be mechanically operated

for finishing spans over 50 feet in length and may not be used to strike off spans in excess of 75 feet without permission.

Spans over 50 feet in length and continuous spans shall be placed with lengths of pours as shown on the plans. Screed strips or headers shall be accurately set to specified grades, checked and adjusted as necessary prior to final screeding operations. The screed shall be worked back and forth over the surface until proper profile and cross section are obtained.

Mechanical finishing machines shall be approved power driven machines, traveling on rails, equipped with transverse or longitudinal screeds and adjusted to conform to profile or cross section. Consolidation by vibratory action of the finishing machine will not be permitted. Screeds shall have sufficient strength to retain their shape after adjustment. The finishing machine shall go over each area of bridge deck as many times as required to obtain required profile and cross section. A slight excess of concrete shall be kept in front of the cutting edge of the screed. This excess of concrete shall be carried to the edge of the pour or form and shall be wasted.

Excess water, laitance or foreign materials brought to the surface during finishing operations shall not be reworked into the slab, but shall be removed immediately.

Addition of water to the surface of concrete to assist in finishing operations will not be permitted. If application of water to the surface is permitted, it shall be applied as a fog spray by means of approved equipment.

(2) Straightedging: After striking off, the surface shall be checked by the contractor with an approved 10-foot metal static straightedge operated parallel to the centerline of the bridge and shall show no deviation in excess of 1/8 inch from the testing edge of the straightedge. Deviations in excess of this requirement shall be corrected before final finishing. The checking operation shall progress by overlapping the straightedge at least 1/2 the length of the preceding pass. Major deviations shall be corrected by the strike-off, with the straightedge being used to correct minor deviations and as a checking device.

(3) Final Texturing: After surface irregularities have been removed and a satisfactorily smooth surface obtained, concrete shall be given a uniformly textured final surface finish by use of a metal tine texturing device.

Grooves produced in concrete shall be spaced on 1-inch centers and shall be 3/16-inch wide and 1/8-inch to 3/16-inch deep. Grooves shall be transverse to the centerline of roadway and shall extend to within 1 foot of the gutterline. A mechanical or manual operation may be used to propel metal tines, provided required texture is obtained.

Depth of final finish will be checked in accordance with DOTD TR 229. Texturing equipment other than that specified herein may be approved provided it produces an equivalent texture.

During final surface texturing operations, areas improperly finished shall be refloated and refinished as required.

(f) Class 7, Sidewalk Finish: After concrete has been placed, it shall be consolidated and the surface struck off by means of a strike board and floated with a wooden or cork float. An edging tool shall be used on edges and at expansion joints. The surface shall not vary more than 1/8 inch under a 10-foot metal static straightedge. The surface shall have a granular or matte texture.

(g) Class 8, Precast-Prestressed Concrete Finish: Precast-prestressed bridge members shall be given Class 1, Ordinary Surface Finish at the plant as soon as possible after casting and prior to shipment by the manufacturer. The manufacturer of precast members will be required to adopt measures to reduce the number and size of trapped air cavities to a minimum; an excessive number of these cavities will be cause for rejection of the precast member.

After completion of the structure, construction damage shall be repaired so as to restore the Class 1, Ordinary Surface Finish. Exposed surfaces of precast-prestressed concrete piles shall be cleaned to produce a uniform color. Cleaning shall not be done in a manner to destroy the glazed surface of concrete resulting from the use of metal forms.

During pouring of decks, the contractor shall keep girders, pilings, and columns clean by washing and shall remove any materials that adhere to the surface and mar the girder finish.

805.14 PRESTRESSED CONCRETE.

(a) Supervision and Inspection: The contractor or fabricator shall provide a technician skilled in the use of the system of prestressing to be used who shall supervise the work and provide assistance to the engineer as required.

Shop drawings as required under Subsection 801.03 shall be approved and in the possession of the plant inspector at least 2 days prior to beginning fabrication. Free access to all parts of the plant engaged in fabrication of prestressed concrete bridge members shall be afforded the engineer while prestressed members are being fabricated. Areas where inspection is required shall be kept free of debris.

The Department will inspect all prestressed concrete bridge members. The fabrication, construction and dimensional tolerances of prestressed members shall conform to the limits specified in the "Manual for Quality Control for Plants and Production of Precast-Prestressed Concrete Products (MNL-116-Latest Edition)" published by the Prestressed Concrete Institute, unless otherwise specified herein. Required finishing, repairs and curing shall be accomplished immediately after casting and before placing members in permanent storage.

The fabricator shall furnish the engineer an office with at least 140 square feet of floor space to perform necessary work. Additional space deemed necessary by the engineer shall be provided. This office shall contain a desk, chair, file cabinet with lock, telephone, electric lights, power outlets, shelves and tables, in the quantity required by the engineer. Fabricator shall be responsible for paying all utility bills. The office shall be provided with adequate heating, ventilation, air conditioning, and convenient sanitary facilities with running water. This office shall be in good condition, located where there is not excessive noise and restricted to the Department's inspectors. Convenient and adequate reserved parking space shall be provided.

The fabricator shall furnish a concrete cylinder breaking machine of minimum 250,000 lb capacity conforming to ASTM C 39 along with all other necessary supplies and equipment. Suitable facilities for use of this machine shall also be furnished. This machine shall be calibrated by an approved laboratory or calibration service at the manufacturer's expense prior to initial use and at one year intervals thereafter. If, during use, the machine appears to be giving erratic results, recalibration will be required.

(b) General Equipment and Stressing Requirements: The fabricator shall provide all equipment necessary for construction and prestressing. Prestressing shall be done with approved equipment. If hydraulic jacks are used, they shall be equipped with accurate reading pressure gages.

In all methods of tensioning, the stress induced in tendons shall be measured both by jacking gages and elongations of reinforcement, and results shall check within specified limits. Means shall be provided for measuring elongation of reinforcement to the nearest 1/32 inch.

Prior to use in fabrication of prestressed members under these specifications, all jacks to be used, with their gages, shall be calibrated by an approved independent calibration service at no direct pay. A certification shall be supplied to the Construction Section. During the work, if a jack or gage appears to be giving erratic results or if gage pressure and elongations indicate materially differing stresses, recalibration will be required.

There may be a difference in indicated stress between jack pressure and elongation of about 5 percent. In such event, the error shall be so placed that the discrepancy shall be on the side of a slight overstress. In the event of an apparent discrepancy between gage pressure and elongation of as much as 10 percent, the operation shall be carefully checked and the source of error determined before proceeding.

The amount of stress to be given each stressing element shall be as shown on the plans.

Pretensioning of tendons shall be in prescribed stages to allow for stress equalization throughout the tendon.

(c) Concrete: Design of the concrete mix shall be the responsibility of the contractor subject to approval, but such approval shall not relieve the fabricator of responsibility for the product furnished.

Concrete shall be controlled, mixed and handled as specified in this Section and Section 901.

Concrete shall not be deposited in forms until the engineer has inspected reinforcement, conduits, anchorages, cleanliness of forms and prestressing tendons and given approval.

Concrete shall be vibrated internally or externally or both, as ordered. Vibrating shall be done in such manner as to avoid displacement of reinforcing, conduits or tendons.

Tops of prestressed beams shall be rough floated. At the time of initial set, the top of beams shall be scrubbed transversely with a coarse wire brush to remove laitance and produce a roughened surface for future bonding.

(d) Forming for Girders: Prestressed members shall be cast in steel forms. Bolted form joints shall be so spaced that no exterior girder shall have more than two bolted joints or seams. Bolted joints or seams shall be sealed to minimize bleeding.

Prior to placement of concrete, forms shall be cleaned and uniformly coated with an approved form release agent. Outside surfaces of forms shall be maintained reasonably clean and free from concrete build-up.

Forms that have become heated shall be cooled by spraying with water immediately prior to placing concrete in each section.

Girder ends shall be coated with an approved protective coating to protect strand ends.

Prestressed members shall be finished in accordance with Subsection 805.13(g).

(e) Curing: To establish adequacy of curing methods and to determine whether concrete has attained the required compressive strength, seven test cylinders will be made and cured under the same condition as the members. Two cylinders will be tested at the end of 28 calendar days. The remaining five cylinders will be tested at any time requested by the contractor. However, no more than two cylinders will be tested in one day. If all five cylinders have been tested and concrete has not attained required strength, the members involved shall be held at the plant until the 28-day cylinders are tested. If each 28-day concrete cylinder has not attained required strength, all members involved will be subject to rejection. Acceptance will be made in accordance with the Department's manual entitled "Application of Quality Assurance Specifications for Precast-Prestressed Concrete Plants." Curing methods other than steam curing shall be in accordance to Subsection 805.10. Hot weather concrete limitations as stipulated in Subsection 901.11(b) shall not be applicable for steam curing; however, precautions such as cooling of forms will be required.

Steam curing shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. Initial application of steam shall be from 2 to 4 hours after final placement of concrete to allow initial set of concrete to take place. When retarders are used, the waiting period before application of steam shall be from 4 to 6 hours. Steam shall be at 100 percent relative humidity. Application of steam shall not be directly on concrete. During application of steam, ambient air temperature shall be increased at a rate not to exceed 40°F per hour until a uniform temperature not exceeding 160°F is reached. Steam curing shall continue at this temperature until concrete reaches release strength. At the contractor's option, the temperature may be decreased to not less than 100°F after 6 hours and held at this temperature until the time of detensioning operations, provided no structural defects occur; if structural defects occur, the defective members will be rejected. At this time, steam curing may be discontinued.

Concrete shall remain covered for at least 2 hours after steam curing has ceased, at which time detensioning shall be accomplished. The 2-hour cool-down period may be waived if the fabricator demonstrates that there will be no adverse effect to members. One recording thermometer showing time-temperature relationship shall be furnished for each 200 feet of bed.

(f) Transportation and Storage: Precast girders shall be transported in an upright position. Points of support and directions of reactions with respect to the girder shall be approximately the same during transportation and storage as when the girder is in its final position.

Care shall be taken during storage and handling of precast units to prevent damage. Units damaged by improper storing or handling shall be replaced by the contractor at no direct pay.

Members may be handled immediately after detensioning. If stressing is not done in a continuous operation, members shall not be handled before sufficiently stressed to sustain all forces and bending moments due to handling.

Prestressed members shall be held at the plant until concrete has attained the specified 28-day compressive strength.

Prestressed members, except for prestressed piling, may be installed at any time after completion of stressing and grouting, providing concrete has attained the specified minimum 28-day compressive strength.

Prestressed concrete piling shall be held at the plant until one of the following criteria is met:

(1) Ten days after the specified minimum 28-day compressive strength is attained, or

(2) Fourteen days after casting, provided the specified minimum 28-day compressive strength has been attained.

(g) Pretensioning Method: Prestressing strands shall be accurately held in position and stressed by approved jacks. A record shall be kept of the jacking force and tendon elongation produced. Several units may be cast in a continuous line and stressed at one time. Sufficient space shall be left between ends of members to permit access for cutting strands after concrete has attained required strength. No bond stress shall be transferred to concrete nor shall end anchors be released until concrete has attained specified release strength as shown by cylinders made in accordance with DOTD TR 226 and cured identically with members and tested in accordance with DOTD TR 230. Strands shall be cut or released in such order that lateral eccentricity of prestress will be a minimum in accordance with approved shop drawings.

Strands to be prestressed in a group shall be brought to a uniform initial tension prior to full pretensioning. This initial tension of 1,000 to 2,000 pounds shall be measured by a dynamometer or other approved means so that its amount can be used as a check against elongation computed and measured.

After initial tensioning, the group shall be stressed until required elongation and jacking pressure are attained within the specified limits.

With cables stressed in accordance with plan requirements and the foregoing specifications and with all other reinforcing in place, the concrete shall be cast to required lengths. Strands shall not be spliced within the casting length of a girder.

(h) Posttensioning Method: The tensioning process shall be so conducted that tension being applied to the tendon and its elongation may be measured at all times. The friction loss shall be estimated as provided below. A record shall be kept of gage pressures and elongations and submitted to the engineer for approval. Loads shall not be applied to concrete until it has attained the compressive strength specified in Heading (f) of this Subsection.

Posttensioning tendons of straight members may be tensioned from one end. Posttensioning tendons of curved members shall be stressed by simultaneous jacking from both ends of the stressing element.

Friction Losses: Friction losses in posttensioned steel shall be based on experimentally determined wobble and curvature coefficients, and verified during stressing operations. Values of coefficients assumed for design, and acceptable ranges of jacking forces and steel elongations shall be as shown on the plans. These friction losses shall be calculated as follows:

$$T_o = T_x e^{(KL + \mu\alpha)}$$

When $(KL + \mu\alpha)$ is not greater than 0.3, the following equation may be used:

$$T_o = T_x (1 + KL + \mu\alpha)$$

in which

T_o = Steel stress at jacking end.
T_x = Steel stress at any point x.
e = Base of Naperian logarithms.
K = Friction wobble coefficient per foot of prestressing steel.
L = Length of prestressing steel element from jacking end to point x, in feet.
μ = Friction curvature coefficient
α = Total angular change of prestressing steel element in radians from jack to point x.

The following values for K and μ may be used when experimental data from the materials used are not available:

Type of Steel	Type of Duct	K	μ
Wire or ungalvanized strand	Bright Metal Sheathing	0.0020	0.30
	Galvanized Metal Sheathing	0.0015	0.25
	Greased or asphalt-coated and wrapped	0.0020	0.30
	Galvanized rigid	0.0002	0.25
High-strength bars ..	Bright Metal Sheathing	0.0003	0.20
	Galvanized Metal Sheathing	0.0002	0.15

Friction losses occur prior to anchoring but shall be estimated for design and checked during stressing operations. Rigid ducts shall have sufficient strength to maintain correct alignment without visible wobble during placement of concrete. Rigid ducts may be fabricated with either welded or interlocked seams. Galvanizing of welded seams will not be required.

(i) Grouting of Bonded Steel: Posttensioning prestressed members shall be of the bonded type in which the tensioned steel is installed in holes or flexible metal ducts cast in the concrete and bonded to surrounding concrete by filling the tubes or ducts with grout. The grout shall consist of portland cement and water and may contain an admixture when approved. Portland cement shall be Type I, II or III conforming to Subsection 1001.01.

Cement used for grouting shall be fresh and shall not contain lumps or other indications of hydration. Water used in grout shall conform to Subsection 1018.01.

Admixtures, when used, shall impart the properties of low water content, good flowability, minimum bleed and expansion if desired. Their formulation shall contain no chemicals in quantities that may have a harmful effect on the prestressing steel or cement. Admixtures containing chlorides in excess of 0.5 percent by weight of admixture, assuming 1 pound of admixture per sack (94 pounds) of cement, fluorides, sulphites and nitrates, shall not be used.

Aluminum powder of the proper fineness and quantity, or other approved gas evolving material, which is well dispersed through the other admixture may be used to obtain 5 to 10 percent unrestrained expansion of grout.

Prestressing reinforcement to be bonded shall be free of dirt, loose rust, grease or other deleterious substances. Before grouting, ducts shall be free of water, dirt or other foreign substances. Ducts shall be blown out with compressed air until no water comes through the duct. For long members with draped strands, an open tap at the low point of the duct may be necessary. Grout cubes shall be molded and cured with the member and shall attain a compressive strength of at least 3000 psi prior to transfer of bond stress or end anchor release. Preparation and testing of grout cubes shall be in accordance with ASTM C 109.

(j) Prestressing Reinforcement: Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength seven-wire strand or high-tensile-strength alloy bars.

Ends of pretensioned strands not to be encased in end diaphragms shall be cut off flush with ends of beam and shall be coated with a suitable asphaltic material.

No more than 75 percent of the minimum ultimate tensile strength of the steel may be used when designing girders or piles with low-relaxation strands. For this design the final compressive stress in the concrete shall be at least as great as that required for the design using normal stress-relieved strands.

Strand for prestressing shall conform to Subsection 1009.05. The manufacturer shall submit to the engineer three copies of Certificates of Analysis of all required tests results and shall provide a typical load-elongation curve for each size and grade of strand shipped. A 24-inch gage length shall be used to obtain the curves.

Load-elongation curves shall show elongation in inches per inch, and inches per 10 feet, from 0 percent to 80 percent of the minimum ultimate tensile strength.

Low relaxation strands shall be clearly identified by color markings on both the reel and the cable at intervals not exceeding 100 feet or as approved. These markings shall be consistent and shall be identified to the engineer prior to shipping.

Mixing of low-relaxation strands and normal stress-relieved strands in girders and piles will not be permitted.

Any strand that has been stretched during stress-relieving operations will be considered to be a low-relaxation strand, even if it does not fully meet the requirements of low-relaxation strands in Subsection 1009.05, and will not be allowed for use as a normal stress-relieved strand nor will they be allowed to be used in the same member containing low-relaxation strands meeting Subsection 1009.05.

(k) Precast-Prestressed Concrete Deck Forms: When specified, concrete decks for girder type bridges may be constructed as a composite utilizing concrete form panels conforming to the following requirements in lieu of conventional full depth cast-in-place construction.

(1) Design: If the contractor elects to use a different concrete panel than detailed in the plans, the contractor shall submit, for approval by the Bridge Design Engineer, detailed drawings of the alternate deck system and design computations for the composite slab and concrete panels complying with the latest AASHTO design specifications and requirements detailed herein.

a. Cover for reinforcing steel shall be as detailed on the plans.

b. Reinforcing steel shall be provided in the concrete panel transverse to the prestressing strands. Steel shall be deformed

reinforcing steel with a minimum area of 0.22 square inch per foot of length.

c. Panels shall be fabricated with 3/8-inch diameter strands only, unless otherwise permitted by the Bridge Design Engineer. The minimum panel length parallel to strands shall be 60 inches.

d. Shear reinforcing steel of 0.40 square inch per 10 square feet of panel surface shall be provided. Top surface of the panel shall be left rough. At approximately the time of initial set, all laitance shall be removed with a coarse wire brush or metal tines at least 1/8 inch deep to ensure proper bond with the cast-in-place concrete.

e. Top of panels may be flat or of other geometric configuration. Panels shall be constructed to provide a minimum vertical clearance of 3/8 inch between the panel surface and longitudinal reinforcing steel in the cast-in-place portion of the deck slab.

f. The top reinforcing steel shall be as required on the panel details for all panel configurations.

g. The joint between adjacent panels shall be butted together and shall be sealed with grout, tape or other approved method prior to placing the cast-in-place portion of the slab.

h. Panels shall extend over girders 3 inches ±1/2 inch. Panels shall be supported on girders with strips of fiberboard, mastic or felt material that provides a mortartight, uniform bearing. Bearing material shall have a width of 1/2 inch to 1 inch and maximum height of 1 1/2 inches. The strips shall be placed in approximate 4-foot lengths using an approved adhesive. Openings of 1/2 inch shall be left between adjacent strips placed longitudinally and parallel to edge of girder.

i. Panels shall not be supported transversely on diaphragms.

j. Panels used with steel girders longer than 100 feet shall be supported with a saddle system resting on the top flange. No welding will be permitted on girder flanges. For short spans with small camber, panels may be placed on girder flanges with prior approval.

k. If panels are used with concrete girders, vertical stirrup reinforcing steel in the girders shall be changed from the plan details for cast-in-place decks to accommodate placement of the panels. The outer 3 inches of the top flange of girders shall be smoothed for seating the panels; the remaining area of the top girder flange shall be left rough.

l. For skewed spans, end panels may be sawed to fit the skew provided the short side of the panel is not less than 1/2 the length of the long side. From a line through the midpoint of the long side and short side of the end panel to the end of the panel, the effects of prestress shall be neglected and No. 4 deformed reinforcement shall be provided to carry required loads.

(2) Materials: Materials for use in the panels shall conform to Subsection 805.02 and the following requirements:

a. Concrete shall be Class P or P(M).

b. Prestressing steel shall be Grade 250 or 270 strand.

c. Deformed reinforcing steel may be Grade 40 or 60.

d. Welded deformed steel wire fabric shall conform to ASTM A 497.

e. Panels with elements less than 3 1/2 inches thick shall require Grade F aggregate. For all other panels, either Grade A or Grade F aggregate may be used.

f. Steel for continuous high (CHC) bar chairs shall conform to ASTM A 108, Grade 1008.

(3) Construction: Forms shall be installed in accordance with approved fabrication and erection plans. To ensure full bond between the precast panel and cast-in-place concrete, this interface shall be free of foreign material during cast-in-place concreting operations. After erection of panels and prior to pouring cast-in-place concrete, laitance or flakes shall be removed from the top surface of panels by water blasting. Water blasting shall be performed by experienced personnel with equipment providing a pressure of 2,500 to 3,000 psig and a fan nozzle pressure of approximately 1,500 psig. Immediately prior to pouring cast-in-place concrete, panels shall be saturated with water.

Riser elevations may have to be adjusted to accommodate the actual camber and vertical curvature while maintaining the minimum cast-in-place slab depth at midspan. Controls for lines and grades above bent caps will be the responsibility of the contractor.

Only the outer 3 inches of the top flange of girders shall be smoothed for purposes of seating the panels. The remaining area of the top girder flange shall be left rough.

Panels shall be so placed as to obtain the minimum slab thickness shown in the plans within a tolerance of +3/8 inch. The tolerance on the cast-in-place concrete cover for the top reinforcing steel will be +1/4 inch to -1/8 inch.

(4) Panel Tolerances:

	Inches
Panel Depth (Thickness)	+1/4, -1/8
Panel Length (Parallel to strands)	± 1
Panel Width	+1/8, -1/2
Position of Strands (Vertical)	±1/8
Position of Strands (Horizontal)	±1/2

(5) Payment: Payment will be based on the plan quantities for full depth cast-in-place concrete construction, regardless of the deck construction method used.

805.15 PLACING ANCHOR BOLTS. Anchor bolts in piers, bents, abutments or pedestals shall be set in an approved non-shrink grout listed in QPL-47 at the location and in the manner described herein.

Locations of anchor bolts to be built into the concrete shall be verified by the contractor prior to setting. Care shall be taken to ensure proper setting of bolts. Inaccuracies detrimental to the structure shall be corrected by approved means.

Anchor bolts not to be built into the concrete shall be set in preformed holes having a minimum diameter of 3 inches to allow for adjustment and sufficient in depth to admit the anchor bolt. Holes may be formed by the insertion in fresh concrete of oiled wooden plugs, metal sleeves or other approved devices which are subsequently withdrawn after concrete has partially set. Such holes shall be adequately protected from ice formation while open. When erecting the members, the contractor shall set members and shoes in place, then fill preformed holes sufficiently with grout so that when anchor bolts are placed to required depth, grout will completely fill holes.

If the contractor elects to set anchor bolts either at initial casting or by drilling, he shall verify the centerline-to-centerline spacing

between anchor bolt holes of each member before setting the anchor bolts. If bolt holes are drilled, the diameter of drilled holes shall not be less than 1/2 inch larger than the bolt diameter.

805.16 MEASUREMENT.

(a) General: Quantities of structural concrete, precast-prestressed girders and expansion joint seal for payment will be the design quantities as specified on the plans and adjustments thereto. The design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made.

(b) Structural Concrete: Design volumes of structural concrete are computed from neat dimensions shown on the plans with the following modifications. Deductions are made for the volumes occupied by fillets, scorings and chamfers with cross-sectional areas over 1 1/2 square inches, expansion joints, and embedded structural steel and piling. Volumes deducted for embedded piling are based on 12 inches butt diameter timber piling and nominal butt dimensions for other types of piling. No deductions are made for volumes occupied by fillets, scorings and chamfers with cross-sectional areas not over 1 1/2 square inches, reinforcing steel, water piping, electrical conduit, weep holes, drain piping and armored joints.

(c) Precast-Prestressed Concrete Girders: Design quantities of precast-prestressed concrete girders are based on out-to-out lengths shown on the plans.

(d) Expansion Joint Seal and Strip Seal Joint: Design quantities of expansion joint seal and strip seal joint are based on lengths shown on the plans.

(e) Bridge Superstructure and Substructure: Bridge superstructure and substructure will be measured per span.

(f) Reinforced Concrete Box Culverts: Reinforced concrete box culverts of each size and type shall be measured by the linear foot in place. The measurement shall be the flow line length, along the centerline, inside face of the headwalls. For multiple barrel structures, the measured length will be the sum of the lengths of all barrels measured as described above.

805.17 PAYMENT.

(a) Structural Concrete: Payment for structural concrete will be made at the contract unit price per cubic yard, adjusted in accordance with the following provisions.

Class A, A(M), AA, AA(M), D and S concrete will be accepted on a lot basis. A lot will be considered an identifiable pour not exceeding 200 cubic yards of concrete. A pour of 200 to 400 cubic yards will be divided into two lots as equal in size as possible while maintaining identifiability. A pour exceeding 400 cubic yards will be represented by three lots.

Two random batches will be sampled for each lot, and three cylinders molded from each batch. The six cylinders per lot will be tested for compressive strength in 28 to 31 calendar days.

In the event of sudden cessation of operation, a minimum of three cylinders will constitute a lot.

Acceptance and payment for each lot will be made in accordance with Table 2 of Section 901.

Concrete that is classified as minor structure concrete will be accepted under these specifications and in accordance with Table 3 of Section 901.

Formwork, falsework, cofferdams, bracing, pumping, expansion joint fillers, steel punchings in counterweight concrete, excavation and backfill will not be measured for payment.

(b) Precast-Prestressed Girders: Payment for precast-prestressed girders will be made at the contract unit price per linear foot, which includes all reinforcing steel, masonry, anchor plates, plain or laminated elastomeric bearings, metal or other bearing plates and assemblies or other appurtenances indicated or necessary in the fabrication, handling and erection of the girders.

Tie-rods, nuts and washers will be considered as miscellaneous steel and paid for as provided in Section 807.

(c) Expansion Joint Seal and Strip Seal Joint: Payment for expansion joint seal and strip seal joint will be made at the contract unit price per linear foot.

(d) Bridge Superstructure and Substructure: Payment for bridge superstructure and substructure will be made at the contract unit price per span, which includes the entire superstructure (with railings) and that portion of the substructure above the bottom of caps.

(e) Reinforced Concrete Box Culverts: Payment for reinforced concrete box culverts will be made at the contract unit price per linear foot, which includes connections to existing structures, concrete, reinforcing steel, excavation, backfill, and all other items of material, labor, and equipment necessary to complete the work in accordance with the plans and specifications.

(f) Payment will be made under:

Item No.	Pay Item	Pay Unit
805(01)	Class A Concrete	Cubic Yard
805(02)	Class A(M) Concrete	Cubic Yard
805(03)	Class AA Concrete	Cubic Yard
805(04)	Class AA(M) Concrete	Cubic Yard
805(05)	Class D Concrete	Cubic Yard
805(06)	Class R Concrete	Cubic Yard
805(07)	Class S Concrete	Cubic Yard
805(08)	Precast-Prestressed Concrete Girder (Type)	Linear Foot
805(09)	Expansion Joint Seal	Linear Foot
805(10)	Bridge Superstructure and Substructure	Span
805(11)	Strip Seal Joints	Linear Foot
805(12)	Reinforced Concrete Box Culverts (Size)	Linear Foot
805(13)	Class F Concrete	Cubic Yard

Section 806
Reinforcement

806.01 DESCRIPTION. This work consists of furnishing and placing reinforcing steel for reinforced portland cement concrete structures.

806.02 MATERIALS.

(a) Steel materials shall conform to Section 1009.

(b) Epoxy coating material and patching material shall conform to Subsection 1009.01. Accessories such as tie wires and metal bar supports used in the fabrication and placement of epoxy coated reinforcing steel shall conform to Subsection 806.06 modified as follows.

(1) Tie Wires: Metal tie wires shall be fully coated with an acceptable epoxy, plastic or nylon material.

(2) Metal Bar Supports: Metal bar supports shall be coated with an acceptable epoxy or plastic material for a minimum distance of 2 inches from the point of contact with the epoxy coated reinforcing steel.

806.03 STEEL LISTS. Before placing reinforcing steel, two copies of a list of all reinforcing steel showing location, mark number, size and type bend shall be furnished to the engineer. The contractor shall be responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified.

The contractor shall also furnish the engineer two copies of placing plans for all structures where reinforcing steel is involved, unless the plans contain sufficient detail for proper placement of reinforcing steel. Placing plans shall show the location, type and spacing of supports.

806.04 FABRICATION. Unless otherwise authorized, bent bar reinforcement shall be cold bent to the shapes shown on the plans in accordance with the following requirements:

(a) Bending: Stirrups and ties shall be bent around a pin having a diameter of at least four bar diameters for No. 5 or smaller bars, and at least five bar diameters for larger bars. All other bars, except as otherwise specified herein, shall be bent around a pin having a diameter as specified in the following Table 1:

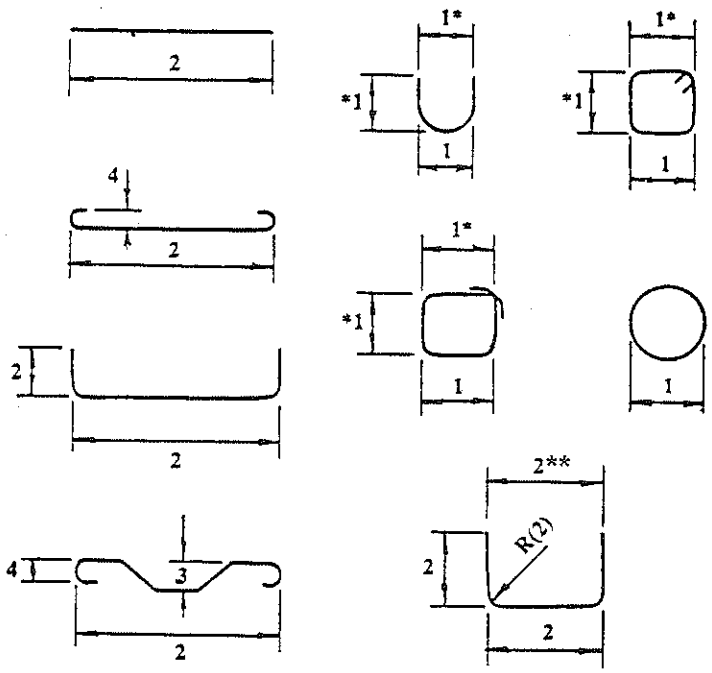
TABLE 1
PINS FOR BAR BENDS

Bar Size	Minimum Pin Diameter
Nos. 3 through 8	6 bar diameters
Nos. 9, 10 and 11	8 bar diameters
Nos. 14 and 18	10 bar diameters

Special fabrication will be required for bending Nos. 14 and 18 bars more than 90°.

(b) Tolerances: Bars shall be fabricated in accordance with the tolerances specified in Table 2. All dimensions given in Table 2 are out-to-out of bars.

TABLE 2
FABRICATION TOLERANCES



Symbol	Tolerance (Inches)
1	± 1/2
2	± 1
3	+0, −1/2
4	+0, −1

*Not to differ for opposite parallel dimension by more than 1/2 inch.
**Not to differ for opposite parallel dimension by more than 1 inch.

(c) Shipping: Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Manual of Standard Practice of the Concrete Reinforcement Steel Institute (CRSI). The tags shall be made of durable material and marked in a legible manner with waterproof markings. There shall be at least one tag per bundle attached by wire. The tags shall show producer's name, brand or trademark, size of reinforcing, number of pieces, grade, heat number, ASTM Designation, and weight of bundle.

(d) Handling and Coating Repairs: Epoxy coated reinforcing steel shall be handled in a manner to avoid damage to the coating. Bundling bands shall be padded. Bundles shall be lifted with multiple supports or strongbacks to prevent abrasion to the coating due to sag.

Patching material used by the applicator and the contractor shall be the same as the prequalified patching material. Repairs shall be made in accordance with the patching material manufacturer's recommendations.

Repairs to the coating will be required on all damaged areas larger than 1/4 inch square. The total bar surface area covered by patching material shall not exceed 2 percent.

Ends of coated bars cut during field fabrication shall also be coated with the patching material before rusting appears; however, the coated ends are not to be included in the 2 percent maximum coverage of patching material. Hairline cracks without bond loss or other minor damage on fabrication bends need not be repaired.

806.05 PROTECTION OF MATERIAL. Reinforcing steel shall be stored above ground on platforms, skids or other supports and shall be protected from damage.

The various sizes, grades and lengths shall be plainly marked and tagged to facilitate inspection.

Epoxy coated steel bars shall be unloaded and stored on the project site in a manner to avoid damage or contamination.

806.06 PLACING AND FASTENING. Steel reinforcement shall be placed in the position shown on the plans and firmly held during placing and setting of concrete. When placed in the work, it shall be free from dirt, loose rust, loose scale, paint, oil, grease or other foreign material. Thin powdery rust and light rust need not be removed. Bars shall be tied with No. 14 or 16 gage wire at all intersections, except where spacing is less than 1 foot in each direction, alternate intersections shall be tied.

Distance of reinforcement from forms shall be maintained by metal chairs, ties, hangers or other approved supports. Metal chairs in contact with exterior surfaces of concrete shall be hot-dipped galvanized, electroplated with zinc (GS Grade), plastic-coated or stainless steel. Layers of bars shall be separated by approved devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks will not be permitted. Vertical stirrups shall pass around main tension members and shall be securely attached thereto. The minimum covering, measured from the surface of concrete to face of reinforcing bars, shall not be less than 2 inches except as follows: bottom of slab, 1 inch; stirrups and ties in T-Beams, 1 1/2 inches. Additional coverage as shown on the plans shall be provided for reinforcement in bottom of footings or where marine environments, corrosive, abrasive or other severe exposure

conditions exist. Reinforcement shall be inspected and will be subject to approval before placing concrete.

During and after installation of epoxy coated bars, the contractor shall repair all significant cuts, nicks and abraded places in the coating on the bars with the epoxy repair material supplied by the epoxy resin manufacturer. Any damaged metallic accessories shall also be repaired with a suitable material.

Damaged areas of the reinforcing steel and accessories shall be repaired before rusting occurs. Coated bars when incorporated into the work shall be free from dirt, paint, oil, grease or other foreign substance. Placing of concrete shall be performed with methods and equipment which will not damage the coated materials.

Since the epoxy coating is flammable, the coated bars shall not be exposed to fire or flame. Cutting coated bars by burning will not be permitted. Reinforcing steel to be partially embedded in concrete shall not be field bent unless specified on the plans or permitted by the engineer.

806.07 SPLICING. Reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without written approval. Splices shall be staggered as far as possible. Unless otherwise specified, bars shall be lapped in accordance with the requirements of Table 3. When Grade 60 is used as a substitute for Grade 40, bars shall be lapped as required for Grade 40. Construction joints shall not be made within the limits of lapped bars. In lapped splices, bars shall be placed in contact and wired together in such manner as to maintain the minimum clear distance to other bars and to the surface of concrete. Welding of reinforcement steel shall be done only if detailed on the plans or if authorized in writing. Welding shall conform to Section 815.

When permitted in the plans or specifications, reinforcing steel splices may be made by an approved mechanical butt splicing device listed in QPL 44 and used in accordance with the manufacturer's recommendations. The splice shall develop at least 125 percent of the specified yield strength of the reinforcing steel bars in tension.

Table 3
Lap Splice Length (inches)

Bar Size	Grade 40 Steel	Grade 60 Steel
3	12	18
4	16	24
5	20	30
6	26	39
7	35	53
8	46	69
9	58	88
10	74	111
11	91	137

806.08 SUBSTITUTIONS. Substitutions of different size bars will be permitted with authorization of the engineer. Substituted steel shall have cross-sectional and surface areas equivalent to the design areas or larger.

806.09 MEASUREMENT. Quantities of reinforcement for payment will be the design weights as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary.

Design quantities are based on theoretical weights of nominal size plain round bars as follows:

Bar No.	Weight Lb/Lin Ft
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.670
9	3.400
10	4.303
11	5.313
14	7.650
18	13.600

Measurement and payment of structural shapes used as reinforcement will be made in accordance with Subsections 807.57 and 807.58.

The following will not be included in pay quantities:

(a) Reinforcement furnished for testing purposes.

(b) Additional reinforcement used for laps in splices other than those shown on the plans.

(c) Additional weight of reinforcement used at the contractor's request as substitutions for reinforcement shown in the plans.

(d) Spacers, clips, chairs and other material used in fastening reinforcement in place.

(e) Additional cleaning and epoxy coating repair.

806.10 PAYMENT. Payment for reinforcing steel will be made at the contract unit price under:

Item No.	Pay Item	Pay Unit
806(01)	Deformed Reinforcing Steel	Pound
806(02)	Deformed Reinforcing Steel (Epoxy Coated)	Pound

Section 807
Structural Metals

807.01 DESCRIPTION. This work consists of furnishing and placing structural metals for structures.

807.02 MATERIALS. Materials shall conform to Section 1013. When the type of structural steel to be used is not specified, steel conforming to ASTM A 709, Grade 36 shall be used.

807.03 DRAWINGS. Shop drawings and working drawings shall be furnished in accordance with Subsection 801.03.

807.04 MINIMUM SHOP REQUIREMENTS FOR FABRICATION OF MAJOR BRIDGE MEMBERS.

The contractor (fabricator) shall provide sufficient lifting capacity, physical plant and equipment for the fabrication of structural steel. The cranes in each working area shall have a combined rated capacity equal to the lifting weight of the heaviest assembly fabricated for shipment unless alternate lifting and turning facilities are approved.

Lifting chains shall be provided with adequate softeners to prevent damage to the corners of material during lifting and turning. When hooks are used for lifting, they shall have sufficient width of jaw and throat to prevent damage to the flanges or to the web-to-flange welds.

Spreader beams, or multiple cranes, shall be provided for lifting plates and long slender members to prevent overstress and distortion from handling.

Shops shall have sufficient enclosed floor spaces to allow oxygen cutting, air carbon arc gouging, assembly and welding to be performed inside, except that shop assembly of field connections for trusses, girders and arches may be performed outside the shop buildings.

The engineer may approve limited fabrication and welding outside the shop, provided the fabricator has made provisions to ensure that the quality of the work produced outside the shop buildings will not be adversely affected by weather or other conditions.

All cutting, fitting and welding shall be done in areas that are kept dry. Areas for automatic and semiautomatic welding shall be kept at a temperature not lower than 40°F for at least 1 hour before work begins and at all times when work is being performed.

807.05 INSPECTION.

(a) The Department will inspect all structural metal including shop inspection of fabrication and assembly of structural steel, castings and other metal items. A schedule of fabrication for the metal items required for the project, including location of the shop and the dates inspection services will be required, shall be furnished to the Construction Section. This information shall be provided at least 10 days in advance of commencement of layout work on fabricated material.

The engineer will have the authority to reject materials and workmanship which does not conform to the requirements of the contract. The Department's Quality Assurance (QA) inspection of material and workmanship may be conducted before, during and after fabrication. Materials and workmanship which are "in the process" of being fabricated and which are found to contain defects or to have been subjected to damaging fabrication procedures shall be rejected while still in process. The inspector will have the right to perform at the expense of the Department, nondestructive tests of materials and workmanship. Department inspection at the mill and shop is a quality assurance function that may be exercised at the option of the engineer.

It shall be expressly understood that the Department's Quality Assurance will not relieve the contractor of responsibility to perform Quality Control to insure that the products conform to the requirements of the contract and shall not relieve the contractor of responsibility concerning unacceptable materials and workmanship and the responsibility to acceptably repair or replace the same.

The contractor shall furnish means and assistance for testing materials and workmanship. The engineer will have free and safe access at all times to any portion of shops where work is being done under these specifications.

The stamping of any material or finished member shall not preclude its subsequent rejection if found defective. Rejected material shall be promptly replaced.

The contractor or fabricator shall furnish the engineer an office with at least 140 square feet of floor space to perform necessary work. Additional space, as deemed necessary by the engineer, shall be provided. This office shall contain desks, chairs, file cabinet with lock, telephone, electric lights, power outlets, shelves and tables, all in the quantity required by the engineer. The office shall be provided with adequate heating, ventilation and air conditioning and convenient sanitary facilities with running water. The office shall be in good repair, located where there is not excessive noise, and restricted to the Department's inspectors only. Convenient and adequate reserved parking space shall be provided.

Metal fabrication work requiring Departmental inspection shall be performed in a plant or shop within the continental United States.

(b) Qualifications: Qualifications of inspectors for Quality Assurance (QA) and Quality Control (QC) will be as specified in ANSI/AASHTO/AWS D1.5-88, Section 6.1.3.

(c) Mill Inspection: Mill inspection of structural metals will be as deemed necessary by the engineer; however, five copies of certified and notarized Certificates of Analysis, a Fabricator's Material Statement and Certificate of Compliance, properly identified as to the intended use, are required and shall be submitted to the Construction Section for approval and distribution.

(d) Obligations of the Contractor: The fabricator's QC Inspectors shall be a separate function of production and shall make the necessary visual inspections prior to assembly, during welding and after welding to insure that materials and workmanship meet the requirements of the contract. The Contractor shall comply with all of the QA Inspector requirements to correct deficiencies in materials and workmanship as provided in the contract.

In the event that faulty welding, or its removal for rewelding, damages the base metal so that, in the judgement of the engineer, its retention is not in accordance with the intent of the contract, the contractor shall remove and replace the damaged base metal or shall compensate for the deficiency in an approved manner.

807.06 MARKING:

Heat number markings shall be steel die stamped on main material. Round rods and bar shapes that are shipped, bundled and tagged with heat number from the mill, shall have this heat number transferred and steel die stamped to each piece as it arrives at the fabrication plant in the presence of the Department's inspector when these pieces are main members. Materials for other than main members may be identified by painting heat numbers. Main material used from stock shall show steel die stamped heat numbers along with test reports.

In the fabrication shop, the transferring of heat numbers shall be steel die stamp for all pieces of main material.

Steel die stamping shall be accomplished with low-stress steel stamps having a minimum face character radius of 0.010 inch and a maximum allowable impression depth of 0.010 inch. Impressions shall be placed on the thickest member in transition joints. Impressions shall not be placed within 1 inch of plate edge.

In case of doubt as to the grade of metal being used, samples will be taken by the inspector for submittal to the Materials and Testing Section for tests to establish the grade.

A color code system in accordance with ASTM A 6 shall be used for all metal. This color shall be placed on material upon entering the shop and carried on all pieces to final fabrication.

Metals not included in ASTM A 6 shall have an individual color code established and on record for the engineer.

807.07 QUALITY OF WORKMANSHIP. Workmanship and finish shall be equal to the best general practice in modern fabrication shops as interpreted by the engineer.

807.08 HANDLING AND STORING MATERIALS. Structural material, either plain or fabricated, shall be stored at the shop and project site above ground on platforms, skids or other supports. It shall be kept free from dirt, grease and other foreign matter and protected from corrosion.

Girders and beams shall be placed upright when stored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent damage from deflection.

807.09 STRAIGHTENING MATERIAL AND CURVING ROLLED BEAMS AND WELDED GIRDERS.

(a) Straightening Material: Rolled material, before being laid off or worked, shall be straight. If straightening is necessary, it shall be done by methods that will not damage the metal. Heat straightening of ASTM A 514 steel shall be done only under rigidly controlled procedures, each application subject to approval of the engineer. In no case shall the maximum temperature of the steel exceed 1125°F. Sharp kinks and bends will be cause for rejection of the material. If normalizing is used, straightening of steel plates shall be completed before normalizing operations begin for tension member material. Heat straightening of the material shall only be performed with approval.

(b) Curving Rolled Beams and Welded Girders:

(1) Materials: Steels that are manufactured to a specified yield point greater than 50,000 psi shall not be heat curved. Heat curving will not be permitted for those portions of girders where span base line curvature is a 200-foot radius or less.

(2) Type of Heating: Beams and girders may be curved by either continuous or V-type heating, as approved in accordance with the AASHTO Standard Specifications for Highway Bridges.

807.10 FINISH. Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately and shall be ground to a neat finish.

807.11 RIVET AND BOLT HOLES.

(a) Holes for Rivets and High Strength Bolts: Holes for rivets or bolts shall be either punched or drilled. Material forming parts of a member composed of not more than five thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of rivets or bolts when the thickness of metal is not greater than 3/4 inch for structural carbon steel or 5/8 inch for alloy steel.

When there are more than five thicknesses or when any main material is thicker than 3/4 inch in structural carbon steel or 5/8 inch in alloy steel or when required under Subsection 807.14, holes shall either be drilled full size or subdrilled.

When required under Subsection 807.14, holes shall be either subpunched or subdrilled (subdrilled if thickness limitation governs) 3/16 inch smaller and, after assembling, reamed 1/16 inch larger or drilled full size to 1/16 inch larger than the nominal diameter of rivets or bolts.

(b) Oversize or Slotted Holes: When specified or approved, oversize, short-slotted, and long-slotted holes may be used with high strength bolts 5/8 inch and larger in diameter except as hereinafter restricted:

(1) Oversize holes shall be 3/16 inch larger than bolts 7/8 inch and less in diameter, 1/4 inch larger than bolts 1 inch in diameter, and 5/16 inch larger than bolts 1 1/8 inches or greater in diameter. They may be used in all plies of friction-type connections. Hardened washers shall be installed over exposed oversize holes.

(2) Short-slotted holes shall be 1/16 inch wider than the bolt diameter and have a length which does not exceed the oversize diameter provisions of Heading (1) by more than 1/16 inch. They may be used in all piles of friction-type or bearing-type connections. The slots may be used without regard to direction of loading in friction type connections, but shall be normal to the direction of the load in bearing-type connections. Hardened washers shall be installed over exposed short slotted holes.

(3) Long slotted holes shall be 1/16 inch wider than the bolt diameter and have a length more than allowed in Heading (2) but not more than 2 1/2 times the bolt diameter.

In friction-type connections, long-slotted holes may be used without regard to direction of loading.

In bearing-type connections, the long diameter of the slot shall be normal to the direction of loading.

Long slotted holes may be used in only one of the connected parts of either a friction-type or bearing-type connection at an individual faying surface.

Structural plate washers or a continuous bar not less than 5/16 inch thick shall be used to cover long slots that are in the outer plies of joints. These washers or bars shall have a size sufficient to completely cover the slot after installation. If hardened washers are required, they shall be placed over the plate or bar.

(4) When enlarged or slotted holes are used, the distances between edges of adjacent holes or edges of holes and edges of members shall not be less than permitted with conventional size holes.

(c) Holes for Other Type Bolts: Holes for ribbed bolts, turned bolts or other approved bearing-type bolts shall be subpunched or subdrilled 3/16 inch smaller than the nominal diameter of bolt and reamed assembled or to a steel template or, after assembling, drilled from the solid.

807.12 PUNCHED HOLES. Diameter of the die shall not exceed diameter of the punch by more than 1/16 inch. Holes that must be enlarged to admit rivets or bolts shall be reamed. Holes shall be clean-cut without torn or ragged edges. Poor matching of holes will be cause for rejection; any repair shall be subject to approval.

807.13 REAMED OR DRILLED HOLES. Reamed holes shall be cylindrical, perpendicular to the member and not more than 1/16 inch larger than the nominal diameter of rivets or bolts. Where practical, reamers and drills shall be directed by mechanical means. Drilled holes shall be 1/16 inch larger than the nominal diameter of rivet or bolt. All burrs shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done by approved methods. If required, assembled parts shall be taken apart for removal of burrs caused by drilling. 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.

807.14 PREPARATION OF FIELD CONNECTIONS.

(a) Subpunching and Reaming of Field Connections: Holes in field connections and field splices of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders and rigid frames shall be subpunched (or subdrilled if required) according to Subsection 807.11 and subsequently reamed while assembled or to a steel template, as required by Subsection 807.18. Holes for floor beam and stringer field end connections shall be subpunched and reamed to a steel template or reamed while assembled. Reaming or drilling full size of field connection holes through a steel template shall be done after template has been located for position and angle and bolted in place. Templates used for reaming matching members, or opposite faces of a single member, shall be exact duplicates. Templates used for connections on like parts or members shall be so accurately located that the parts or members are duplicates and require no matchmarking.

For any connection, in lieu of subpunching and reaming or subdrilling and reaming, holes may be drilled full-size with all thicknesses of material assembled in proper position.

(b) Numerically-Controlled Drilled Field Connections:

(1) General: For any connection or splice designated in Subsection 807.14(a), in lieu of subsized holes and reaming while assembled,

or drilling holes full-size while assembled, holes may be drilled full-size in unassembled pieces or connections including templates for use with matching subsized and reamed holes by means of suitable numerically-controlled drilling equipment subject to the following provisions.

If numerically-controlled drilling equipment is used, the engineer may require the contractor, by means of check assemblies, to demonstrate that this drilling procedure consistently produces holes and connections conforming to Subsections 807.16 and 807.18.

The contractor shall submit to the engineer for approval a detailed outline of the proposed procedures to accomplish the work from initial drilling through check assembly, including members that may be numerically-controlled drilled, sizes of holes, location of common index and other reference points, composition of check assemblies and other pertinent information.

(2) Holes: Holes drilled by numerically-controlled drilling equipment shall be drilled to appropriate size either through individual pieces or a combination of pieces held tightly together.

807.15 ACCURACY OF PUNCHED AND DRILLED HOLES. Holes punched full size, subpunched or subdrilled shall be so accurately punched that after assembling (before any reaming is done) a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. Failure of a hole to pass a pin 3/16 inch smaller in diameter than the nominal size of punched holes will be cause for rejection.

807.16 ACCURACY OF REAMED AND DRILLED HOLES. When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 inch between adjacent thickness of metal.

Steel templates shall have hardened steel bushings in holes accurately dimensioned from centerlines of connection as inscribed on the template. Centerlines shall be used in locating the template from milled or scribed ends of members.

807.17 FITTINGS OR RIVETING AND BOLTING. Contact surfaces of metal shall be prepared as specified in Subsection 807.22(e). Parts of a member shall be assembled, well pinned and firmly drawn together with bolts before reaming or riveting. Assembled pieces shall be taken apart, if necessary, for removal of burrs and shavings produced by reaming. The member shall be free from twists, bends and other deformation.

Before shop riveting of full-size punched material, rivet holes, if necessary, shall be spear-reamed for admission of rivets. Reamed holes shall not be more than 1/16 inch larger than the nominal diameter of rivets.

End connection angles, stiffener angles and similar parts shall be adjusted to correct position and bolted, clamped or otherwise firmly held in place until riveted.

Parts not completely riveted in the shop shall be secured by bolts to prevent damage in shipment and handling.

807.18 SHOP ASSEMBLING. Field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders and rigid frames shall be assembled in the shop with milled ends of

compression members in full bearing, and then shall have their sub-size holes reamed to specified size while connections are assembled. Unless otherwise specified, assembly shall be Progressive Truss or Girder Assembly.

Check Assemblies with Numerically-Controlled Drilled Field Connections shall be in accordance with Heading (g) of this Subsection.

Each assembly, including camber, alignment, accuracy of holes and fit of milled joints, shall be approved before a numerically-controlled drilled check assembly is dismantled.

A diagram shall be furnished the engineer by the fabricator showing camber at each panel point of trusses or arch ribs, and the location of field splices and fractions of span length (1/4 points minimum, 1/10 points maximum) of continuous beam and girders or rigid frames.

(a) Full Truss or Girder Assembly: Full Truss or Girder Assembly consists of assembling all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder or rigid frame at one time.

(b) Progressive Truss or Girder Assembly: Progressive Girder Assembly shall consist of assembling initially for each arch rib, continuous beam line, or plate girder at least three contiguous shop sections. Progressive Truss Assembly shall consist of assembling initially for each truss, bent, tower face, or rigid frame, all members in at least three contiguous panels, but not less than the number of panels associated with three contiguous chord lengths. Successive assemblies shall consist of at least one section or panel of the previous assembly (repositioned if necessary and adequately pinned to assure accurate alignment) plus two or more sections or panels added at the advancing end. In the case of structures longer than 150 feet, each assembly shall not be less than 150 feet long regardless of the length of individual continuous panels or sections. At the option of the fabricator, sequence of assembly may start from any location in the structure and proceed in one or both directions so long as the preceding requirements are satisfied.

Assemblies consisting of less than three shop sections or panels shall require approval of the engineer.

(c) 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 open spandrel arch, or each leg of each bent or tower, then reaming their field connection holes while the members are assembled and reaming the web member connections to steel templates set at geometric (not cambered) angular relation to the chord line.

Field connection holes in web members shall be reamed to steel templates. 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.

(d) Progressive Chord Assembly: Progressive Chord Assembly consists 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.

(e) Special Girder Assembly: This procedure does not apply to continuous girders, but will be required for rolled beams or plate girders that are part of a simple supported span with a horizontal curve, skewed or superelevated, or any combination thereof.

Special girder assembly consists of assembling rolled beams or plate girders in pairs with all adjacent girders, including floor system, lateral bracing, cross frames, etc. These pairs of beams or girders shall

be assembled on blocking, with the proper camber and their relative elevation, in such manner as to ensure proper fittings of all parts during field erection in accordance with any of the previously described methods.

(f) Special Complete Structure Assembly: Special Complete Structure Assembly consists of assembling the entire structure, including the floor system. This procedure is ordinarily needed only for complicated structures such as those having curved girders or extreme skew in combination with severe grade or camber.

(g) Check Assemblies with Numerically-Controlled Drilled Field Connections: A check assembly will be required for each major structural type of each project. It shall consist of at least three contiguous shop sections or, in a truss, 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). Check assemblies shall be based on the proposed order of erection joints in bearings, special points such as portals of skewed trusses and similar considerations.

Use of either geometric angles (giving theoretically zero secondary stresses under dead-load conditions after erection) or cambered angles (giving theoretically zero secondary stresses under no-load conditions) shall be as specified.

The check assemblies shall preferably be the first such sections of each major structural type to be fabricated.

No match-marking and no shop assemblies other than the check assemblies will be required.

Shop drawings shall indicate clearly subpunched holes which are to be reamed assembled or reamed to a template in the shop and all groups of holes which are to be drilled full size with numerically-controlled drills.

If the check assembly fails to demonstrate that required accuracy is being obtained, further check assemblies may be required at no direct pay.

(h) Bearing Assembly: Bearing components shall be completely assembled in the shop and checked to assure accuracy of fit and shall be match-marked for shipping.

807.19 DRIFTING OF HOLES. Drifting done during assembly shall be only such as to bring parts into position and not sufficient to enlarge holes or distort metal. Holes that must be enlarged to admit bolts or rivets shall be reamed.

807.20 MATCH-MARKING. Connection parts assembled in the shop for reaming holes in field connections shall be match-marked with steel stencils. A diagram showing such marks shall be furnished to the engineer.

807.21 BOLTS AND BOLTED CONNECTIONS. All bolts shall conform to the requirements of this Subsection, except for high strength bolts. Bolted connections fabricated with high strength bolts shall conform to Subsection 807.22.

(a) General: Bolts shall be unfinished, turned or ribbed bolts conforming to ASTM A 307, Grade A. Bolts shall have single self-locking nuts or double nuts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to bolt axis.

(b) Turned Bolts: The surface of the body of turned bolts shall meet the ANSI B 46.1 roughness rating value of 125. Heads and nuts shall be hexagonal with standard dimensions for bolts of the specified nominal size or the next larger nominal size. Diameter of threads shall be equal to the body of the bolt or the nominal diameter of the bolt. Holes for turned bolts shall be carefully reamed with specified bolts furnished to provide for a light driving fit. Threads shall be entirely outside of holes. A washer shall be provided under the nut.

(c) Ribbed Bolts: The body of ribbed bolts shall be an approved form with continuous longitudinal ribs. The diameter of the body measured on a circle through the points of the ribs shall be 5/64 inch greater than the nominal diameter of the specified bolt.

Ribbed bolts shall be furnished with round heads conforming to ANSI B18.5. Nuts shall be hexagonal, either recessed or with a washer of suitable thickness. Ribbed bolts shall make a driving fit with the holes. Hardness of the ribs shall be such that the ribs do not mash down enough to permit the bolts to turn in the holes during tightening. If the bolt twists before drawing tight, the hole shall be carefully reamed and an oversized bolt used.

807.22 CONNECTIONS USING HIGH STRENGTH BOLTS.

(a) General: This specification covers the assembly of structural joints using ASTM A 325 or A 490 high strength steel bolts tightened to a high tension. Bolt holes shall be 1/16 inch larger than the nominal bolt size.

All fasteners within a connection shall be of the same type and all bolts within each connection shall be from the same manufacturer.

Construction shall conform to the specifications for riveted or welded structures of wrought iron, carbon structural steel and high strength steel, except as otherwise provided herein.

(b) Lock-Pin and Collar Fasteners: When approved, lockpin and collar fasteners conforming to Subsection 1013.08(c) may be used.

(c) Bolts, Nuts and Washers: Bolts shall conform to ASTM A 325 Type 1 or Type 3, or ASTM A 490. Nuts shall conform to ASTM A 563, Grade DH or DH3 or ASTM A 194, Grade 2H. Washers shall conform to ASTM F 436, marking of bolts, nuts and washers shall conform to Figure 1.

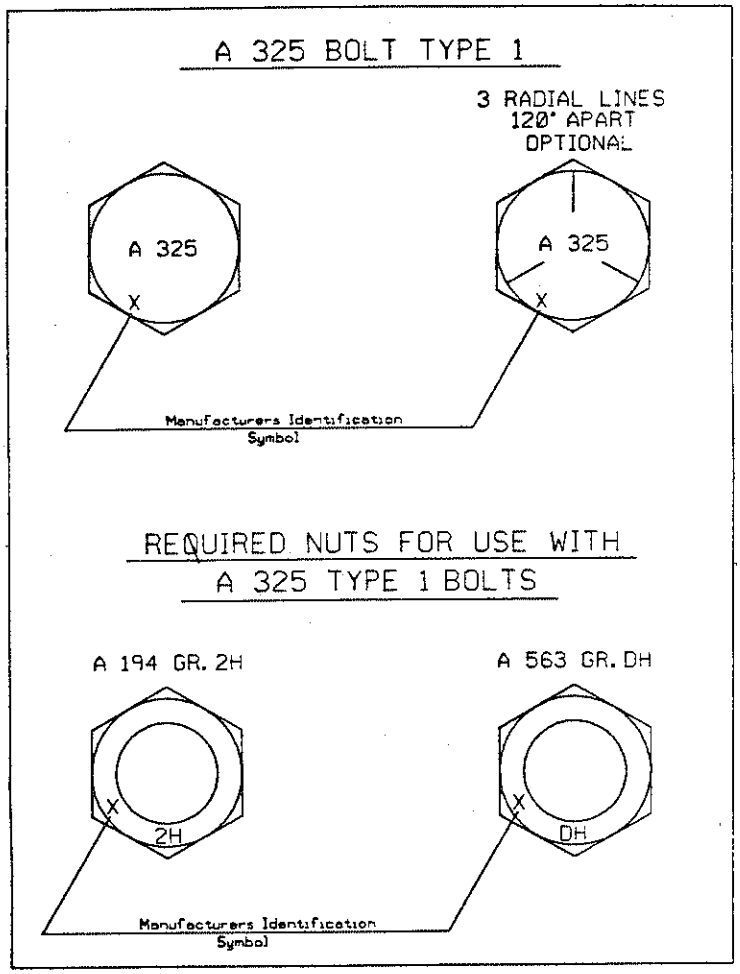
Bolt and Nut Dimensions shall conform to requirements for heavy hex structural bolts and nuts of Table 4.

The minimum bolt length shall be determined by adding the appropriate length given in the following table to the grip (total thickness of all connected material, excluding washers):

BOLT LENGTH

Bolt Size (inches)	Length to Add to Grip (inches)
1/2	11/16
5/8	7/8
3/4	1
7/8	1-1/8
1	1-1/4
1-1/8	1-1/2
1-1/4	1-5/8
1-3/8	1-3/4
1-1/2	1-7/8

FIGURE 1



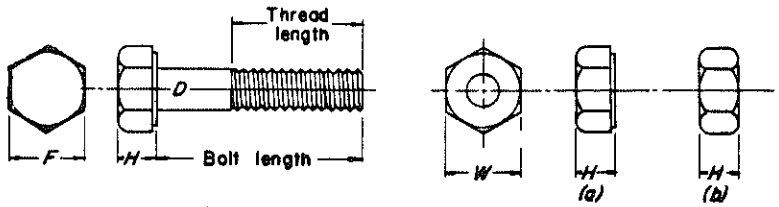
Type 3 Bolts shall have the "A 325" underlined.

ASTM A 490 bolts shall have the heads marked "A 490" and shall also identify the manufacturer.

Washers shall be marked by a symbol identifying the manufacturer. Additionally, Type 3 washers shall be identified by the symbol "3."

TABLE 4

Nominal Bolt Size, D	BOLT DIMENSIONS, INCHES — HEAVY HEX STRUCTURAL BOLTS: Width Across Flats, F	Height, H	Tread Length	NUT DIMENSIONS, INCHES — HEAVY HEX NUTS: Width Across Flats, W	Height, H
1/2	7/8	5/16	1	7/8	31/64
5/8	1 1/16	25/64	1 1/4	1 1/16	39/64
3/4	1 1/4	15/32	1 3/8	1 1/4	47/64
7/8	1 7/16	35/64	1 1/2	1 7/16	55/64
1	1 5/8	39/64	1 3/4	1 5/8	63/64
1 1/8	1 13/16	11/16	2	1 13/16	1 7/64
1 1/4	2	25/32	2	2	1 7/32
1 3/8	2 3/16	27/32	2 1/4	2 3/16	1 11/32
1 1/2	2 3/8	15/16	2 1/4	2 3/8	1 15/32



Nuts may be washer faced as in (a) or doubled chamfered as in (b).

Add 5/32 inch for each hardened flat washer, and add 5/16 inch for each beveled washer. The minimum bolt length thus determined shall be increased to the nearest 1/4 inch to obtain the required bolt length, but in no case shall the bolt have less than two threads beyond the nut after final torque.

(d) Rotational Capacity Testing:

(1) Rotational-capacity tests are required and shall be performed on all black or galvanized (after galvanizing) bolt, nut and wash assemblies by the manufacturer or distributor prior to shipping. Washers are required as part of the test even though they may not be required as part of the installation procedure.

a. Except as modified herein, the rotational-capacity test shall be performed in accordance with the requirements of ASTM A 325.

b. Each combination of bolt production lot, nut lot and washer lot shall be tested as an assembly. Where washers are not required by the installation procedures, they need not be included in the lot identification.

c. A rotational-capacity lot number shall be assigned to each combination of lots tested.

d. The minimum frequency of testing shall be two assemblies per rotational-capacity lot.

e. The bolt, nut and washer assembly shall be assembled in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device.

f. The minimum rotation, from a snug tight condition (10 percent of the specified proof load), shall be:

240° (2/3 turn) for bolt lengths <4 diameters
360° (1 turn) for bolt lengths >4 diameters and <8 diameters
480° (1 1/3 turn) for bolt lengths >8 diameters

g. The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown below.

	Diameter, in.								
	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Required Installation Tension (kips)	12	19	28	39	51	56	71	85	103
Turn Test Tension (kips)	14	22	32	45	59	64	82	98	118

h. After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

$$\text{Torque} \leq 0.25PD$$

Where: Torque = measured torque (foot-pounds)
P = measured bolt tension (pounds)
D = bolt diameter (feet).

i. Bolts that are too short to test in a Skidmore-Wilhelm Calibrator may be tested in a steel joint. The tension requirement of Heading (d)(1)g. need not apply. The maximum torque requirement of Heading (d)(1)h. shall be computed using a value of P equal to the turn test tension shown in the table in Heading (d)(1)g.

(2) Reporting: The results of all tests (including zinc coating thickness) required herein and in the appropriate specifications shall be recorded on the appropriate document. The location where tests are performed and date of tests shall be reported on the appropriate documents.

(3) Witnessing: The tests need not be witnessed by an inspection agency; however, the manufacturer or distributor that performs the tests shall certify that the results recorded are accurate.

(4) Documentation:

a. Mill Test Reports:

1. Mill Test Reports shall be furnished for all mill steel used in the manufacture of the bolts, nuts, or washers.

2. Mill Test Reports shall indicate the place where the material was melted and manufactured.

b. Manufacturer Certified Test Reports:

1. The manufacturer of the bolts, nuts, and washers shall furnish test reports for the item furnished.

2. Each Manufacturer Certified Test Report shall show the information required in accordance with Heading (2).

3. The manufacturer performing the rotational-capacity test shall include the following on the Manufacturer Certified Test Reports.

(a) The lot number of each of the items tested.
(b) The rotational-capacity lot number.
(c) The results of the required tests.
(d) The pertinent information required in Heading (d)(2).
(e) A statement that Manufacturer Certified Test Reports for the items are in conformance with this specification and the appropriate ASTM specifications.
(f) The location where the bolt assembly components were manufactured.

c. Distributor Certified Test Reports:

1. The Distributor Certified Test Reports shall include Manufacturer Certified Test Reports above for the various bolt assembly components.

2. The rotational-capacity test may be performed by a distributor (in lieu of a manufacturer) and reported on the Distributor Certified Test Reports.

3. The Distributor Certified Test Reports shall show the results of the required tests.

4. The Distributor Certified Test Reports shall also show information required in Heading (d)(2).

5. The Distributor Certified Test Reports shall show the rotational-capacity lot number.

6. The Distributor Certified Test Reports shall certify that the Manufacturer Certified Test Reports are in conformance with this specification and the appropriate ASTM specifications.

(5) Shipping:

a. Bolts, nuts and washers (where required) from each rotational-capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Each container shall be permanently marked with the rotational-capacity lot number such that identification will be possible at any stage prior to installation.

b. The appropriate Mill Test Reports, Manufacturer Certified Test Reports, Distributor Certified Test Reports shall be supplied to the Construction Section.

(e) Bolted Parts: Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or other compressible material. Holes may be punched, subpunched and reamed, or drilled, as required by the applicable specification, and shall be of a nominal diameter not more than 1/16 inch in excess of the nominal bolt diameter.

When assembled, joint surfaces, including those adjacent to the boltheads, nuts or washers, shall be cleaned and prepared in accordance with the following:

(1) When steel is to be painted, contact surfaces within joints shall be cleaned in accordance with Subsection 811.06(b) and painted with the first prime coat of the specified paint system. At the contractor's option, the second prime coat may also be applied to contact surfaces.

(2) When the plans specify the steel as unpainted ASTM A 709, Grade 50W contact surfaces within joints shall be thoroughly cleaned by Commercial Blast Cleaning in accordance with Subsection 811.06(c) or other approved methods that will remove all dirt, oil, grease, rust scale, loose mill scale, weld slag and other foreign matter, and shall remain unpainted.

(3) When galvanized steel is specified, after galvanizing and prior to assembly, contact surfaces within joints shall be scored by wire brushing or blasting. Wire brushing treatment shall be a light application of manual or power brushing that marks or scores the surface but removes relatively little of the zinc coating. Blasting treatment shall be a light brush-off treatment which will produce a dull gray appearance. Neither treatment shall be severe enough to produce a break or discontinuity in the zinc surface. When ASTM A 490 bolts are specified to connect galvanized parts, bolts shall be painted to prevent electrolytic action. ASTM A 490 bolts shall not be galvanized.

(4) When contact surfaces within the joint are to be coated with metallized zinc or aluminum, application shall be in accordance with AWS C2.2., except that subsequent sealing treatments described in Section IV therein shall not be used.

(f) Installation: Bolts shall be installed with a hardened washer under nut or bolt head, whichever is the element turned in tightening. A flat washer may be used when the abutment surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to bolt axis. If an outer face of the bolted part has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for lack of parallelism.

ASTM A 490 bolts shall have two hardened washers. ASTM A 490 and ASTM A 325 bolts shall not be reused or retorqued. Retightening previously tightened bolts which have been loosened by tightening adjacent bolts shall not be considered as reuse or retorque.

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 is present in as-delivered condition.

A tension measuring device shall be at all job sites where high strength bolts are being installed and tightened. The tension measuring device shall be used to confirm the following:

(1) The conformance to the requirements of Table 5 of the complete fastener assembly, including lubrication if required, to be used in construction.

(2) Calibration of the wrenches, if applicable.

(3) The understanding and proper use by the bolting crew of the method to be used.

The frequency of testing, the number of tests to be performed and the test procedure shall be as specified in Headings (g) through (j) as applicable. The job inspection torque wrench shall be used to verify that the tightening method used will provide the minimum bolt tension as specified in Table 5. The accuracy of the tension measuring device shall be confirmed through calibration by an approved testing agency at least annually.

Fasteners together with washers of size and quality specified shall be installed in properly aligned holes and tightened by any of the methods described in Headings (g) through (j) to at least the minimum tension specified in Table 5 when all the fasteners are tight. Tightening may be done by turning the bolt while the nut is prevented from rotating when it is impractical to turn the nut. Impact wrenches, if used, shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately 10 seconds.

TABLE 5 - BOLT TENSION

ASTM A 325 BOLTS

Bolt Size (inches)	Minimum Bolt Tension (lb)[1]	Recommended Bolt Tension for Calibrated Wrenches (lb)[2]
1/2	12,050	12,500
5/8	19,200	20,000
3/4	28,400	30,000
7/8	39,250	41,000
1	51,500	54,000
1 1/8	56,450	59,000
1 1/4	71,700	75,000
1 3/8	85,450	89,500
1 1/2	104,000	109,000

ASTM A 490 BOLTS

Bolt Size (inches)	Minimum Bolt Tension (lb)[1]	Recommended Bolt Tension for Calibrated Wrenches (lb)[2]
1/2	14,900	15,500
5/8	23,700	25,000
3/4	35,100	37,000
7/8	48,500	51,000
1	63,600	67,000
1 1/8	80,100	84,000
1 1/4	101,800	107,000
1 3/8	121,300	127,500
1 1/2	147,500	155,000

[1]Equal to 70 percent of specified minimum tensile strength of bolt.
[2]Approximately 5 percent in excess of the minimum bolt tension.

(g) Turn-of-Nut Tightening: When turn-of-nut tightening is used, hardened washers are required.

A representative sample of not less than three bolt and nut assemblies of each diameter, length and grade to be used in the work shall be checked at the start of work in a device capable of indicating bolt tension. The test shall demonstrate that the method for estimating the

snug tight condition and controlling the turns from snug tight given in Table 6 to be used by the bolting crew develops a tension not less than 5 percent greater than the minimum tension in Table 5.

Bolts shall be installed in all holes of the connection and brought to a "snug tight" condition. Snug tight is defined as the tightness that exists when the plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Snug tightening shall progress systematically from the most rigid part of the connection to the free edges, and then the bolts of the connection shall be retightened in a similar systematic manner as necessary until all bolts are simultaneously snug tight and the connection is fully compacted. Following this initial operation all bolts in the connection shall be tightened further by the tightening operation, there shall be no rotation of the part not turned by the wrench. Tightening shall progress systematically from the most rigid part of the joint to its free edges.

(h) Calibrated Wrench Tightening:

(1) Calibrated wrench tightening may be used only when installation procedures are calibrated on a daily basis and when a hardened washer is used under the element turned in tightening. This specification does not recognize standard torques determined from tables or from formulas which are assumed to relate torque to tension.

When calibrated wrenches are used for installation, they shall be set to provide a tension not less than 5 percent nor more than 25 percent in excess of the minimum tension specified in Table 5. The installation procedures shall be calibrated at least once each working day for each bolt diameter, length and grade using the following.

a. The length of air hose that will be used and the fastener assemblies that are being installed in the work. Calibration shall be accomplished in a device capable of indicating actual bolt tension by tightening three typical bolts of each diameter, length and grade from the bolt being installed and with a hardened washer from the washers being used in the work under the element turned in tightening.

b. The bolts, nuts and washers used for calibration one time may be used in the structure. Wrenches shall be recalibrated when significant differences are noted in the surface condition of the bolts threads, nuts or washers.

When calibrated wrenches are used to install and tension bolts in a connection, bolts shall be installed with hardened washers under the element turned in tightening bolts in all holes of the connection and brought to a snug tight condition. Following this initial tightening operation, the connection shall be tightened using the calibrated wrench. Tightening shall progress systematically from the most rigid part of the joint to its free edges. The wrench shall be returned to touch up previously tightened bolts which may have been relaxed as a result of the subsequent tightening of adjacent bolts until all bolts are tightened to the prescribed amount.

(2) Job Inspection Torque Wrench: A manual job inspection torque wrench will be calibrated in a device capable of indicating bolt tension. Five bolts of each diameter, length and type to be used will be installed in a tension indicating device and tensioned to 15 percent of the minimum required bolt tension (snug tight). Tightening shall then continue with the job inspection torque wrench to the minimum required bolt tension. The torque required to produce the minimum and maximum bolt tension specified in Table 5 shall be recorded. For each torque

range, the low and the high values will be discarded and the remaining three values averaged. The average torque needed to provide the minimum bolt tension shall be the job inspection torque and the average torque needed to provide the maximum bolt tension shall be the maximum job torque.

(i) Installation of Alternate Design Bolts: When fasteners which incorporate a design feature intended to indirectly indicate the bolt tension or to automatically provide the tension required by Table 5 and which have been qualified under Heading (f) are to be installed, a representative sample of not less than three bolts of each diameter, length and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each bolt develops a tension not less than 5 percent greater than the tension required by Table 5. The manufacturer's installation procedure as required by Heading (f) shall be followed for installation of bolts in the calibration device and in all connections.

When alternate design fasteners which are intended to control or indicate bolt tension of the fasteners are used, bolts shall be installed in all holes of the connection and initially tightened sufficiently to bring all plies of the joint into firm contact but without yielding or fracturing the control or indicator element of the fasteners. All fasteners shall then be further tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening prior to final twist-off of the control or indicator element of individual fasteners.

(j) Direct Tension Indicator Devices: When direct tension indicator devices are used, a representative sample of not less than three devices for each diameter and grade of fastener to be used in the work shall be assembled in a calibration device capable of indicating bolt tension. The test assembly shall include flat hardened washers if required in the actual connections to be tensioned. The calibration test shall demonstrate that the device indicates a tension not less than 5 percent greater than that given in Table 5.

Manufacturer's installation procedure as required by Heading (f), if appropriate, shall be followed for installation of bolts in the calibration device and in all connections. Special attention shall be given to proper installation of flat hardened washers when direct tension indicator devices are used with bolts installed in oversize or slotted holes and when the load indicating devices are used under the turned element.

When bolts are installed using direct tension indicators meeting the requirements of ASTM F 959, bolts shall be installed in all holes of the connection and brought to snug tight condition. Snug tight is indicated by partial compression of the direct tension indicator protrusions. All fasteners shall then be tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening prior to final tightening to deform the protrusion to the specified gap.

(k) Inspection: Before the installation of fasteners in the work, the engineer will check the marking, surface condition and storage of

bolts, nuts and washers and the faying surfaces of joints for compliance with the requirements of these specifications.

The engineer shall observe calibration and/or testing procedures required in Headings (f) through (j), as applicable, to confirm that the selected procedure is properly used and that, when so used with the fastener assemblies supplied, the tensions specified in Table 5 are provided. He shall monitor the installation of fasteners in the work to assure that the selected procedure, as demonstrated in the initial testing to provide the specified tension, is routinely properly applied.

Installations of fasteners will be inspected as follows:

(1) One bolt from each connection shall be selected and the job inspection wrench shall be applied with sufficient torque to set the bolt or nut in motion. The torque shall be noted and the torque shall be greater than the job inspection torque, but less than the maximum job torque as determined during calibration.

(2) Bolts will be inspected by applying the job inspection torque wrench to 10 percent of the bolts, but not less than two bolts, selected by the engineer at random in each connection. If no nut or bolt head is turned by application of the job inspection torque, the connection shall be accepted as properly tightened. If a nut or bolt head is turned by the application of less than the job inspection torque, this torque will be applied to all bolts in the connections, and all bolts whose nut or head is turned by less than the specified torque shall be tightened and reinspected; or the fabricator or contractor may retighten all bolts in the connection and resubmit the connection for inspection.

TABLE 6
Nut Rotational from Snug Tight Condition[1]

	Disposition of Outer Faces of Bolted Parts		
Bolt Length (measured from underside of head to extreme end of point)	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 washers 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]	2/3 turn	5/6 turn	1 turn

[1]Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance ±30°; for bolts installed by 2/3 turn and more, the tolerance is ±45°.
[2]When bolt lengths exceed 12 diameters, the required rotation must be determined by actual test in a suitable tension device simulating actual conditions.

The procedures for inspecting and testing lock-pin and collar fasteners and their installation for required preload tension shall be as approved. The contractor, shall provide the personnel and required job inspection torque wrench in order for the engineer to perform the inspection specified herein. The job inspection torque wrench will be calibrated by the Materials and Testing Section.

807.23 RIVETS AND RIVETING. The specified size of rivets shall be the size before heating. Rivet heads shall be of standard shape and uniform size for the same diameter of rivet. They shall be in full contact with the surface of the member.

Except as otherwise provided herein, rivets shall be heated uniformly to a light cherry red color and driven hot. A rivet whose point is heated more than the remainder shall not be driven. When a rivet is ready for driving, it shall be free from slag, scale and other adhering matter.

Rivets that are loose, burned, badly formed or otherwise defective shall be removed and replaced with satisfactory rivets. A rivet whose head is defective in size or whose head is driven off center shall be removed and replaced. Stitch rivets that are loosened by driving of adjacent rivets shall be removed and replaced with satisfactory rivets. Caulking, recupping or double gunning of rivet heads will not be permitted.

Shop rivets shall be driven by direct-acting rivet machines when practical. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. When the use of a direct-acting rivet machine is not practicable, pneumatic hammers of approved size shall be used. Pneumatic bucking tools will be required when the size and length of rivets warrant their use.

Rivets may be driven cold provided their diameter is not over 3/8 inch.

807.24 PLATE CUT EDGES.

(a) Edge Planing: Sheared edges of plates more than 5/8 inch thick and carrying calculated stress shall be planed, milled, ground or thermal cut to a depth of 1/4 inch. Reentrant corners shall be filleted to a minimum radius of 3/4 inch before cutting.

(b) Visual Inspection and Repair of Plate Cut Edges: Visual inspection and repair of plate cut edges shall be in accordance with Section 3.2.3 of the ANSI/AASHTO/AWS D1.5-88 Bridge Welding Code.

807.25 SHOP WELDING. Shop welding of metal structures shall conform to Section 815.

807.26 ORTHOTROPIC-DECK BRIDGES.

(a) Protection of Deck Plate After Sandblasting: If sandblasting to white metal, or an equivalent method, is used to prepare the deck plate to receive a wearing surface, a protective coating shall be applied to the plate immediately after cleaning.

(b) Dimensional Tolerance Limits: Dimensional tolerance limits for orthotropic-deck bridge members shall be applied to each completed but unloaded member and shall be as specified in latest AASHTO specifications except as otherwise provided herein. The deviation from detailed flatness, straightness or curvature at any point shall be the perpendicular

distance from that point to a template edge having the detailed straightness of curvature and which is in contact with the element at two other points. The term "element" as used herein refers to individual panels, stiffeners, flanges or other pieces. The template edge may have any length not exceeding the greatest dimension of the element being examined and, for any panel, not exceeding 1.5 times the least dimension of the panel; it may be placed anywhere within the element. The deviation shall be measured between adjacent points of contact of the template edge with the element; the distance between these adjacent points of contact shall be used in formulas to establish the tolerance limits for the segment being measured when this distance is less than the applicable dimension of the element specified for the formula.

(1) Flatness of Panels: The term "panel" as used herein means a clear area of steel plate surface bounded by stiffeners, webs, flanges or plate edges and not further subdivided by any such elements. These provisions apply to all panels in the bridge; for plates stiffened on one side only, such as orthotropic-deck plates or flanges of box girders, this includes the total clear width on the side without stiffeners as well as the panels between stiffeners on the side with stiffeners.

The maximum deviation from detailed flatness of curvature of a panel shall not exceed the greater of:

$$3/16 \text{ inch or } \frac{D}{144\sqrt{T}}$$

where: D = least dimension in inches along boundary of panels, and
T = minimum thickness in inches of plate comprising the panel.

(2) Straightness of Longitudinal Stiffeners Subject to Calculated Compressive Stress, Including Orthotropic-Deck Ribs: Maximum deviation from detailed straightness or curvature in any direction perpendicular to its length of a longitudinal stiffener subject to calculated compressive stress, including orthotropic-deck rib, shall not exceed.

$$\frac{L}{480}$$

where: L = length of stiffener or rib between cross members, webs or flanges, in inches.

(3) Straightness of Transverse Web Stiffeners and Other Stiffeners not Subject to Calculated Compressive Stress: Maximum deviation from detailed straightness or curvature in any direction perpendicular to its length of a transverse web stiffener or other stiffener not subject to calculated compressive stress shall not exceed.

$$\frac{L}{240}$$

where: L = length of stiffener or rib between cross members, webs or flanges in inches.

807.27 FACING OF BEARING SURFACES. The surface of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall conform to the following surface finish of ANSI B 46.1, Surface Roughness, Waviness and Lay, Part 1:

	Surface Finish
Steel slabs	2,000
Heavy Plates in contact in shoes to be welded	1,000
Milled ends of compression members, stiffeners, and fillers	500
Bridge rollers and rockers	250
Pins and pin holes	125
Sliding bearings	125
All other surfaces	500

807.28 ABUTTING JOINTS. Abutting joints in compression members, girder flanges and tension members, when specified, shall be faced and brought to an even bearing. When joints are not faced, the opening shall not exceed 1/4 inch.

807.29 END CONNECTION ANGLES. Floor beams, stringers and girders having end connection angles shall be built to specified length (+0, -1/16 inch) between heels of connection angles. If continuity is required, end connections shall be faced. Thickness of connection angles shall not be less than 3/8 inch nor less than that shown on the plans after facing.

807.30 LACING BARS. Ends of lacing bars shall be neatly rounded.

807.31 FABRICATION OF MEMBERS. Steel plates for main members and splice plates for flanges and main tension members, not secondary members, shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and compressive stresses. Fabricated members shall be true to line and free from twists, bends and open joints.

807.32 BENT PLATES. Unwelded, cold-bent, load-carrying, rolled steel plates shall be so taken from the stock plates that the bend line will be at right angles to the direction of rolling, except that cold-bent ribs for orthotropic-deck bridges may be bent in the direction of rolling if permitted.

Bending shall be such that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are shown in the following:

Plate Thickness (t) (inches)	Minimum Bend Radius
Up to 1/2	2t
Over 1/2 to 1	2 1/2t
Over 1 to 1 1/2	3t
Over 1 1/2 to 2 1/2	3 1/2t
Over 2 1/2 to 4	4t

Low alloy steel over 1/2 inch thick may require hot bending for small radii.

Allowance for springback of ASTM A 709, Grade 100 steel should be about three times that for structural carbon steel. For brake press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable.

If shorter radius is essential, plates shall be bent hot at a temperature not greater than 1150°F, except for ASTM A 709, Grade 100 steel. If ASTM A 709, Grade 100 steel plates to be bent are heated to a temperature greater than 1125°F, they must be requenched and tempered in accordance with the producing mill's practice. Hot-bent plates shall conform to the requirements herein for cold-bent plates.

Before bending, corners of the plate shall be rounded to a radius of 1/16 inch throughout the portion of the plate at which bending is to occur.

807.33 FIT OF STIFFENERS. End stiffeners of girders and stiffeners intended as supports for concentrated loads shall have full bearing (either milled, ground or welded, as specified) on the flanges. Stiffeners not intended to support concentrated loads shall have a tight fit. As an alternate, stiffeners may be cut short, jammed to the tension flange and seal-welded to the compression flange. Fillers under stiffeners shall fit within 1/4 inch at each end. Welding transversely across tension flanges of beams or girders will not be permitted unless shown on the plans.

807.34 EYEBARS. Fabrication for eyebars shall conform to the latest AASHTO specifications.

807.35 ANNEALING AND STRESS RELIEVING. Structural members to be annealed or normalized shall have finished machining, boring and straightening done subsequent to heat treatment. Normalizing and full annealing shall be as specified in ASTM E 44. Temperatures shall be maintained uniformly throughout the furnace during heating and cooling so that the temperature at no two points on the member shall differ by more than 100°F at any time.

Members of ASTM A 709, Grade 100 steel shall not be annealed or normalized and shall be stress-relieved only with approval.

A record of each furnace charge shall identify pieces in the charge and show temperatures and schedule used. Proper instruments, including recording pyrometers, shall be provided for determining at any time the temperatures of members in the furnace. Records of the treatment operation shall be available to, and meet approval of the engineer. Holding temperature for stress relieving ASTM A 709, Grade 100 steel shall not exceed 1125°F.

When specified, members such as bridge shoes, pedestals or other parts which are built up by welding sections of plate together shall be stress-relieved in accordance with Section 815.

807.36 PINS AND ROLLERS. Pins and rollers shall be accurately turned to specified dimensions and shall be straight, smooth and free from flaws.

Pins and rollers more than 9 inches in diameter shall be forged and annealed. Pins and rollers 9 inches or less in diameter may be either forged and annealed or cold-finished carbon-steel shafting.

In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent damage by too rapid cooling and before being annealed.

807.37 BORING PIN HOLES. Pin holes shall be bored true to specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other. 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 inch. Boring of holes in built-up members shall be done after connections are completed.

807.38 PIN CLEARANCES. Pin hole diameter shall not exceed pin diameter by more than 0.020 inch for pin diameters of 5 inches or less, and 0.03125 inch for larger pins.

807.39 SCREW THREADS. Threads for bolts and pins for structural steel construction shall conform to the Unified Standard Series UNC/ANSI B1.1, Class 2A for external threads and Class 2B for internal threads, except that pin ends having a diameter of 1 3/8 inches or more shall have six threads to the inch.

807.40 PILOT AND DRIVING NUTS. Two pilot nuts and two driving nuts for each size pin shall be furnished.

807.41 CAMBER FOR ROLLED BEAMS IN SIMPLE SPAN. When specified, beams shall be cambered to conform to the vertical curve or level grade required after full dead load is applied. Camber shall approximate a simple curve from end to end of beam. The camber ordinate at midlength of the beam shall be equal to the dead load deflection of the beam plus the midordinate of the vertical curve, if the span is on a vertical curve. The camber ordinate may vary from the above by ±1/4 inch.

Beams may be cambered cold or may be heated. When heat is used, the tension flange shall be heated uniformly and progressively to not more than a red heat visible in ordinary shop light (1150°F) while the beam is loaded to produce compression in the bottom flange. The contractor shall furnish pyrometers or temperature-indicating crayons for checking the desired temperatures. Heating and loading shall be done in such manner that the permanent camber remaining shall be within the limits specified above. After cambering, the beam shall be left to air cool and no quenching process shall be permitted.

807.42 STRAIGHTENING OF OTHER MEMBERS. No quenching process shall be used without permission.

807.43 ARMORED JOINTS. Armored joint assemblies shall be paired and fitted before shipping. Plates, angles or other structural shapes shall be accurately shaped at the shop to conform to the specifications covering those items. 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 placing of concrete. The opening at expansion joints shall be that designated on the plans at normal temperatures, and care shall be taken to avoid impairment of the clearance.

807.44 SHEAR CONNECTORS. Shear connectors may be either 3/4 inch or 7/8 inch studs. Stud shear connectors shall conform to the requirements of Section 7, Stud Welding of ANSI/AASHTO/AWS D1.5-88 Bridge Welding Code.

807.45 MARKING AND SHIPPING. Unless otherwise specified, girders and beams shall be placed in the upright position for shipment. Each member shall be painted or marked with an erection mark for identification and an erection diagram shall be furnished with erection marks shown thereon.

The contractor shall furnish to the engineer as many copies of material orders, shipping statements and erection diagrams as directed. Weights of individual members shall be shown on the statements. Members weighing more than three tons shall have weights marked thereon. Structural members shall be loaded in such manner that they may be transported and unloaded at their destination without being excessively stressed, deformed or otherwise damaged.

Pins, small parts and packages of bolts, rivets, washers and nuts shall be shipped in boxes, crates, kegs or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and description of the contained materials shall be plainly marked on the outside of each shipping container.

807.46 PAINTING. Shop and field paints and their application shall conform to Section 811.

807.47 FALSEWORK. Falsework shall be designed properly, constructed substantially and maintained for the loads which will come upon it.

807.48 BEARINGS AND ANCHORAGES. Bearings shall be set level, in exact position, and shall have full and even bearing on the masonry. Bearings shall not be placed on masonry bearing areas which are irregular or improperly formed.

(a) Elastomeric bearing pads, if used, shall be set directly on the concrete masonry.

(b) Cast iron or steel or rolled steel bearings shall be bedded on the masonry with single thickness of sheet lead, or preformed fabric bearing pad.

(c) PTFE Sliding Plate Bridge Bearings: When PTFE Sliding Plate Bridge bearings are specified on the plans, they shall conform to the following requirements.

Sliding plate bearings shall be fabricated by companies and shops normally engaged in production of bridge bearings similar to the types specified. Structural steel components shall conform to ASTM A 709, Grade 36 or Grade 50. Fabrication and erection of bearings shall conform to Section 807 as amended herein.

Anchor bolts shall be grouted in preformed wells in the top of existing piers. Grout shall be an approved non-shrink, non-metallic type conforming to Subsection 1018.27

Sliding surfaces shall be stainless steel operating against a bearing surface of polytetrafluorethylene (PTFE). Such bearing shall be structurally equal to those shown on the plans and shall be designed to accommodate all required movements and reactions.

(1) Construction Methods: Before fabrication of bearings, the contractor shall submit shop drawings for approval.

After fabrication and before bonding, stainless steel or PTFE back-up material shall be planed to a true plane. Bonding of PTFE sheets shall be performed at the factory of the bearing manufacturer under controlled conditions and in accordance with written instructions of the

adhesive system manufacturer. Side of PTFE sheet to be bonded to metal shall be factory treated by an approved manufacturer by the sodium napthalene or sodium ammonia process.

After bonding operations, the PTFE surface shall be smooth, flat and free from bubbles. Filled PTFE surfaces shall then be polished. Fabric shall be capable of carrying unit loads of 10 KSI without cold flow. PTFE fabric shall be bonded or mechanically attached to a rigid substrate.

The fabric-substrate bond shall be capable of withstanding a shear force equal to 10 percent of the perpendicular application loading without delamination in addition to the shear force developed as a result of the natural bearing frictions shear force. The test method shall conform to ASTM D 1002.

Welding to steel plate which has bonded PTFE surface will be permitted providing a welding procedure is established and approved which restricts temperature reached by bond area to less than 300°F as determined by temperature indicating wax pencils or other suitable means.

The clad plate shall conform to ASTM A 264. In lieu of the clad plate the stainless steel plate may be continuously Tungsten Inert Gas Fillet Welded to the sole plate.

The back-up plate for the PTFE surface shall be factory vulcanized to the lower neoprene bearing element.

Where unfilled PTFE sheet is used, PTFE shall be recessed in backup plate by 1/2 the PTFE sheet thickness.

Bearings shall be assembled at the plant, marked for identification and delivered as a complete unit. Bearings shall have permanent matchmarks to indicate the normal position of the bearing. During transportation and storage, bearings shall be covered with moisture proof and dustproof covers, and shall be protected against damage.

The contractor shall furnish manufacturer's certification of steel, elastomeric pads, PTFE and other materials used in fabrication of bearings.

(2) Fabrication Inspection: Fabrication will be inspected by the Construction Section in accordance with Section 807.05 as amended herein.

Test for coefficient of friction shall be performed by the manufacturer or in an approved laboratory. One completed bearing shall be tested from each group. Test method and equipment shall be approved and shall include, but shall not be limited to, the following:

a. Test shall be arranged so that coefficient of friction of first movement of bearing can be determined.

b. Bearing surface shall be cleaned prior to testing and a silicon gel may be added to the surface. When silicon gel is used between the bearing surfaces during the test, silicon gel shall be applied to each bearing either before assembly at the fabrication plant or before erection in the field.

c. Test shall be conducted at maximum working stress for the PTFE working surface with test load supplied continuously for 12 hours prior to measuring friction.

d. First movement static and dynamic coefficient of friction of test bearing shall be determined at a sliding speed of less than one inch per minute and shall not exceed 75 percent of the coefficient of friction specified below.

	Bearing Pressure[1]		
	500 psi	2000 psi	3500 psi
	Coefficient of Friction		
Unfilled PTFE, Fabric containing PTFE fibers, and PTFE-Perforated Metal Composite	0.08	0.06	0.04
Filled PTFE	0.12	0.10	0.08

[1]The actual bearing pressure shall be supplied to the fabricator upon request.

e. Bearing specimen shall then be subjected to 100 movements of at least one inch of relative movement and if test facility permits, full design movement at a speed of less than one foot per minute. Following this test, static and dynamic coefficient of friction shall be determined again and shall not exceed values measured in Heading 4 above. Bearing specimen shall show no appreciable sign of bond failure or other defects.

Bearings represented by test specimens passing above requirements will be approved subject to onsite inspection for visible defects.

807.49 STRAIGHTENING BENT MATERIAL AND CAMBERING.

(a) Straightening Bent Material: Straightening of plates, angles, other shapes and built-up members, when permitted, shall be done by methods that will not produce fracture or other damage. Distorted members shall be straightened by mechanical means or, if approved, by supervised application of a limited amount of localized heat, except that heat straightening of ASTM A 709, Grade 100 steel shall be done only under rigidly controlled procedures, each application subject to approval of the engineer. In no case shall the maximum temperature of ASTM A 709, Grade 100 steel exceed 1125°F, nor shall the temperature exceed 950°F at weld metal or within 6 inches of weld metal. Heat shall not be applied directly on weld metal. In all other steels, the temperature of the heated area shall not exceed 1150°F (a dull red) as controlled by temperature indicating crayons, liquids or bi-metal thermometers.

Parts to be heat straightened shall be substantially free of stress from external forces, except stresses resulting from mechanical means used in the application of heat.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

(b) Cambering: Correction of errors in camber in welded beams and girders of ASTM A 709, Grade 100 steel shall be done only under rigidly controlled procedures, each application subject to approval.

807.50 ASSEMBLING STEEL. Parts shall be accurately assembled and any matchmarks shall be followed. Materials shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will damage or distort members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before members are assembled.

Unless erected by the cantilever method, truss spans shall be erected on blocking so placed as to give the trusses proper camber. Blocking shall be left in place until tension chord splices are fully riveted or bolted and all other truss connections pinned and bolted.

Rivets or permanent bolts in splices of butt joints of compression members and rivets or permanent bolts in railings shall not be driven or tightened until the span has been swung.

Splices and field connections shall have at least 50 percent of the holes filled with bolts and pins (either erection or untorqued permanent bolts) and at least 10 percent of cylindrical erection pins for fit-up and alignment. Splices and connections carrying traffic during erection shall have 75 percent of the holes filled. Main member splices shall have all holes filled with bolts and cylindrical erection pins (half bolts and half pins) for fit-up and alignment.

Fit-up bolts shall be of the same nominal diameter as rivets or permanent bolts and cylindrical erection pins shall be 1/32 inch larger.

Permanent field bolting shall be performed in accordance with Subsection 807.22.

807.51 RIVETING. Pneumatic hammers shall be used for field riveting except when the use of hand tools is permitted. Rivets larger than 7/8 inch diameter shall not be driven by hand. Cupfaced dollies fitting the head closely to insure good bearing shall be used. Connections shall be accurately and securely fitted before rivets are driven. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled. In other respects, riveting shall conform to Subsection 807.23. Field rivets shall not be smaller than the heads of the shop rivets. In removing rivets, the surrounding metal shall not be damaged, and if necessary, they shall be drilled out.

807.52 PIN CONNECTIONS. Pilot and driving nuts shall be used in driving pins. They shall be furnished by the contractor without charge. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be tightened and the threads burred at the face of the nut.

807.53 FIELD WELDING. Field welding of steel structures, when authorized, shall conform to Section 815.

807.54 MISFITS. Correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of erection. However, any error in fabrication or deformation resulting from handling and transportation which prevents proper assembling and fitting of parts by moderate use of drift pins or reaming and slight chipping or cutting, shall be reported immediately to the inspector and approval of the method of correction obtained. The correction shall be made in the presence of the inspector. The contractor shall be responsible for the correction of all misfits, errors and damages and shall make the necessary corrections and replacement at no direct pay.

807.55 SETTING BENCH MARKS. A bench mark bolt furnished and delivered by the contractor shall be set by the contractor without extra compensation on each bridge. The bench mark bolt shall be either hex head or square head 4 inches by 5/8 inch threaded galvanized bolt. It shall be located on the downstream side at the end of the bridge on the right descending bank. If the bridge has a concrete deck, the bench mark plate shall be set at the end of the curb unless otherwise directed. No permanent plates or markers other than those furnished or specified will be permitted on any structure.

807.56 WEATHERING STEEL. When ASTM A 709, Grade 50W weathering steel is specified to be left unpainted, the following modifications in the requirements of this Section shall apply.

(a) Materials: Steel to be completely embedded in concrete shall be either ASTM A 709, Grade 36 or Grade 50W steel. Anchor bolt assemblies and other steel partially embedded in concrete shall be ASTM A 709, Grade 50W steel.

(b) High Strength Bolts: High strength bolts shall be ASTM A 325, Type 3.

(c) Stiffeners: To facilitate drainage adjacent to stiffeners, the lower end of transverse stiffeners shall be clipped at least 1 1/2 inches, and longitudinal stiffeners shall be terminated at least 1 inch short of transverse stiffeners.

(d) Cleaning of Exposed Surfaces: Exposed surfaces of weathering steel to be left unpainted shall be cleaned of all grease, oil, paint or other soilage.

Outside surfaces of exterior girders and the bottom surface of the bottom flange of exterior girders shall be blast cleaned, either before or after erection, in accordance with Subsection 811.06(c). At the contractor's option, any other weathering steel surface may be blast cleaned. Blast cleaned surfaces shall be kept free of grease, oil, markings, paint or other soilage; such soilage of blast cleaned surfaces shall be removed by approved methods. Concrete splatter shall be washed off immediately.

(e) Restoration of Concrete Finish: All concrete surfaces requiring a Class 2A finish shall be restored to the required finish at the time of final acceptance.

807.57 MEASUREMENT.

(a) Weight Basis: Structural steel will be measured by the weight of metal in pounds remaining in the completed and accepted structures. The weight will be computed on the basis of theoretical net weight from the approved shop drawings. No allowance will be made for rivets, bolts, nuts, washers or welds and no deductions will be made for rivet holes, bolt holes, beam copings, cut flanges or edge preparation for welding. Deduction will be made for pin holes. Plates shall be estimated from the sizes billed and deductions made for cut corners. Shear connectors will not be measured for payment.

No measurement of structural steel of any class will be allowed for temporary work or for additional weight in members provided for erection purposes.

No allowance will be made in the pay quantity for any items not remaining in the finished structure, except as hereinafter provided.

No allowance will be made for shop or field paints, galvanizing or other coatings.

No allowance will be made for overrun on plates or rolled sections.

When full-size tests of built-up structural members and eyebars are required, any fullsize members tested to destruction will be measured if the test proves satisfactory. However, if the test proves unsatisfactory, the members represented by it will be rejected and no measurement or allowance will be made for such members.

ASTM A 709, Grade 36 steel shall include all metal classified as such in the plans and specifications and such minor items as anchor materials including pins, rollers, metal railings, steel plates and shapes for expansion joints, ladders, wrought iron sheets, checkered

floor plates, bronze castings and plates, steel and iron castings (except cast iron drains in floors) ladders, stairways, platforms, structural supports and brackets for machinery and power equipment including pit pumps, steel framework for counterweights, floor plates, keeper plates and their tap bolts, sheet metal covers for gears and drum switches and other parts, shim plates, bearing plates for approach spans, curb angles, anchor bolts including those for roadway gates, and bronze and cast iron for expansion plates.

ASTM A 709, Grades 36, 50, 50W, 70W, and 100 steel shall include all steel classified as such in the plans or specifications.

Metal weights will be computed on the following bases:

Metal	Unit Wt (lb/cu ft)
Aluminum, cast or wrought	173.0
Bronze, cast	536.0
Copper-alloy	536.0
Copper, sheet	558.0
Iron, cast	445.0
Iron, malleable	470.0
Iron, wrought	487.0
Lead, sheet	707.0
Steel, rolled, cast, copper bearing, silicon, nickel, and stainless	490.0
Zinc	450.0

(b) Lump Sum Basis: When payment is specified to be made by the lump sum, no weight measurement of metal will be made. Any estimate of the weight of structural metalwork shown on the plans is approximate and no guarantee is made that it is the correct weight of each grade of metal to be furnished. It is the contractor's responsibility to determine the correct weight of each grade of metal furnished. No adjustment in contract price will be made due to errors in the estimated weight shown on the plans. Shop bills will not be required.

807.58 PAYMENT.

(a) Weight Basis: Payment for the various classifications of structural metals will be made at the respective contract unit prices per pound.

(b) Lump Sum Basis: Payment for the completed and accepted items will be made at the contract lump sum price, which includes furnishing, fabricating, erecting, painting, galvanizing or other coating of all necessary materials; furnishing all required labor, plants, equipment, tools, staging, falsework, forms, power welding, bolts and other hardware; and the performance of all work necessary to complete the item.

When changes in the work are ordered by the engineer, which vary the weight of steel to be furnished, the lump sum payment will be adjusted as follows:

The value per pound of the increase or decrease in the weight of structural steel involved in the change will be determined by dividing the contract lump sum amount by the estimated weight shown on the plans. The adjusted contract lump sum payment will be the contract lump sum amount plus or minus the value of the steel involved in the change, and no additional compensation will be made on account of said change.

If a change in the grade of steel to be furnished is ordered by the engineer, resulting in additional cost to the contractor, compensation will be made in accordance with Subsection 109.04.

Payment will be made under:

Item No.	Pay Item	Pay Unit
807(01)	Steel (ASTM A 709, Grade 36)	Pound
807(02)	Steel (ASTM A 709, Grade 50)	Pound
807(03)	Steel (ASTM A 709, Grade 50W)	Pound
807(04)	Steel (ASTM A 709, Grade 70W)	Pound
807(05)	Steel (ASTM A 709, Grade 100)	Pound
807(06)	Structural Metalwork	Lump Sum

Section 808
Steel Grid Flooring

808.01 DESCRIPTION. This work consists of furnishing and installing steel grid flooring of the open or concrete-filled type, as specified, in accordance with these specifications and in reasonably close conformity with the details shown on the plans.

Before fabrication or construction is undertaken, the contractor shall submit shop and assembly details in accordance with Subsection 801.03.

808.02 MATERIALS. Steel grid flooring shall conform to Subsection 1013.21.

Concrete in filled steel grid floors shall be Class A conforming to Section 901, except Grade F coarse aggregate shall be used.

Paint shall conform to Section 811.

808.03 FABRICATION. Deviations from these specifications to conform to manufacturer's specifications will not be permitted without approval of the Bridge Design Engineer.

Upper edges of members forming the wearing surface of open type grid flooring shall be fabricated or treated to give maximum skid resistance.

808.04 NOTICE OF BEGINNING OF WORK. The contractor shall give the DOTD Construction Engineer Administrator at least 10 days advance written notice of the beginning of work at the mill or shop so that inspection may be provided. No material shall be manufactured or work done in the shop before shop drawings have been approved and before the DOTD Construction Engineer Administrator has been notified.

808.05 FACILITIES FOR INSPECTION. The contractor shall furnish facilities for inspection of material and workmanship in the mill and shop as described in Subsections 807.04 and 807.05.

808.06 STORAGE OF MATERIALS. Steel grid flooring shall be stored as specified in Subsection 807.08.

808.07 STRAIGHTENING MATERIAL. Steel grid flooring sections, before being installed, shall be straight, except for camber if specified. If straightening is necessary, it shall be done by methods that will not damage the metal.

808.08 ARRANGEMENT OF SECTIONS. Where main elements are normal to centerline of roadway, the units generally shall be of such length as to extend over the full width of roadway for roadways up to 40 feet, but in every case the units shall extend over at least three panels. Where joints are required, ends of main floor members shall be welded at joints over their full cross-sectional area or otherwise connected to provide continuity.

Where main elements are parallel to centerline of roadway, sections shall extend over at least three panels, and ends of abutting units shall be welded over their full cross-sectional area or otherwise connected to provide continuity.

808.09 PROVISION FOR CAMBER. Steel units so rigid that they will not readily follow the camber required shall be cambered in the shop. To provide a bearing surface parallel to the crown of the roadway, stringers shall be canted or provided with shop-welded beveled bearing bars. If beveled bars are used, they shall be placed along the centerline of stringer flange, in which case the design span length shall be governed by width of bearing bar instead of width of stringer flange.

Longitudinal stringers shall be mill-cambered or provided with bearing strips so that the complete floor, after deadload deflection, shall conform to the required longitudinal camber.

808.10 FIELD ASSEMBLY. Areas of considerable size shall be assembled before the floor is welded to its supports. Main elements shall be made continuous and sections shall be connected along their edges by welding. Connections will be subject to approval.

808.11 CONNECTION TO SUPPORTS. The floor shall be connected to its steel supports by welding. Before welding, the floor shall either be loaded to make a tight joint with full bearing or clamped down. Location, length and size of welds shall be subject to approval of the Bridge Design Engineer, but in no case shall they be less than the manufacturer's standards.

Ends of main steel members of the slab shall be securely fastened together at the sides of the roadway for the full length of span by steel plates or angles welded to ends of main members.

808.12 WELDING. Shop and field welding shall conform to Section 815. Field welding shall conform to the approved method and location as shown on the shop drawings.

808.13 PAINTING. The open steel grid floor shall be cleaned and painted in accordance with Section 811. For filled type grid flooring, only the underside of the bottom plate and the other faces of headers, trim bars and end bars shall be painted.

808.14 CONCRETE FILLER. When specified, concrete filler shall be placed in the open grid.

Floor types with bottom flanges not in contact shall be provided with bottom forms of metal to retain the concrete filler.

Metal forms shall fit tightly on bottom flanges of floor members and be placed in short lengths so as to extend only about 1 inch onto the edge of each support, and in all cases forms shall provide for adequate bearing of the slab on the support.

Concrete shall be consolidated by vibrating the steel grid floor. The vibrating device and manner of operating it will be subject to approval.

808.15 MEASUREMENT. The quantity of steel grid flooring for payment will be the design area as specified on the plans and adjustments

thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven or if design changes are necessary.

Concrete for filling steel grid flooring will not be measured for payment.

808.16 PAYMENT. Payment for steel grid flooring will be made at the contract price per square foot, which includes furnishing and fabricating all steel materials, including base plates, trim angles, trim plates, painting or other coating (if required) and all welding and bolting, and any additional materials or fabrication in the floor system necessitated by the use of an approved alternate grid flooring type.

Payment will be made under:

Item No.	Pay Item	Pay Unit
808(01)	Steel Grid Flooring	Square Foot

Section 809
Movable Bridges

809.01 DESCRIPTION. This work consists of furnishing, fabricating and erecting movable span bridges and all appurtenances required for their operation such as machinery, operating house, traffic barriers, and machinery houses.

The requirements for fixed span bridges, as given in these specifications, shall apply to movable bridges except as herein provided.

809.02 GUARANTEES. The contractor guarantees, by signing the contract, all machinery, operating houses, power plant and traffic barriers equipment, materials and workmanship for one year after the date of final acceptance of the project.

Prior to final acceptance of the project, the contractor shall furnish warranties and guarantees as specified in Subsection 104.05.

If it should be found that parts failed due to defective material or faulty workmanship and if such parts should, within the said 1 year, cause any breakdown or accident, the contractor will not only be required to furnish and install the defective part, but will also be held pecuniarily responsible to the Department for all expenses due to accident or breakdown caused by such a failure. The contractor shall insert one copy of all warranties and guarantees into the maintenance manuals specified. Routine maintenance during the guarantee period will be performed by the Department.

809.03 BOND. As a guarantee to cover the replacement of warranted equipment and apparatus as stated above, the contractor will be required to furnish satisfactory bonding in full amount of the contract price for machinery, operating houses, traffic barriers, power plant and machinery houses. This bond shall remain in effect for 1 year from date of final acceptance of the project and must be filed in the offices of the Department before payment of the final estimate will be made.

809.04 DRAWINGS. Shop drawings, brochures and work drawings shall be furnished in accordance with Subsection 801.03.

809.05 MAINTENANCE AND OPERATION MANUALS. Maintenance and operation instruction manuals shall be furnished in accordance with Subsection 801.03(f)(2).

809.06 INSTRUCTION TO DEPARTMENTAL PERSONNEL. The contractor shall notify the engineer when the span, including the power plant, operating house, traffic barriers and machinery, is fully operational in order that the permanent bridge operators may be assigned for instruction. At this time the contractor shall furnish a competent person, experienced in operation of equipment of this character, for 5 working days of 8 hours each to instruct the Department's bridge operators in the complete and correct operation of the bridge and to provide complete instruction to the Department's electrical, mechanical and bridge maintenance personnel in proper operation, maintenance, lubrication and adjustment of equipment. This 5-day period of instruction shall be prior to final inspection.

809.07 METALS. Structural and miscellaneous metals used in the manufacture of parts for movable bridges shall be as listed in Section 1013 and the current AASHTO Standard Specifications for Movable Highway Bridges.

809.08 WIRE ROPE, COUNTERWEIGHT ROPE, AND ATTACHMENTS. Wire rope and attachments shall conform to Subsections 1009.10 and 1009.11.

809.09 GENERAL FABRICATION AND ERECTION REQUIREMENTS. Except as otherwise provided herein, the fabrication and erection of structural parts shall conform to Section 807.

809.10 MANUFACTURE AND FABRICATION OF MACHINERY AND TRAFFIC BARRIERS.

(a) Shop Practice: The manufacture of machinery and traffic barrier parts shall be in accordance with the current and best practice of modern foundries and machine shops. The manufacture of machined parts shall be in accordance with ANSI standards for the various items. Surface finish requirements refer to ANSI B 46.1.

(b) Inspection: The contractor shall give the DOTD Construction Engineer Administrator 10 days advance written notice before beginning the manufacture of any item, so that inspection may be provided. The contractor shall furnish facilities for inspection of material and workmanship as described in Subsections 807.04 and 807.05. Inspectors shall be allowed free access to plant facilities for adequate inspection of the work. This inspection shall be at the option of the Department and shall not relieve the contractor of any responsibility placed upon him by the contract.

(c) Fit Tolerances for Accurate Work: Allowances which should be made for different kinds of fits are tabulated hereinafter. They are based on the use of the hole as the nominal size and give the amounts by which the shaft should be less than or greater than the nominal hole size. If the shaft is selected as the base, the allowances for the hole will be of the same magnitude but of opposite sign. The permissible tolerance is the difference between the minimum and maximum allowances.

(d) Classifications of Fits and Surface Finishes:

Classifications	ANSI Surface Finish
Loose Fit (Class 1), Large Allowance. This fit provides for considerable freedom and embraces certain fits where accuracy is not essential. Suitable for ordinary bearings on shafts which are subject to journal pressures of 600 psi or less.	Bearings - 16 Journals - 8
Free Fit (Class 2), Liberal Allowance. For running fits with speeds of 600 rpm or over and journal pressure of 600 psi or over, and for heavily loaded journals on trunnions and shafts.	Bearings - 16 Journals - 8
Medium Fit (Class 3), Medium Allowance. For running fits under 600 rpm and journal pressures less than 600 psi, and for sliding fits.	Bearings - 16 Journals - 8
Snug Fit (Class 4), Zero Allowance. This is the closest fit which can be assembled by hand and necessitates work of considerable precision.	125
Wringing Fit (Class 5), Zero to Negative Allowance. This is also known as a tunking fit and is practically metal to metal.	125
Tight Fit (Class 6), Slight Negative Allowance. Light pressure is required to assemble these fits.	125
Medium Force Fit (Class 7), Negative Allowance. Considerable pressure is required to assemble these fits, and the parts are considered permanently assembled.	125
Heavy Force and Shrink Fit (Class 8), Considerable Negative Allowance. These fits are used for steel holes where the metal can be highly stressed without exceeding its elastic limit.	125
Shafts Outside bearings:	250

Allowances for the various classifications of fits shall be in accordance with the following tables.

ALLOWANCES FOR VARIOUS TYPES OF FIT

(Allowances, Tolerances and Interference are given in ten-thousandths of an inch)

Size, Inches	Loose Fit (Class 1)		Free Fit (Class 2)		Medium Fit (Class 3)		Snug Fit (Class 4)		Wringing Fit (Class 5)		Tight Fit (Class 6)	Medium Force Fit (Class 7)	Heavy Force or Shrink Fit (Class 8)
	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Selected fit	Selected fit	Selected fit
	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Average Interference	Average Interference	Average Interference
1 1/16–1 3/16	30	90	15	43	10	26	0	10	4	6	3	6	11
1 3/16–1 3/8	30	90	16	44	10	28	0	10	4	6	3	6	13
1 3/8–1 5/8	30	90	18	48	12	30	0	12	4	7	4	8	15
1 5/8–1 78	40	100	20	52	13	33	0	12	5	7	5	9	18
1 7/8–2 1/8	40	100	22	54	14	34	0	13	5	8	5	10	20
2 1/8–2 3/8	40	100	24	58	15	35	0	13	5	8	6	11	23
2 3/8–2 3/4	50	110	26	62	17	39	0	13	5	8	6	13	25
2 3/4–3 1/4	50	130	29	67	19	43	0	15	6	9	8	15	30
3 1/4–3 3/4	60	140	32	72	21	45	0	15	6	9	9	18	35
3 3/4–4 1/4	60	140	35	77	23	49	0	16	6	10	10	20	40
4 1/4–3 3/4	70	150	38	80	25	51	0	17	7	10	11	23	45
4 3/4–5 1/2	70	150	41	85	26	54	0	17	7	10	13	25	50
5 1/2–6 1/2	80	180	46	94	30	60	0	18	7	11	15	30	60
6 1/2–7 1/2	90	190	51	101	33	63	0	19	8	11	18	35	70
7 1/2–8 1/2	100	200	56	108	36	68	0	20	8	12	20	40	80

For larger than 8 1/2 inch diameter, use the following:

Formulas for Recommended Allowances and Tolerances

Class of Fit	Method of Assembly	Allowance	Selected Average Interference of Metal	Hole Tolerance	Shaft Tolerance
(1) Loose	Strictly Interchangeable	$0.0025\sqrt[3]{d^2}$	---	$0.0025\sqrt[3]{d}$	$0.0025\sqrt[3]{d}$
(2) Free	Strictly Interchangeable	$0.0014\sqrt[3]{d^2}$	---	$0.0013\sqrt[3]{d}$	$0.0013\sqrt[3]{d}$
(3) Medium	Strictly Interchangeable	$0.0009\sqrt[3]{d^2}$	---	$0.0003\sqrt[3]{d}$	$0.0003\sqrt[3]{d}$
(4) Snug	Strictly Interchangeable	0.0000	---	$0.0006\sqrt[3]{d}$	$0.0004\sqrt[3]{d}$
(5) Wringing	Selective Assembly	---	0.0000	$0.0006\sqrt[3]{d}$	$0.0004\sqrt[3]{d}$
(6) Tight	Selective Assembly	---	0.00025d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$
(7) Medium force	Selective Assembly	---	0.0005d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$
(8) Heavy force or shrink	Selective Assembly	---	0.001d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$

d = diameter of fit in inches.

The formulas for allowance values give the ideal condition of fit for Classes 1 to 4.

The formulas for selected average interference of metal give the ideal condition of fit for Classes 5 to 8.

809.11 TRUNNIONS, SHAFTS AND JOURNALS. Trunnions and shafts shall be made with fillets where abrupt changes in section occur.

Journals of trunnions and shafts shall be polished to ANSI No. 8 surface finish after being machined. Fillets shall be polished to ANSI No. 63 surface finish in the direction of turning. For trunnions and shafts more than eight inches in diameter, a hole approximately 1/5 the diameter of shaft or trunnion shall be bored lengthwise through the center.

809.12 COUPLINGS. Faces of flange couplings shall be planed to an ANSI No. 125 surface finish and holes bored in pairs.

809.13 HUBS. Hubs of wheels, pulleys, gears and couplings shall be bored true to center for Class 7 fit upon their shafts or axes. Ends of hubs shall be finished as required.

809.14 BUSHINGS. Bushings shall be bored to fit the matching shaft or journal to within the tolerances specified.

The bearing housing shall be bored to fit the outside of the bushing. Contact edges of oil grooves and bushings shall be rounded.

Babbitt metal, when required shall be poured in the bearing in such a way that the thickness of the bushing after boring will be uniform.

809.15 BEARING HOUSING. Rubbing and bearing surfaces shall have an ANSI No. 16 surface finish and the joints between cap and base of bearings shall have an ANSI No. 125 finish. Holes in cap and base shall be drilled. Holes in bearings, for bolts fastening them to their supports, shall be drilled or reamed to size for turned bolts as required in Subsection 809.21. Holes in the supports shall be reamed to fit after bearings have been adjusted. Bearings shall be finished on both ends. Trunnion bearings shall be bored parallel with the base.

809.16 GEAR TEETH. Gear teeth transmitting power for operation of the bridge shall be machine cut. The periphery and ends of teeth shall be turned. The pitch circle shall be scribed on the teeth. Rack teeth may be either cast or cut and finished.

Open gears shall be fabricated to AGMA 390.03 standard and AGMA Gear Quality Number 6 or 7.

809.17 BEVEL GEARS. Bevel gear teeth shall be cut by a planer having a rectilinear motion in lines through the apex of the cone. Rotating milling cutters shall not be used for making bevel gears.

Open bevel gears shall be fabricated to AGMA 390.03 and AGMA Gear Quality Number 6 or 7.

809.18 WORMS AND WORM WHEELS. Threads on worms shall be machine cut and worm wheel teeth shall fit the worm accurately with surface or line contact.

Open worms and worm wheels shall be fabricated to AGMA 390.03 and AGMA Gear Quality Number 6 or 7.

809.19 KEY AND KEYWAYS. Keys shall be planed and keyways machine cut. Finish of keys and keyways shall be finished to give the key a Class 6

fit on all sides. Tapered keys shall bear on the top, bottom and sides; parallel faced keys on side only.

809.20 CASTINGS. Castings shall be cleaned and fins and other irregularities removed. Contact surfaces of castings to be attached to structural steel or other castings shall have an ANSI No. 250 finish. Unfinished edges of bases, ribs and similar parts shall be neatly cast with rounded corners. Inside angles shall have proper fillets. Bosses shall be finished to the correct plane. Surfaces of castings in contact with masonry shall have an ANSI No. 2000 finish.

809.21 BOLT HOLES, MACHINE BOLTS AND TURNED BOLTS. Holes for unfinished bolts 1/2 inch diameter or larger, inclusive, shall be drilled or reamed not more than 1/16 inch larger in diameter than the bolt. Holes for unfinished bolts less than 1/2 inch diameter shall be drilled or reamed not more than 1/32 inch larger in diameter than the bolt. Diameter of the shank of turned bolts shall be of such size as to make a Class 5 fit for the holed parts.

809.22 AIR BUFFERS. Workmanship on air buffers shall be so accurate that the weight of the cylinder and its attachments will be sustained by the confined air for 6 minutes, with the cylinder lubricated with a light oil and with a piston travel not more than that which occurs during closure of the bridge. Valves shall be closed and buffers balanced so that the whole weight is carried by the piston rod.

809.23 BRAKES AND BRAKE LININGS. Brake shoes or bands shall be made so as to bear uniformly on the brake wheel. Brake linings shall be attached to the shoes by copper rivets or approved bonding and in such manner as to be easily accessible for replacement.

809.24 RACK AND TRACK. In swing bridges, track segments shall be finished on the top and at ends to an ANSI No. 250 finish. The track centerline shall be scribed on the surface.

Tooth segments forming the rack shall be fitted accurately and installed to AGMA 390.03 and AGMA Gear Quality Number 6 or 7. Care shall be taken to have the pitch of teeth at joints accurate and continuous. Tips of rack teeth shall be machine finished to a true circle. The pitch line shall be scribed on teeth.

Backs of racks which bear on metal surfaces and surfaces in contact with them shall be finished to an ANSI No. 1000 finish. Surfaces which bear on masonry shall have an ANSI No. 2000 finish.

809.25 PIVOT BEARING SEATS. Seats shall be finished to ensure a horizontal position of the span.

809.26 PIVOT BEARINGS. Discs for pivot bearings shall be fitted accurately, finished to gage and ground accurately to final finish. The sliding contact surface of steel and phosphor-bronze discs shall be given an ANSI No. 8 finish. Disc centers shall be assembled, fitted accurately and match-marked.

When specified, rolling element bearings shall be furnished for the pivot. Rolling bearings shall be accurately fitted to the pivot jacket and top. The rotating parts shall be shop assembled and the alignments confirmed. The bearing pivot base and pivot top shall be shipped to the site as an assembly.

809.27 BALANCE WHEELS. The periphery and faces of balance wheels shall be turned to an ANSI No. 250 finish, corners shall be rounded and the centerline of the balance wheels shall be scribed on the periphery. Hubs shall be bored accurately and faced on both ends.

809.28 PLANING GIRDERS. In-built track girders and segmental girders of rolling bascule bridges, the edges of webs, side plates and angles shall be given an ANSI No. 250 finish.

809.29 TREAD PLATES AND TRACK SEGMENTS. Contract surfaces of tread plates and track segments shall be given an ANSI No. 250 finish.

809.30 OIL OR GREASE GROOVES IN TRUNNION BEARINGS. Oil or grease grooves in trunnion bearing surfaces shall be machine cut. After machining, small imperfections may be removed by filing and honing. Grooves shall be smooth, especially the rounded corners.

809.31 BORING AND ASSEMBLY OF TRUNNION BEARINGS. Trunnion bearings to be mounted on flexible supports shall be so bored that when the trunnion girder or support deflects under full dead load, the axes of trunnions will be coincident.

Trunnions shall be fitted to their bearings in the manufacturer's shop. If they are to be disassembled for shipment, they shall be match-marked for field erection.

809.32 SHEAVES. Grooves in sheaves shall be turned. The shape of grooves shall conform as closely as feasible to the rope section so that while ropes run freely in the grooves, the sides of grooves shall prevent wire ropes from flattening under static loads, as when supporting counterweights. Segmental sheaves shall be completely assembled and, if of welded construction, shall be stress relieved before grooves are turned. Variation from required diameter shall not exceed 0.01 inch.

Sheaves shall have an ANSI Class 8 fit on shafts up to and including 10 inches, and an ANSI Class 7 fit on shafts over 10 inches.

Both ends of hub shall be finished as specified.

809.33 HOLES FOR SHEAVE BEARINGS. In vertical lift bridges, holes in girders and columns for bolts connecting main sheave bearings to their supporting members shall be drilled from the solid through cast iron or steel templates on which the bearings were set and accurately aligned when holes in the bearings are bored. Bolt holes and bolts shall be the same diameter. Bolts shall be driven in place without damage to bolts, bearings, girders or columns.

809.34 SHOP ASSEMBLY OF MACHINERY. When specified, machinery parts shall be assembled in the shop on their structural supports. They shall be aligned, adjusted and fitted in their correct relative positions and holes in structural supports shall be drilled to correctly match the holes in machinery parts. Parts shall be match-marked before disassembling and shall be erected in the field in the same relative positions.

When specified, the complete center of swing spans, including rack and track segments, shall be assembled in the shop and aligned, fitted, drilled and the parts match-marked. When specified, the complete gear train shall be assembled in the shop and subjected to a specified time run.

When assembling in the shop is not required, holes in structural supports shall be left blank to be drilled in the field after machinery parts have been set to correct alignment and adjustment or subpunched or drilled 1/4 inch smaller and reamed to size after erection.

Hydraulic power units shall be shop assembled. When specified, hydraulic system components shall be shop assembled into modules. Power units and modules shall be shipped to the bridge site as assemblies after testing. Power units and modules shall be tested in the shop and certified test data submitted to the Bridge Design Engineer. No hydraulic assemblies shall be shipped to the site without test data approval. The contractor shall give the Department 10 calendar days written notice before beginning the test of any equipment, so that inspection may be provided. This inspection shall be at the option of the Department and does not relieve the contractor of any of responsibilities in the contract.

809.35 HYDRAULIC PIPING. Inside of the hydraulic piping shall be bright, clean and free from grease, drainage compounds, oxide, scale and carbon deposits. Any pipe which has been pickled to remove scale shall be treated to eliminate pickle brittleness. The inside of the pipe shall then be coated with clean oil and ends of the pipe sealed for protection against corrosion during shipment and storage. The corrosion preventive oil used shall be such that after extended storage periods, it can be readily removed with an alkaline cleaning solution. Welding of hydraulic pipe shall conform to Section 815.

Hydraulic fluid shall be as specified on the plans. Hydraulic fluid shall be filtered whenever added to the system either for tests, addition of make-up fluid, or original and final system filling. The degree of filtration shall be as specified on the plans.

809.36 PROTECTION OF MACHINERY, POWER PLANT AND TRAFFIC BARRIER PARTS DURING SHIPMENT. Finished rubbing and bearing surfaces of machinery and traffic barrier parts shall be given a protective coating before shipment. Bearing surfaces of trunnions, heavy axles and shafts, in addition to the protective coating, shall be protected by wood lagging securely attached.

Bearing surfaces of other shafts, axles and similar parts shall be covered with burlap or other satisfactory protecting material. Small machinery and traffic barrier parts shall be boxed or crated.

Electrical equipment and apparatus shall be protected by boxes or crates. Electric motors not designed to be operated fully exposed to the weather shall be protected by waterproof coverings.

Hydraulic equipment fluid ports shall be securely sealed prior to shipment and shall remain sealed until final assembly of the hydraulic system. Seals shall not be removed until just before the connection of components.

Modular and power unit components shall be properly supported to prevent damage to flanged joints.

809.37 ERECTION.

(a) Position of Span During Erection: Movable bridges may be erected in either the open or closed position, as approved by navigation authorities and the engineer.

(b) Protection of Machinery, Operator House and Traffic Barrier Parts During Erection: Parts which are protected from weather in the

completed structure or during shipment from the shop also shall be protected during unloading, field storage and erection. Care shall be exercised in protecting electrical parts. Wire ropes shall be stored at least 16 inches above ground and free from conditions likely to produce corrosion of wires or decay of hemp cores. While being unwound or otherwise handled during installation, wire ropes shall not be kinked or bent to short radius curves nor dragged over stones, rough metal surfaces or other material likely to produce abrasions on exposed surfaces of the wires.

(c) General Requirements for Machinery and Traffic Barrier Erection: Alignment and adjustment of machinery, electrical equipment and traffic barriers shall be done by skilled mechanics. Trunnion bearings and important shaft bearings shall be set using piano wire or optical methods to determine their correct adjustment. Alignment of the gear train shall be in accordance with AGMA 390.03.

Shims shall be of sheet steel and brass shim stock. The contractor shall have a supply of shims varying in size and thickness with a minimum thickness of 0.003 inch. Shims shall be used for aligning and adjusting machinery to its proper place prior to securing it rigidly in position with bolts or other fastenings. Brass shim stock shall be used for final adjustment. To prevent localization of stresses in machinery and traffic barrier parts, shims shall not be less in dimensions than the bearing area being shimmed.

Flanges on hydraulic systems shall be welded so that there is no visible deviation from the normal to the pipe axis.

Bolted flange connections on hydraulic piping systems shall be evenly assembled by use of feeler gauges and torque wrenches to ensure equal bolt tightening.

Minor pockets and depressions formed as a result of erection and which may collect moisture or oil shall be drained provided that none of the parts drained are weakened by the drainage openings.

(d) Lubrication: Rotating and sliding parts shall be thoroughly lubricated during erection. All parts shall be properly lubricated before operating machinery is tested. Counterweight and operating ropes shall be given one coat of an approved lubricant.

(e) Camber, General Requirements: When movable bridges are being erected, care shall be taken to set camber blocking to the necessary heights, so that the span will be assembled to proper camber curves when structural parts are unstressed. When the camber blocking is struck and spans swung, all joints shall be 100 percent pinned and bolted so that no slip will occur at connections.

(f) Camber for Swing Spans: When swing spans are erected on camber blocking, blocking shall be set to such elevation as to fulfill the requirements of the plans.

(g) Alignment of Bascule Leaves: Trusses or girders of a bascule span erected in an open position shall be held to correct alignment and position with struts, braces and guys. When required, punching of laterals shall be left blank until the bridge is lowered to permit adjustment of alignment to ensure correct closing and locking.

(h) Alignment and Trunnion Bearings: When full deflection of trunnion girders or bearing supports occur under full dead load, the axes of trunnions shall be coincident.

(i) Alignment of Vertical Lift Spans: Towers and guides shall be vertical when the dead load of the span and counterweight has been applied.

(j) Pressure Testing of Hydraulic Piping Systems: Hydraulic piping systems, after installation but before connection to power units and assemblies, shall be pressure tested in accordance with the plans.

(k) Service Test of Machinery: A service test of power operation of the span shall be made by moving the span through a number of complete open and close cycles. The number of cycles required will be determined by the engineer. These cycles of movement shall be executed in succession without intervals of rest between them. Defects in the operation of the span shall be corrected.

The contractor shall also verify the proper operation of safety devices (limit switches, relief valves, etc.).

After completion of final tests, hydraulic fluid shall be removed, properly discarded, replaced with new fluid, in-line filter elements replaced and air bled from the entire system.

(l) Barriers: Vertical lifting barriers shall be balanced to provide a counterweight heavy condition throughout the entire travel.

809.38 COUNTERWEIGHTS. Counterweights shall be sufficient to balance the moving span and its attachments in any position, except that on vertical lift bridges, the counterweight ropes shall not be balanced.

After all work is completed, the contractor shall balance the span with counterweights. For lift spans, balancing shall be accomplished by noting the traction motor currents required to raise and lower the span. Each traction motor shall be balanced with the corresponding counterweight, and for lift spans both traction motors shall be balanced with each other. During balancing operations, power selsyns shall be deactivated.

When correctly balanced, span motors shall require approximately the same current through span operation.

When span and counterweights are at equal elevations and span controller is placed in the "Drift" position, span should drift slightly and then stop in either the raise or lower operation. If span and counterweights are stopped at equal elevations and the span controller placed in the "Drift" position, the span shall not drift in either direction.

Bascule spans shall be balanced by noting the span pump motor currents required to raise and lower each span. Counterweight blocks shall be added or removed until opening and closing currents are approximately equal.

When spans and counterweights have been properly balanced, balance blocks shall be removed from each counterweight to give spans a small positive reaction in the closed position, as directed. Balancing shall be accomplished in the presence of the engineer.

Counterweights shall be of concrete supported in a steel box or by a steel frame. They shall be made adjustable so that variations in the weight of the movable span may be easily provided by adding or taking off concrete or cast iron blocks in properly located pockets. Concrete blocks weighing not over 100 pounds each shall be used. They shall be provided with eye or ring bolts to facilitate handling. Space for 5 percent under and over the calculated weight shall be provided. Movable blocks shall be provided as specified. Pockets shall be provided with drain holes at least 6 inches in diameter. If counterweights of bascule and vertical lift bridges are located above the floor of approaches, the vertical clearance between counterweights and the floor, curbs, sidewalks or handrails shall not be less than 2 1/2 feet when the bridge is fully open including any overtravel. In calculating the minimum clearance,

counterweight ropes shall be assumed to stretch 2 percent of their calculated length.

Concrete for counterweight and adjusting blocks shall be Class A, conforming to Section 901 weighing approximately 145 pounds per cubic foot. Steel punchings or scrap metal may be used. They shall be placed in layers and grouted with a cement mortar composed of one part portland cement and two parts sand. The maximum available total weight shall not be taken as more than 315 pounds per cubic foot. Such a mixture shall not be used as a counterweight which revolves above a horizontal axis, unless retained in place by surrounding steel box or by walls of reinforced concrete.

The structural steel fabricator shall determine the weight and when it is necessary, location of the center of gravity of the moving span, including all parts attached thereto, and of the counterweights, including their frames. These determinations shall be based on weights computed from approved shop plans and shall include structural steel, machinery, flooring and everything attached to movable parts of the bridge. The adjustment pocket of counterweights is to be assumed 1/2 full when determining the size of counterweights. The contractor shall submit to the Bridge Design Engineer for approval, calculations for determining the weight of concrete for counterweights.

Determination of the proper mixture for counterweights to give the desired unit weight is especially important. A series of tests shall be made well in advance of the time that placing of concrete is to begin to determine the unit weight of concrete which can be obtained from the materials at hand. Test blocks containing at least 1 cubic foot shall be made and a record kept showing the weight of the blocks when cast and when 1, 2, 3 and 7 days old. The engineer shall be notified at least 3 days prior to casting of test blocks. The casting and weighting of blocks shall be done in the presence of the engineer. This record of test blocks shall be submitted for approval before concreting is to begin. These tests shall be made by the contractor in time to have the information available for the fabricator by the time the latter is ready to detail counterweights.

The contractor shall furnish the engineer and fabricator with the unit weight of materials used in the deck. The determination of unit weights shall be made by actually weighing samples of these materials. If the floor is concrete, test blocks shall be made as outlined above to determine the unit weight of the deck slab as constructed.

The contractor shall be responsible for the correctness of the center of gravity calculations and for the detailed drawings of counterweights and construction of counterweights of correct unit weight so that the completed bridge will be in proper balance. The contractor shall be responsible for the balancing of the bridge and shall make necessary adjustments and alterations required to obtain proper balance.

809.39 POWER PLANT. The power plant shall conform to the requirements for Electrical Systems in Section 730.

809.40 OPERATING AND MACHINERY HOUSES. The operating house and machinery house shall be constructed in accordance with the plans. Necessary parts of fittings not shown or specified shall be furnished by the contractor at no direct pay.

809.41 MEASUREMENT.

(a) Movable Bridge Machinery: Movable bridge machinery will be measured on a lump sum basis, which includes all gears (including gears for operating limit switches), shafts, couplings, bearings, castings, wedges, wedge bases, latches, speed reducers, lubricating system, center pivots, racks and tracks for swing spans, bearing discs, balance wheels, trunnions and trunnion bearings, pins, sleeves, sheaves, wire ropes and their sockets and socket pins, bolts, screws, bolts and nuts connecting machinery parts to structural steel, castings which form an integral part of machinery, winding drums, tread plates and castings for segmental girders and track girders for rolling lift spans and their connecting bolts, pistons and cylinders, eccentrics, pinions, ring gears, racks, clutches, brakes other than electrical brakes, rollers, valves, locks, toggles, crank arms, cranks, axles, hooks, bearing liners, wrenches, springs, manually operated roadway traffic gates, mechanically operated position indicators and all other parts and fittings necessary for the satisfactory operation of the bridge which require machine shop work and which are not included in any other class, and all items classified as "Movable Bridge Machinery" on the plans.

(b) Traffic Barriers: Traffic barriers will be measured on a lump sum basis, which includes furnishing all materials and erecting the traffic barriers.

(c) Power Plant: The power plant will be measured on a lump sum basis in accordance with Electrical Systems in Section 730.

(d) Operating House: The operating house will be measured for payment on a lump sum basis, which includes all obviously necessary parts of the house, including furniture and cabinets. If the house is supported on piling, the piling will be measured as provided in Section 804.

(e) Machinery Houses: Machinery houses will be measured for payment on a lump sum basis, which includes all obviously necessary parts of the houses.

(f) Counterweights: Class A concrete in counterweights will be measured by the cubic yard in accordance with Subsection 805.16.

Deformed reinforcing steel or structural steel used in counterweights will be measured as provided in Subsections 806.09 and 807.57.

809.42 PAYMENT. Payment for machinery, traffic barriers, operating house and machinery houses will be made at the lump sum contract prices.

Payment for concrete, reinforcing steel or structural steel used in counterweights will be made as provided in Subsections 805.17, 806.10 and 807.58. Power plant will be made as provided for Electrical System in Subsection 730.09.

Payment will be made under:

Item No.	Pay Item	Pay Unit
809(01)	Movable Bridge Machinery	Lump Sum
809(02)	Traffic Barriers	Lump Sum
809(03)	Operating House	Lump Sum
809(04)	Machinery Houses	Lump Sum

Section 810
Bridge Railings and Barriers

810.01 DESCRIPTION. This work consists of furnishing and constructing bridge railings and barriers.

810.02 MATERIALS. Materials shall conform to Section 1012.

810.03 CONSTRUCTION, FABRICATION, ERECTION AND PAINTING. All construction, fabrication, erection and painting shall conform to Sections 805, 806, 807 and 811 as modified herein.

After completing the deck pour, a minimum of 3 days shall elapse or concrete in the deck slab shall attain a minimum compressive strength of 1600 psi before placing of reinforcing steel and forms for concrete railings. The deck slab shall attain a minimum compressive strength of 3200 psi before pouring concrete railings. Compressive strength cylinders shall be made in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230. The use of curing compounds will not be permitted on concrete railings.

Slip-formed concrete will be permitted, subject to the following provisions. Sliding forms shall be rigidly held together to prevent spreading of forms, and after passing there shall be no noticeable slumping of concrete. Concrete shall be held at a uniform consistency, having a slump of 1/2 inch to 1 1/2 inches. The contractor's proposed slip-form procedures and equipment shall be approved prior to beginning slip-form concrete placement. If, in the opinion of the engineer, the slip-form operation fails to produce satisfactory results, the contractor shall immediately discontinue slip-form operations, shall replace or satisfactorily repair the unacceptable concrete, and shall complete the work using conventional forming methods.

810.04 LINE AND GRADE. Line and grade of the top of the railing or barrier shall be true to that shown on the plans and shall not follow any unevenness in the superstructure. Barrier, railing and curbs shall be normal to roadway cross slope and grade.

810.05 EXPANSION JOINTS. Expansion joints, sawed or formed, shall be so constructed as to permit freedom of movement. After the work is completed, loose or thin mortar likely to spall under movement shall be removed.

810.06 PLACING RAILING: Concrete barrier or railing shall not be placed until centering of falsework for the span has been released, and the span is self-supporting. On continuous spans, railing or barriers shall not be placed until the deck of the continuous unit is completed.

810.07 METAL RAILING. Metal railing shall be adjusted prior to its being fixed in place to ensure proper matching at abutting joints and correct alignment and camber throughout its length. Holes for field connections shall be drilled with the railing in place on the structure at proper grade and alignment.

810.08 MEASUREMENT. Quantities of railings and barriers for payment will be the design lengths as specified on the plans and adjustments thereto. Design quantities for railing include all work constructed above the roadway curb, sidewalk or sidewalk curb. Design quantities of barriers include all work constructed above the roadway. Design quantities will be adjusted if the engineer makes change to adjust to field conditions, if plan errors are proven, or if design changes are made.

Reinforcing steel and hardware for railings and barriers will not be measured for payment.

810.09 PAYMENT. Payment for railing and barriers will be made at the contract unit price per linear foot, subject to the following provisions.

Payment for concrete railing will be made on a lot basis. A lot will be a completed unit or an identifiable pour that is completed in one day.

Payment for each lot will be in accordance with Table 2 of Section 901.

Payment will be made under:

Item No.	Pay Item	Pay Unit
810(01)	Concrete Railing (Type)	Linear Foot
810(02)	Steel Railing	Linear Foot
810(03)	Pipe Railing	Linear Foot
810(04)	Steel and Concrete Railing	Linear Foot
810(05)	Pipe and Concrete Railing	Linear Foot

Section 811
Painting and Protective Coatings

811.01 DESCRIPTION. This work consists of furnishing and applying paints and other protective coatings, including preparation of surfaces.

Unless otherwise specified, an approved 3-coat organic zinc paint system as specified under Subsection 811.03(a) shall be used for coating all metal surfaces requiring painting.

The contractor shall notify in writing the Bridge Design Engineer, and the Consulting Engineer if one is involved, of the approved paint system that will be used on the project prior to submitting required shop drawings. This paint system must be shown on shop or working drawings.

Metal surfaces to be painted shall be cleaned in accordance with the Near-White Blast Cleaning Method described in Subsection 811.06(b).

811.02 SAFETY STANDARDS. The contractor shall comply with Federal, State and local laws, rules and regulations concerning construction safety and health standards and all requirements of Section 107. Appropriate respiratory protective devices shall be provided by the contractor and shall be used. Respiratory equipment, including hood type respirator with external air supply to hood, shall meet the approval of the U.S. Bureau of Mines.

811.03 MATERIALS.

(a) The 3-Coat Organic Zinc Primer and Topcoat System shall conform to Subsection 1008.02. The contractor has the option of using any one of these systems; however, no modification or combining of systems will be permitted and the same system shall be used throughout the project.

(b) The Coal Tar Epoxy-Polyamide Paint System shall conform to Subsection 1008.04.

(c) Cold galvanizing repair compound shall conform to Subsection 1008.06.

811.04 PAINTING METAL. All metal surfaces shall be painted with the 3-coat organic zinc paint system unless painting would interfere with proper operation of movable metal parts.

When field welded connections are required, areas to be welded shall be masked before shop painting of members and painted after welding.

Control desks and switchboards shall be painted as described on the plans. Equipment mounted on control desks and switchboards shall not be painted.

Preassembled and precoated parts shall be treated with one coat of wash primer conforming to SSPC-Paint No. 27 at a dry film thickness of 0.5 to 1.0 mil prior to application of topcoat.

When required, galvanized, sherardized or metallized surfaces of sheet metal, electrical conduit, and water, air and gas pipes that are exposed and visible shall be painted. Surfaces to be painted shall be treated with one coat of wash primer conforming to Subsection

811.09(a)(3), at a dry film thickness of 0.5 to 1.0 mil prior to application of topcoat. Other galvanized, sherardized or metallized surfaces shall not be painted.

Metal surfaces to be encased in concrete shall be painted with a minimum of one prime coat, the top coat will not be allowed. Painting of aluminum surfaces will not be required.

(a) 3-Coat Organic Zinc Primer and Topcoat Systems: The minimum dry film thickness of each coat shall be as follows:

1st Prime Coat (Tinted Red)	3.0 mils
2nd Prime Coat (Tinted Green)	2.0 mils
Vinyl Aluminum Topcoat	2.0 mils

(b) Coal Tar Epoxy-Polyamide System: The minimum dry film thickness of coatings shall be as follows:

1. 1st Coat	8.0 mils
2. Final Coat	8.0 mils

811.05 WEATHER LIMITATIONS. Paint shall be applied on thoroughly dry surfaces and during periods of favorable weather with the relative humidity being below 85 percent. Painting will not be permitted when the surface temperature is less than 5°F above the dew point, the wind velocity is 15 mph or the ambient air temperature is below 50°F in the shade and away from artificial heat except as provided in this Subsection for enclosures. When fresh paint is damaged by the elements, it shall be replaced by the contractor at no direct pay.

Painting shall not be applied unless the surface temperature of the metal is at least 45°F and rising, and shall not exceed manufacturer's recommendations or be hot enough to cause the paint to blister and produce a porous paint film, whichever is less.

Subject to approval in writing, the contractor may provide and maintain suitable enclosures to permit painting during inclement weather at no direct pay. Provisions shall be made to control atmospheric conditions inside the enclosure within limits suitable for painting throughout the painting operation.

811.06 CLEANING OF SURFACES.

(a) General: Metal surfaces to be painted or coated shall be abrasive blast cleaned in accordance with Heading (b) and shall produce an anchor pattern from 1 to 3 mils.

When steel abrasive blasting is used, the abrasive mixture shall have a minimum of 25 percent by volume of approved grit material. Grit size shall be SAE G-25 with a minimum hardness of 45, Rockwell "C" Range.

Surfaces of a casting shall be blast cleaned before the casting is machined.

Weld spatter and other undesirable materials shall be removed and sharp edges ground smooth prior to blast cleaning. All abrasive blasting equipment shall be equipped with an oil/moisture trap with replaceable cartridges (filters) located between the air supply and the pressure pot.

(b) Near-White Blast Cleaning Method: This method prepares metal surfaces for painting or coating by the use of abrasives propelled through nozzles or by centrifugal wheels.

(1) Definition: The near-white cleaned surface is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides or slight and tight residues of paint or coating. At least 95 percent of each square inch of surface area shall be free of visible residues and the remainder shall be limited to the light discoloration mentioned above.

(2) Procedures: Near-White Cleaning shall be in accordance with SSPC-SP 10 with the following modifications. Rate of blast cleaning may vary from one area to the next to achieve the desired pattern. The use of recycled steel abrasive blasting materials will be permissible, provided anchor pattern requirements are met and adhesion is not compromised. Blast cleaned surfaces shall be painted before rusting occurs, preferably within 8 hours after blasting. Blast cleaned surfaces shall be painted the same day or reblasted. Occurrence of rusting after cleaning shall be cause for recleaning by blasting or other cleaning methods as directed.

(3) Safety Precautions: Safety precautions shall be in accordance with SSPC-SP 10.

(c) Commercial Blast Cleaning Method: This method prepares metal surfaces for painting or coating by the use of abrasives propelled through nozzles or propelled by centrifugal wheels.

(1) Definition: The commercial blast cleaned surface is defined as one from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale and old paint have been completely removed except for slight shadows, streaks or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain; if the surface is pitted, slight residues of rust or paint may be found in the bottom of pits; at least 2/3 of each square inch of surface area shall be free of visible residues and the remainder shall be limited to the light discoloration, slight staining or tight residues mentioned above.

(2) Procedures: Procedures for Commercial Blast Cleaning shall be in accordance with SSPC-SP 6.

(3) Safety Precautions: Safety precautions shall be in accordance with SSPC-SP 6.

(d) Prior to the application of paint, blast cleaned surface shall be cleaned of excess abrasive using compressed air that has been filtered by an approved oil/moisture trap.

811.07 PROTECTION OF THE PUBLIC AND WORK. The contractor shall protect the public and all parts of the work against disfigurement by spatters, splashes and smirches of paint materials and damage caused by surface preparation. The contractor shall be responsible for damage caused by the contractor's operations to vehicles, persons or property, including plants and animals. The contractor shall provide protective measures to prevent such damage.

Paint stains which result in an unsightly appearance shall be removed or obliterated by the contractor at no direct pay.

When traffic causes an objectionable amount of dust, the contractor shall alleviate the dust for the necessary distance on each side of the work and take other precautions necessary to prevent dust and dirt from

coming in contact with freshly painted surfaces or with surfaces before paint is applied.

811.08 MIXING OF PAINT. Except as otherwise specified in Section 1008, paint shall be premixed at the factory. Paint shall also be mechanically field-mixed before applying and shall be mechanically agitated sufficiently while being used to keep pigments in uniform suspension.

811.09 APPLICATION.

(a) 3-Coat Organic Zinc Primer and Topcoat System: Primer and topcoat paint shall be applied with airless or conventional spray equipment. The spray equipment shall apply paint in a fine, even spray. If thinning of paint is allowed, it shall be done in accordance with the paint manufacturer's recommendations, but shall not exceed the limitations specified in Subsection 1008.02. An approved oil/moisture trap shall be placed between air supply and pressure pot, and regulators and gages shall be provided for both air supply and pressure pot. Fluid pressure shall be regulated to deliver a uniform and wet coat of material from the spray gun.

On surfaces inaccessible to spray equipment, paint shall be applied with brushes or approved daubers to insure coverage.

Film thickness measurements will be made with an approved dry film thickness tester. Measurement of dry film thickness will be made by adjusting the approved measuring device to read 3 mils on a 3-mil shim placed on the blast surface. Since different readings will be obtained at various places, the devices will be adjusted so that the average reading for a section is 3 mils. Other approved thickness measurement instruments which allow for the direct measurement of thickness of various coats of paint will be allowed. These instruments typically do not require calibration since they normally employ magnification and measuring scales.

(1) Primer: Primer for new steel shall be applied after fabrication and the two prime coats shall be applied at the shop.

Each prime coat shall be cured at least 72 hours before the next coat of primer or topcoat is applied. The maximum time between application of the first and second prime coats shall be 7 calendar days. The curing times shall be the cumulative time that the ambient air temperature is 50°F or above.

Potlife of the primer shall not exceed limits specified by the manufacturer, but in no case shall the potlife exceed 12 hours. When the limit is reached, the spray pot must be emptied, material discarded, and new material mixed.

Before application of subsequent coats of paint, all surfaces shall be cleaned of any dirt, dry spray, overspray or other residue.

(2) Field Spot Painting: Damaged areas or other surfaces to be field primed or painted shall be blast cleaned and painted with the approved organic zinc primer and/or top coat to a minimum dry film thickness of 5.0 mils for primer and 2.0 mils for topcoat. Surface preparation shall be the same as required under Subsection 811.06. Primer shall be allowed to cure 72 hours prior to application of topcoat.

(3) Topcoat: Topcoat paint for new steel may be applied after field erection, field spot painting and cleaning of primer surfacing or may be applied in the shop.

Dust film, dry spray, overspray or other residue shall be removed prior to painting. The use of sandpaper for cleaning is acceptable, provided the minimum dry film thickness of primer remains.

Maximum time between application of the second prime coat and the topcoat shall be 4 months. If more than 4 months have elapsed after application of the second prime coat, a vinyl wash primer shall be sprayed on surfaces to be topcoated to a dry film thickness of 0.3 to 0.7 mil. The topcoat shall be applied to the wash primer the same day, after allowing the wash primer to dry thoroughly. Any wash primer not topcoated the same day shall be removed by approved methods and a new coat of wash primer shall be applied. The wash primer shall conform to SSPC Paint No. 27 except the requirement for the ratio of pigment to non-volatile vehicle shall not apply.

Topcoat shall be applied at the specified minimum film thickness. Where members are found low in film thickness, the entire member shall be recoated. The contractor shall exercise the necessary controls to eliminate laps, sags, overspray patterns and other undesirable characteristics.

(b) Coal Tar Epoxy-Polyamide System: Coal tar epoxy-polyamide paint shall be applied in accordance with the paint manufacturer's recommendations. Recoat time shall be in accordance with manufacturer's recommendations, but in all cases, the application of the second coat shall be within 24 hours unless cold temperatures have affected the cure of the first coat.

811.10 SHOP PAINTING.

(a) Surfaces to be Painted: When fabrication and cleaning are completed, surfaces not painted during assembly shall be painted with one coat of the specified paint before damage occurs to the cleaned surface from weather or other exposure. Shop and field contact surfaces shall be prepared as specified in Subsection 807.22(e). Where paint would be detrimental to field welding operations, the surface shall not be shop painted within a suitable distance from edges to be welded or spliced.

(b) Erection Marks: Erection marks shall be painted on surfaces with a compatible paint of contrasting color.

(c) Loading: Material shall not be loaded for shipment until paint is dry.

(d) Inaccessible Surfaces: Surfaces not to be in contact, but which will be inaccessible after assembly or erection, shall receive the complete paint system prior to assembly or erection.

(e) Machine Finished Surfaces: With the exception of abutting chord and column splices, rocker shoes and bases, and column and truss shoe bases, machine finished surfaces shall be coated with an approved protective coating as soon as practical after being accepted and before removal from the shop. Surfaces of iron and steel castings which are machine finished for the purpose of removing scales, fins, blisters or other surface deformations shall be painted with the specified paint system.

(f) Pins and Pin Holes: Pins and pin holes shall be given a coat of an approved protective coating. The protective coating shall be removed and replaced with a graphite coating prior to erection.

811.11 FIELD PAINTING. As soon as surfaces have been cleaned to the satisfaction of the engineer, heads of field rivets and bolts and any surfaces from which the shop coats of paint have been worn off or have otherwise become defective shall be covered with two coats of the same paint used in the shop in accordance with Subsection 811.09(a)(1). When

the paint applied for touching up rivet or bolt heads and abraded surfaces has dried, the field coat may be applied. No coat shall be applied until the previous coat has dried throughout the full thickness of paint film.

The field coat of paint shall not be applied to the steel work below the highway floor level until the concrete roadway slab has been completed and metalwork cleaned. If concreting operations have damaged the paint, the surface shall be cleaned and spot primed as directed.

During pouring of decks, the contractor shall keep steel members clean by washing and shall remove any materials that adhere to the surface and mar the finish of the steel members.

811.12 SPECIAL STENCILING. The date (month and year) of painting and type of paint system used shall be stenciled at two locations determined by the engineer on all structures in block letters 2 1/2 inches high. The paint used shall form a contrast with the background and shall be compatible with the paint system used.

811.13 PAINTING LUMBER AND TIMBER. Lumber and timber requiring painting shall be satisfactorily cleaned and painted with three coats of the specified paint. If not specified, the paint to be used will be selected by the engineer. Treated timber to be painted shall be processed in accordance with Subsection 1014.04(c).

All applicable requirements of this section shall apply to the painting of lumber and timber.

811.14 PAINTING GALVANIZED SURFACES. Galvanized surfaces shall be prepared for painting by applying a vinyl wash primer coat as specified in Subsection 811.09(a)(3).

811.15 GALVANIZING. The following criteria shall be properly controlled and shall meet standards that are satisfactory for the galvanizing process.

1. Defects arising from fabrication
2. Thickness and uniformity of coating
3. Adherence of coating
4. Appearance
5. Embrittlement

Handling, stacking, transporting and erecting galvanized parts shall be done in such manner as to protect the coating and its appearance.

Galvanized parts shall be assembled with nonabrasive equipment.

Drip holes shall be satisfactorily plugged.

Galvanizing of products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips, 1/8 inch thick and heavier, shall conform to ASTM A 123. Galvanizing shall be performed after fabrication into the largest practical sections. Fabrication shall include all operations such as shearing, cutting, punching, forming, drilling, milling, bending, welding and riveting. Components of bolted assemblies shall be galvanized separately before assembly. When it is necessary to straighten sections after galvanizing, such work shall be performed without damage to the zinc coating.

Galvanizing of iron and steel hardware shall conform to ASTM A 123 and A 153 or shall be accomplished by an approved mechanical galvanizing method conforming to ASTM B 695 that provides the same thickness of coating. Galvanizing shall be performed after fabrication of hardware. Components of bolted assemblies shall be galvanized separately before assembly.

Galvanized surfaces that are abraded or damaged after application of the zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing loose and cracked coating, after which the cleaned areas shall be repaired by application of an approved cold galvanizing repair compound. Zinc coating by the metallizing process may be allowed when approved.

The galvanizer shall utilize all of the options available to prevent "white rust" from occurring. However, should "white rust" occur and in the opinion of the engineer it is excessive or unsightly it shall be cause for rejection. Should rejection of the product occur the galvanizer or contractor shall have prior approval before taking any corrective action.

811.16 METALLIZING OF METAL PARTS AND SURFACES. When specified, metallizing shall be performed in accordance with AWS C 2.2 and thickness of the sprayed zinc coat shall be a minimum of 5 mils. The method of applying the zinc coating shall be approved prior to application.

811.17 MEASUREMENT AND PAYMENT. No measurement or payment will be made for painting or any protective coating.

Section 812
Untreated and Treated Timber

812.01 DESCRIPTION. This work consists of furnishing lumber of the sizes and grade specified and of furnishing timber of the stress-grade, sizes and dimensions for the different uses specified, treated or untreated, and of preparing, framing, assembling and erecting the same, including painting where specified, and all hardware.

812.02 MATERIALS. Materials shall conform to the following Subsections:

Castings	1013.05(a), 1013.06(a)
Structural Timber and Lumber	1014.01
Preservatives	1014.03
Treatment	1014.04
Connectors	1018.07
Hardware and Structural Shapes	1018.08
Roofing Pitch	1018.13

812.03 SPECIES OF WOOD.

(a) Permanent Structures: Timber and lumber used in permanent bridges, bridge fenders and bulkheads may be either Douglas Fir or Southern Yellow Pine, provided the same species is used throughout each structure, except in bridge structures as hereinafter provided.

Caps and stringers for bridges may be either fir or pine; however, all caps and stringers furnished for any structure shall be the same species. Timber and lumber shall not be used in exposed structures without preservative treatment.

(b) Temporary Structures: Temporary bridges shall conform to Section 725. All other temporary structures may be any satisfactory species and grade of timber.

812.04 STORAGE OF MATERIAL. Lumber and timber stored on the site shall be kept in orderly stacks. Untreated material shall be openstacked on supports at least 12 inches above ground, and shall be so stacked and stripped as to permit free circulation of air between tiers and courses. When directed, protection from the weather by suitable covering will be required.

812.05 TREATED TIMBER.

(a) Workmanship: Nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and sufficient cause for removal of the workman causing them.

(b) Surfacing: Lumber and timber, except bulkhead planks and sway bracing, shall be S4S.

(c) Handling: Treated timber shall be handled with rope slings, without dropping or breaking of outer fibers, bruising, or penetrating the surface with tools.

(d) Framing and Boring: Cutting, framing and boring of treated timbers shall be done before treatment insofar as practical. When treated timber is to be placed in waters infested by marine borers, untreated cuts, borings or other joint framings below highwater elevation shall be avoided.

(e) Installation of Timber Connectors: The split ring and the shear plate shall be installed in precut grooves of dimensions as specified or as recommended by the manufacturer. The toothed ring and the spike grid shall be forced into contact surfaces of the timbers joined by means of pressure equipment. Connectors of this type at a joint shall be embedded simultaneously and uniformly. Fabrication of structures using connectors shall be done prior to treatment. Bolt holes shall not be more than 1/16 inch larger than bolt diameter and shall be bored perpendicular to the face of the timber.

Timber, after fabrication, shall be stored in a manner which will prevent changes in dimensions of members before assembly.

Dimensions of materials and details not specified shall be subject to approval.

(f) Cuts and Abrasions: Cuts and abrasions in creosoted piles or timbers, after having been carefully trimmed, shall be covered with two applications of creosote conforming to Subsection 1014.03(e) and covered with hot roofing pitch.

Cuts and abrasions in timbers treated with other preservatives shall be repaired with the same preservative.

(g) Bolt Holes: Holes bored in pressure-treated material shall be filled with preservative. Unused bore holes and spike holes shall be poured full of preservatives and plugged with tight-fitting treated plugs.

(h) Temporary Attachment: When, with the approval of the engineer, forms or temporary braces are attached to treated timber with nails or spikes, holes shall be filled by driving galvanized nails or spikes flush with the surface or plugged as required for bolt holes.

812.06 TREATMENT OF PILE HEADS.

(a) General: Pile heads, after cutting to receive caps and prior to placing caps, shall be treated to prevent decay. Pile heads to be encased in concrete will not require treatment.

Immediately after making final cut-off on treated timber foundation piles, the cut area shall be given two liberal applications of preservative followed by a heavy application of coal-tar pitch or other approved sealer. Heads of treated timber piles in bents or where the cut-off is exposed shall be protected by one of the following methods, as specified. If not specified, galvanized metal coverings shall be used.

(b) Galvanized Metal Coverings: The sawed surface shall be thoroughly brush coated with two applications of hot creosote oil, after which there shall be placed two layers of heavy canvas size 20 by 20 inches saturated with hot asphalt, followed by 24 by 24 inches 28 gage galvanized metal cover. The cover shall be bent down over the pile at an angle of approximately 45°.

(c) Fabric Covering: Heads of treated piles shall be covered with alternate layers of hot pitch and loosely woven fabric conforming to AASHTO M 117, using four applications of pitch and three layers of fabric. The cover shall measure at least 6 inches 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 at least seven complete turns of galvanized wire securely held in place by large-headed galvanized nails and staples. Edges of fabric projecting below the wire wrapping shall be trimmed to present a workmanlike appearance.

Heads of untreated piles shall be thoroughly brush coated with two applications of Creosote conforming to Subsection 1014.03(e).

812.07 HOLES FOR BOLTS, DOWELS, RODS AND LAG SCREWS. Holes for drift-bolts and dowels shall be bored 1/16 inch less in diameter than bolt or dowel. For square drift bolts or dowels, the diameter of the bored hole shall be equal to the least dimension of the bolt or dowel.

Holes for machine bolts shall be bored the same diameter as the bolt.

Holes for rods shall be bored 1/16 inch greater in diameter than the rod.

Holes for lag screws shall be bored not larger than the body of the screw at the base of the thread.

812.08 BOLTS AND WASHERS. A washer of the size and type specified shall be used under bolt heads and nuts which would otherwise come in contact with wood. Stacked washers will not be permitted. Bolts shall not project more than 1 inch beyond the nut on work securely tightened. Long bolts shall be saw-cut or clipped, ground smooth and repaired as specified in Subsection 811.15.

Nuts of bolts shall be locked after they have been tightened.

812.09 COUNTERSINKING. Countersinking shall be done when smooth faces are required. Horizontal recesses formed for countersinking shall be painted with creosote conforming to Subsection 1014.03(e) and, after bolt or screw is in place, filled with hot pitch.

812.10 FRAMING. Lumber and timber shall be accurately cut and framed to a close fit in such manner that joints will have even bearing over the contact surfaces. No shimming will be permitted in making joints nor will open joints be accepted. Mating pieces shall be tightly bound or clamped in position prior to drilling bolt holes.

812.11 PILE BENTS. Piles shall be driven in accordance with Section 804.

812.12 FRAMED BENTS.

(a) Mud Sills: Timber mud sills shall be of heart cedar, heart cypress, heart redwood, treated southern yellow pine, or treated fir. Mud sills shall be firmly and evenly bedded to solid bearing and tamped in place.

(b) Concrete Pedestals: Concrete pedestals for support of framed bents shall be finished so that sills or posts will take an even bearing on them. Dowels of at least 3/4 inch diameter and projecting at least 6 inches above the tops of pedestals shall be set in them when they are cast for anchoring sills or posts.

(c) Sills: Sills shall have true and even bearing on mud sills, piles or pedestals. They shall be drift-bolted to mud sills or piles with bolts of at least 3/4 inch diameter and extending into mud sills or piles at least 6 inches. When possible, all earth shall be removed from contact with sills.

(d) Posts: Posts shall be fastened to pedestals with dowels of at least 3/4 inch diameter, extending at least 6 inches into the post. Posts shall be fastened to sills by one of the following methods:

(1) By dowels of at least 3/4 inch diameter, extending at least 6 inches into posts and sills.

(2) By drift-bolts of at least 3/4 inch diameter driven diagonally through the base of post and extending at least 9 inches into sill.

812.13 CAPS. Timber caps shall be placed, with ends aligned, in a manner to secure uniform bearing over tops of supporting posts or piles. Caps shall be secured by drift-bolts of at least 3/4 inch diameter extending at least 9 inches into posts or piles. Drift-bolts shall be approximately in center of the post or pile.

812.14 BRACING. Ends of bracing shall be bolted through pile, post or cap with a bolt of at least 5/8 inch diameter. Intermediate intersections shall be bolted or spiked with wire or boat spikes. Spikes shall be used in addition to bolts.

812.15 STRINGERS. Stringers shall be sized at bearings and placed in position so that knots near edges will be in top portions of stringers.

Outside stringers may have butt joints with ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of floor beam or cap at each end. Lapped ends of untreated stringers shall be separated at least 1/2 inch and shall be securely fastened by drift-bolting where specified. When stringers are two panels in length, joints shall be staggered.

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 sides of stringers. Cross-bridging shall be placed at the center of each span.

812.16 PLANK FLOORS. Single plank floors shall consist of a single thickness of plank supported by stringers or joists. Planks shall be laid heart side down, with 1/4 inch openings between them for seasoned material and with light joints for unseasoned material. Each plank shall be securely spiked to each joist. Planks shall be graded as to thickness and so laid that no two adjacent planks vary in thickness by more than 1/16 inch.

Two-ply timber floors shall consist of two layers of flooring supported on stringers or joists. The lower course shall be pressure-treated with creosote oil. The top course may be laid either diagonal or parallel to the centerline of roadway, as specified, and each floor piece shall be securely fastened to the lower course. Joints shall be staggered at least 3 feet. If the top course is placed parallel to the roadway centerline, care shall be taken to securely fasten ends of flooring. At each end of the bridge, these members shall be beveled.

812.17 LAMINATED OR STRIP FLOORS. Strips shall be placed on edge at right angles to the roadway centerline. Each strip shall be spiked to the preceding strip at each end and at approximately 18-inch intervals, with the spikes driven alternately near the top and bottom edges. Spikes

shall be of sufficient length to pass through two strips and at least halfway through the third strip.

If timber supports are used, every other strip shall be toe-nailed to every other support. When specified, strips shall be securely attached to steel supports with approved galvanized metal clips. Care shall be taken to have each strip vertical and tight against the preceding one and bearing evenly on supports.

812.18 COMPOSITE WOOD-CONCRETE DECKS.

(a) Slab Spans: When wood and concrete are to be used compositely, the joining of the two materials shall be such as to resist all horizontal shear at that plane and provision shall be made to prevent separation of materials.

Horizontal shear may be resisted by metal devices set into and projecting above the top of laminated strips or by fabricating the upper edge of strips in a serrated manner.

Separation of materials may be resisted by nails driven at an angle in the upper edge of strips or by other suitable devices, or by grooves or other working of upstanding strips.

(b) T-Beams: Spans consisting of concrete slabs placed on wood stringers may be designed as T beams when the two materials are suitably joined to resist horizontal shear at their junction and materials are bonded permanently together.

A horizontal shear joint may be made using metal devices or by serrating tops of stringers.

Separation of concrete from stringers may be prevented by driving nails in top of stringers at an angle or by other suitable metal devices or by grooving sides of stringers near the top or other working of the wood and then forming the concrete into patterns worked in the wood.

812.19 WHEEL GUARDS AND RAILING. Wheel guards and railing shall be framed in accordance with the plans and erected true to line and grade. Wheel guards shall be laid in sections at least 12 feet long.

812.20 TRUSSES. Trusses, when completed, shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and, in vertical projection, shall show a smooth curve through panel points conforming to correct camber. All bearing surfaces shall fit accurately.

812.21 TRUSS HOUSING AND RAILINGS. Unless otherwise directed, housing and railings shall be built after removal of falsework and adjustment of trusses to correct alignment and camber. Workmen wearing shoes with cleats will not be permitted on the roof.

812.22 PAINTING AND PROTECTIVE COVERINGS. Parts of structures to be painted will be as specified. Metal parts not galvanized shall be painted in accordance with Section 811.

When timber decks are provided, top flanges of stringers and floor beams shall be protected by a covering composed of a heavy layer of asphaltic material (tar, asphalt or pitch) applied hot and one thickness of 2-ply tar paper wide enough to project 3 inches beyond edges of members. These edges shall be bent down at an angle of approximately 45°.

812.23 MEASUREMENT. Quantities of timber for payment will be the design quantities and adjustments thereto. The design quantities are based on the number of thousand board feet of timber in the completed work. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary. Hardware will not be measured for payment. Metal parts not classified on the plans as hardware will be measured and paid for in accordance with Section 807.

812.24 PAYMENT. Payment for timber will be made at the contract unit price per thousand board feet (MFBM). Payment will be made under:

Item No.	Pay Item	Pay Unit
812(01)	Untreated Timber	MFBM
812(02)	Treated Timber	MFBM

Section 813
Concrete Approach Slabs

813.01 DESCRIPTION. This work consists of furnishing and constructing concrete approach slabs for bridges and other structures in accordance with the details, locations and dimensions shown on the plans.

813.02 MATERIALS. Materials shall conform to the following Sections and Subsections:

Portland Cement Concrete	901
Bedding Material	1003.08
Joint Materials	1005
Plastic Underdrain Pipe	1006.08
Deformed Reinforcing Steel	1009.01
Polyethylene Film	1011.01(d)
Timber Piling	1014
Hardware Cloth	1018.22
Geotextile Fabric	1019.01
Geocomposite Drainage Systems	1019.02

Bedding material shall be either shell, stone, or recycled portland cement concrete.

813.03 EMBANKMENT. The entire embankment affecting the construction of the abutment shall be constructed to grade in accordance with Section 203 before building the end bent or bridge abutment. A surcharge shall be constructed in areas where designated fill heights will result in settlement. The plans will indicate the amount of surcharge and length of time to remain in place. The surcharge will be removed prior to driving piles for end bent.

Geotextile fabric shall be placed as a separation layer between the embankment and the bedding material beneath the approach slab in accordance with Subsection 203.11. No equipment will be allowed on the fabric unless there is at least 6 inches of cover.

When specified, the approach slab subgrade shall be placed on a layer of bedding material placed in accordance with plan details. Bedding material shall be placed and compacted as directed and covered with approved polyethylene film of at least 6-mil nominal thickness.

813.04 DRAINAGE SYSTEMS: Drainage systems shall be constructed in accordance with Section 703.

813.05 REINFORCING STEEL. Reinforcing steel shall conform to Section 806.

813.06 BEARING PILES. When shown in the plans, the approach slab shall be supported on bearing piles in accordance with Section 804.

813.07 CONCRETE. Concrete for pile-supported approach slabs shall be Class AA. Concrete for all other approach slabs shall be Class A or one of the concrete pavement types. The slabs shall be constructed in accordance with Section 805.

Portland cement concrete headwalls for perforated pipe shall conform to Section 901, Class M concrete constructed in accordance with plan details.

Curing shall conform to Subsection 601.10. Surface tolerances shall conform to Subsection 805.13(e)(2).

Joints shall conform to Section 601.

813.08 ROADWAY FINISH. The roadway shall be given a metal tine texture finish. Surface finishing operations shall be performed in accordance with Subsection 601.08(h).

813.09 MEASUREMENT. Quantities of concrete approach slabs for payment will be the design areas as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Design quantities are based on horizontal dimensions shown on the plans. Required reinforcing steel, bearing piles, joint materials, bedding materials, surcharge material, geotextile fabric, polyethylene film, plastic underdrain pipe, geocomposite drainage system, rodent screen and headwalls will not be measured for payment.

813.10 PAYMENT. Payment for concrete approach slabs will be made at the contract unit price per square yard subject to the following provisions:

Acceptance and payment for concrete approach slabs will be made on a lot basis. A lot will be considered as a complete approach slab or an identifiable pour that is completed in one day. Two random batches will be sampled for each lot, and three cylinders molded for each batch. The six cylinders per lot will be tested for compressive strength in 28 to 31 days. In the event of sudden cessation of operations, a minimum of three cylinders will constitute a lot. Acceptance and payment for each lot will be made in accordance with Table 2 of Section 901. If one of the Types of pavement concrete is used, payment adjustments as specified for Class A concrete will be applied.

Payment will be made under:

Item No.	Pay Item	Pay Unit
813(01)	Concrete Approach Slabs	Square Yard
813(02)	Concrete Approach Slabs (Pile Supported)	Square Yard

Section 814
Drilled Shaft Foundations

814.01 DESCRIPTION. This work consists of furnishing and constructing foundations of reinforced concrete shafts with or without bell type concrete footings in accordance with the plans and these specifications or as directed. Concrete shafts shall be placed in drilled excavation when shafts are without bell type footings and in drilled and underreamed excavation when shafts are with bell type footings.

814.02 MATERIALS. Materials shall conform to the following Sections and Subsections. Concrete shall be Class S with a water reducing, set retarding admixture.

Portland Cement Concrete	901
Granular Material	1003.07
Reinforcing Steel	1009

814.03 CONSTRUCTION REQUIREMENTS.

(a) Experience Requirements: Prior to beginning drilled shaft construction, the contractor shall submit in writing to the engineer for approval information showing experience in constructing the types of shafts required and the equipment and techniques proposes for use in constructing the shafts.

(b) Drilling: The contractor shall perform the drilling required for shafts and bell footings, through whatever materials are encountered. When satisfactory material is not encountered at plan tip elevation, the bottom of the shaft will be adjusted, or the foundation altered, as directed. Shafts shall be bored plumb to a tolerance of 1/4 inch per foot from vertical or from the batter shown on the plans. For shafts supporting single columns, the center shall lie within 3 inches of plan location. For foundation shafts, the center shall be within a 12-inch diameter circle having the plan location as its center. Bells, when required, shall be excavated to form a bearing area of the size and shape shown on the plans.

Shafts and bells shall be excavated by mechanical methods. Blasting may be used only with written permission and shall be so controlled as to avoid disturbance of the formations below or outside the proposed shaft.

When caving occurs or excess ground water is encountered, no further drilling will be allowed until a construction method is approved which will prevent caving. Slurry displacement method will only be allowed when seepage water cannot be cutoff by using other methods of construction. The slurry displacement method shall be in accordance with Heading (c).

Casings will be required for shaft excavations when necessary to prevent caving of material or to shut off seepage water. Casings shall be of sufficient strength to withstand handling stresses and the pressure of concrete and surrounding earth or backfill materials, and shall be watertight.

The diameter of the casing shall not be less than required to obtain the specified shaft diameter for the full length of the shaft. Drilling slurry, if used in conjunction with casing, shall be removed from the shaft hole prior to placing concrete. Casing shall be smooth, clean and free of accumulations of hardened concrete. A vibratory hammer or vibratory extractor will be allowed for the placement and/or removal of casing with approval.

If the elevation of the top of shaft is below ground at the time of concrete placement, an oversize surface casing from ground elevation to a point below the top of shaft shall be used to prevent caving of materials into fresh concrete. Surface casing shall not remain in place unless permitted. It shall not be extracted until completion of concrete placement.

Excavation for footing bells or shafts beyond the lines required by plan dimensions, where casings are not required, shall be backfilled with Class S concrete at no direct pay. When casings are used, the contractor will be permitted to backfill around the upper portion of casing with approved granular material. Where a double casing is required for a portion of the shaft, the area between casings shall be filled with Class S concrete. Casing removal shall not be started until shaft concrete placement is completed. Movement of the casing for short pulls of a few inches or rotating the casing to insure the breaking of the bond of concrete to the casing will be permitted. When conditions warrant, the casing may be pulled in stages. A sufficient head of concrete shall be maintained above the bottom of the casing to overcome hydrostatic pressure. At least two points of connection to the casing will be required for removal. Extraction of the casing shall be at a slow, uniform rate and the pull shall be concentric with the centerline of the shaft. If upward movement of concrete or steel inside the casing occurs during the pulling operation, the following criteria shall govern:

(1) When the upward movement is 1 inch or less, the casing may be left in place and the shaft used if concrete is reconsolidated. Vibration or rodding shall not be used to break the casing loose for extraction unless the entire shaft is to be replaced.

(2) When the upward movement is greater than 1 inch, all material shall be removed and the shaft redone.

Casings shall not remain in place unless the shafts were designed for end bearing only or unless permitted.

Drilled shaft concrete shall not be placed underwater without approval. When such permission is granted, concrete shall be placed underwater in accordance with Subsection 805.05.

Material excavated from shafts and bells, and not used elsewhere on the project, shall be disposed of in accordance with Section 202.

The bottom of the shaft hole shall be cleaned with a cleanout bucket or other appropriate tool. When a cleanout bucket is used, it shall be equipped with a one-way flap gate that prevents spoil in the bucket from re-entering the shaft.

When concrete is placed, the drilled hole and base shall be free from accumulated seepage water, and loose material shall be removed from the base. The contractor shall provide suitable access and lighting for the engineer to inspect the completed drilled hole and base and check the dimensions and alignment of drilled shafts and the bell (when underreaming is required).

Provisions shall be made for pumping fresh air to workmen and inspectors in the drilled hole and base hole. Any required lighting shall be by electric lights. The use of internal combustion engines placed in the drilled hole and base for pumping or drilling will not be permitted.

When directed, the contractor shall make soundings or take borings to determine the character of supporting materials at no direct pay. The depth of such soundings or borings will not be required to extend more than 5 feet below tip elevation.

Bridge end embankments shall be completed prior to drilling for end bent shafts.

(c) Slurry Displacement Method: The slurry displacement method is defined as a construction procedure whereby the sides of the excavation are supported by a specified slurry, which is then displaced by concrete to form a continuous concrete shaft. This method can only be used with approval when a dry hole cannot be obtained by other methods of construction. Casing, other than surface casing, will not be permitted. Shaft construction shall be in accordance with Heading (b) as amended herein.

The slurry shall consist of a stable colloidal suspension of various pulverized solids or polymers thoroughly mixed with water as required to obtain and maintain the properties of Table 7. The slurry may be made with colloidal fines from soil being excavated provided it meets the requirements of Table 7. Tests shall be performed using the procedures for water base drilling fluids shown in API Recommended Practice 13B. The slurry shall be obtained from approved sources. Any physical or chemical treatment of the water or the slurry necessary to meet the requirements of Table 7 shall be submitted for approval. Slurry testing results shall be recorded. All field test equipment shall be provided by the contractor. Slurry shall be tested from samples recovered within 6 feet from the bottom of the drilled shaft just prior to placement of concrete.

TABLE 7
SLURRY SPECIFICATIONS

Property	Test Method	Requirements
Density, lb/ft^3, max	API 13B (Mud Balance)	70
Flow Time, sec	API 13B (Marsh Funnel Method)	30 - 50
Sand Content, percent, max	API 13B	4
pH	API 13B (Paper Test Strip or Glass Electrode pH meter)	8 - 12

The specified slurry shall be mixed in the excavation as drilling progresses, or premixed in a reservoir adjacent to the excavation of sufficient size to fill the excavation and for recovery of the slurry during concrete placement.

The slurry level shall be maintained 5 feet above ground water level or higher if caving or sloughing soils are present above this level. When a surface casing is used, the slurry shall fill the excavation to at least 2 feet above the bottom of the casing or as directed.

Just prior to placement of reinforcing steel, a clean-out bucket or other acceptable tool shall be passed down and up the drilled hole to

remove loose cuttings or material that has fallen from its sides after cessation of drilling operations. The bottom of the drilled shaft shall be inspected by sounding with a weighted line. Concrete placement shall not start until the concrete supply is assured. Concreting the drilled shaft shall be completed the same day that the excavation is completed. When this is not possible,the excavation shall be redrilled at least 6 inches larger in diameter, cleaned, and slurry tested before concreting at no direct pay.

Material excavated from shafts, including slurry, which is not used in the backfill around the completed bents or piers shall be disposed of in accordance with Subsection 202.02.

(d) Reinforcing Steel: Fabrication and placement of reinforcing steel shall conform to Section 806. The reinforcing steel cage shall be assembled and placed in the shaft as a unit. Subject to approval, the reinforcing steel cage may be fabricated in two sections; an upper and a lower section. The upper section shall be lapspliced to the lower section while the lower section is partially lowered into the shaft hole. The completely assembled reinforcing steel cage shall then be lowered into final position as a unit. The reinforcing steel cage shall not be placed until immediately before concrete operations are to be started.

The reinforcing steel cage shall be supported from the top by positive methods to prevent slumping downward during concrete placement or extraction of casing. The elevation of the top of the steel cage shall be checked before and after casing extraction. Downward movement not exceeding 6 inches in 20 feet of shaft length will be acceptable.

The minimum length of steel required for lap with column steel shall be maintained. Dowel bars may be used if proper lap length is provided both into the shaft and the column. Dowel bars in the top of the shaft which are not tied together with a cage may be inserted immediately after completion of concrete placement.

In uncased shafts, side spacer blocks of concrete or steel shall be used at intervals along the shaft to insure concentric spacing for the entire length of shaft. In cased shafts, concrete spacer blocks shall not be used. Metal chair-type spacers shall be placed vertically at intervals around the steel cage to insure concentric spacing inside the casing.

(e) Concrete: Concrete shall be placed in accordance with Section 805 and the requirements herein.

Concrete placing shall be continuous from the bottom of shaft or footing bell to the top of shaft or to construction joint as indicated on the plans. Time intervals will be allowed for pulling casings, placing forms and other necessary operations in sequence with placing operations.

When concrete is placed in a dry hole or where a casing is to be pulled, concrete shall be placed as soon as possible after excavation is completed and reinforcing steel placed, and shall be of such workability that vibrating or rodding will not be required. Casings shall extend sufficiently above the grade of finished shaft to provide for excess concrete to be placed for the anticipated slump due to casing removal. Concrete shall be placed through a tremie to the bottom of the excavation to prevent segregation of concrete materials and unnecessary splashing on reinforcing steel. The tremie shall be made in sections to permit its being raised as placement progresses.

When a pump is used, the discharge tube shall be submerged in previously placed concrete. Additional concrete shall be placed to assure removal of any contaminated concrete at the top of the shaft.

When concrete placement is interrupted due to withdrawal of the submerged end of the tremie, the tremie shall be removed, resealed at the bottom, forced well into the concrete already placed and recharged prior to progressing further.

Concrete coring will be required in any shaft that shows indication of improper procedures which may have caused seepage, infiltration, or entrapment of air or soil within the shaft. Core samples shall be at least 2 inches in diameter with one core per 4 square feet of cross-sectional area and shall extend through the total length of shaft at designated locations. When the shaft is found to be defective, core samples will be at no direct pay. If the shaft is accepted, core sampling and regrouting shall be paid by the Department.

When the drilled shaft is continued by means of a column, the contractor shall make provisions for holding the column form at the top of the drilled shaft by means of inserts or by forming and pouring a stub the size of the column.

After concrete placement is completed, the top surface shall be cured and construction joint areas shall be treated as specified in Section 805.

814.04 TEST HOLES: When shown on the plans or ordered in writing, test holes will be required to establish elevations for belling to determine soil characteristics or elevation of ground water. Diameter and depth of test holes shall be as shown on the plans or as directed.

814.05 TEST BELLS: When shown on the plans or ordered in writing, underreaming of bells on test holes will be required to establish the ability to underream in the soil strata present. Diameter and shape of test bells shall be as shown on the plans or as directed.

814.06 MEASUREMENT:

(a) Drilled Shafts: Drilled shafts will be made by the linear foot. At interior bridge bents and piers, shafts will be measured from a point 6 inches below ground elevation at the center of shaft after clearing operations are completed. At highway grade separations and railroad underpasses, the ground elevation will be the completed roadway section under the structure. At stream crossings and railroad overpasses, the ground elevation will be the elevation existing at the time drilling begins. At abutment bents, the length of the shaft will be measured from the top of shaft elevation shown on the plans.

(b) Bell Footings: Bell footings will be measured by the cubic yard of authorized volume outside the dimensions of the drilled shaft, which will be considered as extending to the bottom of the bell.

(c) Test Holes and Test Bells: Test holes and test bells will be measured from the elevation of the ground at the time drilling begins by the linear foot of test hole drilled and underreamed.

814.07 PAYMENT

(a) Drilled Shafts: Payment for drilled shafts will be made at the contract unit price per linear foot, subject to the following limitations for authorized overruns. Payment will include required excavation,

pumping, furnishing and placing casings, furnishing and placing concrete and reinforcement, removing casings, casings left in place, supplying equipment and performing slurry testing, and disposal of excess excavated material. No payment will be made for concrete required to fill oversize casings or excavation.

(1) Payment for shaft lengths up to and including 5 feet in excess of plan length will be made at the contract unit price per linear foot.

(2) Payment for that portion of shaft length greater than 5 feet and up to and including 15 feet more than plan length will be made at 115 percent of the contract unit price per linear foot.

(3) Payment for shaft lengths over 15 feet in excess of plan length will be in accordance with Subsection 109.04.

(4) Payment for additional reinforcement required, including splices, for the extra shaft length will be made at the contract unit price per pound for deformed reinforcing steel.

(5) Payment for shaft coring (if necessary) shall be by approved invoice from the contractor. Unit price per linear foot shall be determined prior to coring.

(b) Bell Footings: Payment for bell footings will be made at the contract unit price per cubic yard. Payment for authorized increases in footing bell diameters beyond three times the nominal shaft diameter will be in accordance with Subsection 109.04.

(c) Test Holes and Test Bells: Test holes will be made at the contract unit price per linear foot. Payment for test bells will be made at the contract unit price per each.

Payment for test holes or test bells required by the engineer but not specified by the plans will be made in accordance with Subsection 109.04.

(d) Payment will be made under:

Item No.	Pay Item	Pay Unit
814(01)	Drilled Shaft (Diameter)	Linear Foot
814(02)	Bell Footing	Cubic Yard
814(03)	Test Hole (Diameter)	Linear Foot
814(04)	Test Bell (Diameter)	Each

Section 815
Welding

815.01 DESCRIPTION. Welding of structural steel, steel pipe and tubular members, reinforcing steel and aluminum alloys (including qualification of procedures, welders and welding operators, destructive and nondestructive testing, etc.) shall conform to these specifications.

815.02 QUALIFICATION OF PROCEDURES, WELDERS AND WELDING OPERATORS.

(a) General:

(1) The Construction Section shall be the qualifying agency.

(2) Qualifying tests may be made at locations selected by the contractor and approved by the Department. Advance notice of not less than 1 week shall be given to the Construction Section so that the Department can arrange for the presence of the inspector.

(3) Seven copies of the required reports shall be furnished to the Construction Section.

(4) Each welder and welding operator's work shall be identified with a steel stencil.

(5) The social security number and 1 inch by 1 inch passport type picture of each qualifying welder and welding operator shall be furnished. The social security number of the qualified welder and welding operator shall be recorded on the required reports. The qualified welder and welding operator shall have the identification card in their possession when working.

(6) All costs incidental to welding qualifications shall be the responsibility of the contractor.

(b) Structural Steel, Steel Pipe and Tubular Members:

(1) Structural Steel: Welding procedures, welders and welding operators shall be qualified in accordance with the ANSI/AASHTO/AWS D1.5-88 Bridge Welding Code.

(2) Steel Pipe and Tubular Members: Welding procedures, welders and welding operators shall be qualified in accordance with the ANSI/AWS D1.1-90 Structural Welding Code-Steel.

(c) Reinforcing Steel: Welding qualification for reinforcing steel shall conform to AWS D 1.4-92 Structural Welding Code-Reinforcing Steel.

(d) Aluminum: Welding qualification for aluminum alloys shall conform to ANSI/AWS D 1.2-90 Structural Welding Code-Aluminum.

(e) Electrodes:

(1) Structural Steel: Electrodes shall be qualified and certified in accordance with the ANSI/AASHTO/AWS D1.5-88 Bridge Welding Code.

(2) Steel Pipe and Tubular Members: Electrodes shall be qualified and certified in accordance with the ANSI/AWS D1.1-90 Structural Welding Code-Steel.

(3) Aluminum: Electrodes shall be qualified and certified in accordance with the ANSI/AWS D1.2-90, Structural Welding Code-Aluminum.

815.03 WELDING. Size, type and length of welds shall be shown on the plans. The use of electroslag and electrogas welding processes will not be permitted.

(a) Structural Steel, Steel Pipe and Tubular Members:

(1) Structural Steel: Welding of structural steel shall conform to the ANSI/AASHTO/AWS D1.5-88 Bridge Welding Code.

(2) Steel Pipe and Tubular Members: Welding of steel pipe and tubular members shall conform to the ANSI/AWS D1.1-90 Structural Welding Code-Steel.

(b) Reinforcing Steel: Welding of reinforcing steel shall conform to the AWS D1.4-92 Structural Welding Code-Reinforcing Steel.

(c) Aluminum: Welding of aluminum alloys shall conform to the ANSI/AWS D1.2-90 Structural Welding Code-Aluminum.

815.04 NONDESTRUCTIVE TESTING:

(a) Structural Steel, Steel Pipe and Tubular Members:

(1) Structural Steel: Non-destructive testing shall conform to the ANSI/AASHTO/AWS D1.5-88 Bridge Welding Code except that the ends of all groove welds on main members shall be tested with the dye penetrant inspection method.

(2) Steel Pipe and Tubular Members: Non-destructive testing shall conform to the ANSI/AWS D1.1-90 Structural Welding Code-Steel.

(b) Reinforcing Steel: Non-destructive testing shall conform to AWS D1.4-92 Structural Welding Code-Reinforcing Steel.

(c) Aluminum: Non-destructive testing shall conform to ANSI/AWS D1.2-90 Structural Welding Code-Aluminum. For sign structures, the dye penetrant method shall be used on butt welds in columns and main chord members, including associated flanges, gussets or main load carrying brackets or members also on fillet welds connecting flanges to main truss chord members.

(d) Personnel Qualification: Persons performing ultrasonic testing shall be qualified by tests administered by the Construction Section, unless otherwise approved.

815.05 MEASUREMENT AND PAYMENT. There will be no direct payment for radiographic inspection, magnetic particle inspection, dye penetrant inspection or other tests as specified.

There will be no measurement or payment made for weld metal deposited; however, there will be no deduction made for removal of metal to be welded due to edge preparation.

Part IX — Portland Cement Concrete

Section 901
Portland Cement Concrete

901.01 GENERAL. This Section specifies requirements for portland cement concrete, including methods and equipment for handling and storing materials, and mixing and transporting concrete to the site.

Structural concrete is designated by class and pavement concrete by type.

No concrete shall be mixed, placed or finished when natural light is insufficient, unless an approved artificial lighting system is provided. No concrete shall be placed on a frozen subgrade nor shall frozen aggregates be used in concrete.

Portland cement concrete shall conform to the requirements of Table 1. It shall be a mixture of portland or portland-pozzolan cement, fine aggregate, coarse aggregate, water and, when specified or allowed, approved admixtures. Fly ash will be permitted as a partial replacement for portland cement in accordance with Subsection 901.08.

Trucks and plants furnishing, transporting and placing portland cement concrete, shall be certified by the Department. The design, control and transportation of concrete mixtures in accordance with these specifications shall be the responsibility of the contractor.

Sufficient plant capacity and transporting apparatus to ensure delivery at the required rate shall be provided. Rate of concrete delivery during concreting operations shall provide for proper handling, placing and finishing of concrete and maintain a workable surface.

Methods of delivery and handling concrete shall facilitate placing with a minimum of rehandling and without damage to the structure or concrete. Concrete shall not be placed after the initial set has been reached when tested in accordance with ASTM C 953.

Approved laboratory facilities and testing equipment necessary to sample, test, and control concrete mixtures shall be provided by the contractor. These facilities will not be required for plants producing only minor structure concrete conforming to Table 1. A laboratory conforming to Section 722 shall be located at an approved location at the plant site. The laboratory shall be for quality assurance purposes.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures" or "Application of Quality Assurance Specifications for Precast-Prestressed Concrete Plants."

901.02 MATERIALS. Materials shall conform to the following Subsections:

Portland Cement	1001.01
Portland-Pozzolan Cement	1001.02
Masonry Cement	1001.03
Aggregates	1003.01 & 1003.02
Admixtures	1011.02
Water	1018.01
Fly Ash	1018.15

Coarse and fine aggregates for concrete that will be subject to wetting, extended exposure to humid atmosphere, or contact with moist ground shall not contain materials detrimentally reactive with alkalies in the cement or fly ash in an amount sufficient to cause excessive expansion of mortar or concrete. When such materials are present in harmful amounts, the aggregate may be used with a cement containing 0.6 percent or less alkalies, or fly ash containing 1.5 percent or less alkalies calculated as sodium oxide equivalent.

The contractor will be permitted to use recycled portland cement concrete as coarse aggregate in concrete mixtures for minor structures only.

Cement and fly ash shall be certified by the manufacturer in accordance with the Department's current procedures.

The contractor shall keep accurate records of cement and fly ash deliveries and their use in the work. Copies of these records shall be furnished to the engineer in such form as required.

901.03 TRANSPORTATION AND STORAGE OF CEMENT AND FLY ASH. Cement and fly ash shall be transported in watertight conveyances and stored in silos or other approved facilities so that cement and fly ash will be protected from dampness or water intrusion. Material which has become contaminated, partially set or containing lumps of caked material will be rejected. When the use of bagged cement or fly ash is permitted, the handling and storage will be as directed.

Different brands or types or the same brand or type from different mills, shall not be mixed or used alternately unless authorized by the DOTD Materials Engineer Administrator. This requirement may be waived in case of plant breakdown during production to allow concrete to be furnished from another plant to finish the placement in progress.

901.04 HANDLING AND STORAGE OF AGGREGATES. Equipment and methods for stockpiling aggregates shall be such that no detrimental degradation or segregation of aggregate will result; no appreciable amount of foreign material will be incorporated into aggregate; and there will be no intermingling of stockpiled materials. Stockpiles of aggregates shall be well drained and shall have uniform moisture content. Material shall not be added to working faces of the stockpiles during continuous operations.

When specified, coarse aggregate shall be separated into two or more sizes to ensure greater uniformity of the concrete mixture. Different grades and types of aggregates shall be stored in separate stockpiles separated by bulkheads or sufficiently removed from each other to prevent material at edges of piles from becoming intermixed. When segregation occurs in the processing and handling of Grade D coarse aggregate, the aggregate shall be separated on a 1-inch sieve into two stockpiles. The stockpiled material shall be reproportioned prior to mixing with cement to meet the gradation requirements of Grade D. Activity which results in contamination or intermixing of aggregates, including overhead handling for the loading of bins or building of stockpiles will not be permitted.

Aggregates shall be handled from stockpiles or other sources to the batch plant so as to secure uniform grading of material. Aggregates that have become segregated or contaminated shall not be used. Aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or placed in bins for adequate drainage. Transport containers will be accepted as an adequate bin when adequate

drainage is provided. Drainage of aggregates shall meet the approval of the engineer prior to batching. The engineer may require water sprinkling of coarse aggregates in stockpiles that have dried to the extent that the aggregates absorb mixing water. Such sprinkling shall continue until aggregates are saturated.

901.05 SAMPLING AND TESTING. Sampling and testing will be done in accordance with the Department's Materials Sampling Manual and the Department's Testing Procedures Manuals. The contractor shall furnish necessary materials for testing at no direct pay.

901.06 QUALITY CONTROL OF CONCRETE. The contractor shall be responsible for quality control of materials during handling, blending, mixing, and placement operations; for initial determination and necessary subsequent adjustments in proportioning of materials used to produce the specified concrete; and for providing suitable equipment for determination of aggregate gradation, moisture, air content, slump, temperature, and trial mixes as necessary. Testing and analysis of the mix for quality control purposes, the setting of dials, gages, scales or meters, adjusting batch weights, and accurate batching shall be the responsibility of the contractor.

A Authorized Concrete Batcher shall perform all batching operations. A Certified Concrete Technician shall be present at the plant or job site when the plant is in operation. The contractor shall have a Certified Concrete Technician at each plant. The contractor's Authorized Concrete Batcher, Authorized Concrete Field Tester, and Certified Concrete Technician shall be qualified or certified upon satisfactory completion of the Department's requirements. Daily plant operations shall not begin unless the Authorized Concrete Batcher and/or Certified Concrete Technician are at the plant. Gradations, moisture contents, and adjusted batch weights shall be completed. The results shall be within specification limits before batching begins.

The Certified Concrete Technician shall design concrete mixes, make adjustments in batch weights for moisture content, perform necessary adjustments in proportioning of materials to produce the specified concrete, and shall perform tests necessary for control of the concrete mix within specification requirements. If a Certified Concrete Technician is not available at the job site, an Authorized Concrete Field Tester will be allowed to perform control tests for slump and air content and report results to the Certified Concrete Technician. The use of an Authorized Concrete Field Tester will not relieve the Certified Concrete Technician from performing the remaining duties as outlined in these specifications.

(a) Mix Design: The contractor shall submit a proposed mix design on a form provided by the Department giving the intended sources of materials and the mix design for concrete to be furnished. No work shall be started until the Portland Cement Concrete Mix Design has been reviewed and accepted.

When unusual materials necessitate tests on trial mixes, the contractor shall conduct trial mixes and submit test results for slump, air content, and compressive strength at 3, 7 and 28 days. The contractor shall furnish materials to the Department for verification of trial mixes.

Trial mixes will be required for the following:

(1) New mix designs containing fly ash as partial replacement for cement.

(2) New mix designs containing recycled portland cement concrete coarse aggregate.

(3) Mix designs with materials not noted in the project specifications.

(4) Mix designs where the compressive strengths from tested compressive strength specimens do not conform to the minimum requirements.

Review and acceptance of this mix design does not release the contractor from the responsibility of producing concrete which meets the minimum requirements of this Section.

Gradation, unit weight, specific gravity, and absorption factor of aggregate intended for use will be determined by the Department when requested by the contractor.

The mix design shall produce concrete conforming to Subsection 901.08 and Table 1 of this Section.

(b) Quality Control Tests: 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 at the job site for slump, temperature, and air content (when used). The contractor shall conduct operations to produce a mix conforming to the reviewed and accepted mix design, except that variations will be permitted within specified control limits for individual samples. Test results for gradation, slump, and air content shall be plotted on control charts for individual samples. These control charts shall be submitted to the engineer.

Times at which to obtain control test samples shall be set by the contractor using random number tables in accordance with DOTD S 605 or by random selection. Gradation control limits of aggregates shall be as shown in Subsection 1003.02. When required, additional test samples shall be taken as directed for slump mix temperature, and air content.

The minimum number of control tests shall be in accordance with the Materials Sampling Manual.

For minor structure concrete only, the contractor shall be responsible for establishing a quality control testing program which shall ensure that the concrete meets the requirements of these specifications.

(c) Mix Adjustments: The contractor may vary the ratio of fine to coarse aggregate as reviewed and accepted, but in no case shall it be varied so as to materially affect the volume of cement per unit volume of concrete as determined by original proportions designed to obtain a cement factor of not less than that specified in Table 1. The mix produced shall be uniform and within specification limits. When plant operations do not produce a uniform mix, plant operations will be discontinued.

When tendency of individual slump, air content, mix temperature, or gradation measurements, as plotted on control charts, indicates that the mix being produced is not uniform and may fall outside tolerance limits, the contractor shall immediately make adjustments to keep the mix within specified limits. If the contractor fails to make proper adjustments, and the mix deviates from specification requirements or if the mix is obviously defective, the mix will be rejected.

Adjustments to the ratio of fine to coarse aggregate shall not cause the minimum cement factor to deviate from that accepted on the mix design. For workability properties only, changes in mix proportions will be permitted provided the water-cement ratio is not exceeded, minimum cement factor is obtained, proper batch adjustments are made, and prior notification is given to the engineer.

No changes in source of materials or percentage of cement or fly ash shall be made until a new Mix Design form showing the new material or adjusted proportions has been submitted by the contractor and approved.

901.07 SUBSTITUTIONS: Mixtures may be substituted with approval in accordance with the following Table.

STRUCTURAL CLASS[1]	SUBSTITUTE
AA(M)	No Substitutions
AA	AA(M)
A(M)	AA(M), AA
A	AA(M), AA, A(M)
D	No Substitutions
F	No Substitutions
P(M)	No Substitutions
P	P(M)
S	No Substitutions
X	No Substitutions
MINOR STRUCTURE CLASS[1]	
M	AA(M), AA, A(M), A, B
R	AA(M), AA, A(M), A, B, M
Y	X
PAVEMENT TYPE[1]	
B	AA(M), AA, A(M), A, C, D
C	AA(M), AA, A(M), A, B, D
D	AA(M), AA, A(M), A, B, C

[1]The mixture being substituted shall meet the requirements of Table 1 and the mix design for its class or type. The compressive strength of the substituted mix shall meet the strength requirements of the original mixture specified.

901.08 COMPOSITION OF CONCRETE. Type of cement and composition of concrete shall be in accordance with the requirements of this Subsection and Table 1 of this Section.

(a) Cement and Aggregates: Allowable types of cement are as follows:

Use	Allowable Cement Types
General Construction (including paving and structural concrete)	Type I(B) or II portland cement; Type IP portland-pozzolan cement
Minor Structure Concrete	Type I, I(B) or II portland cement; Type IP portland-pozzolan cement
Prestressed or Precast Concrete	Type I, I(B), I(C), II or III portland cement; Type IP portland-pozzoland cement

Specified cement contents indicated in Table 1 are the minimum permitted, for durability only; however, due to the gradation of aggregate or other conditions, additional cement may be required to achieve minimum compressive strength.

The contractor will be permitted partial substitution on a pound for pound basis of fly ash for portland cement in concrete mixes only when using Type I, I(B) or II portland cement up to a maximum of 20 percent, by weight, for minor structure and concrete pavement, and up to 15 percent, by weight of cement for structural concrete.

(b) Admixtures: An air-entraining admixture will be required in concrete when a central mixing plant, or non-agitating haul trucks are used. For other concrete, placed by slip-form methods, air entraining admixture will be required.

The use of admixtures in other classes or types of concrete will be optional with the contractor with written approval. When the contractor desires to use air-entraining or water-reducing admixtures, in other classes, types, or uses of concrete it will be at no direct pay.

Air-entraining and water-reducing admixtures will be required in Class AA, F or AA(M) concrete. A water-reducing admixture will be required for mass concrete.

When an air-entraining admixture is used, the total air content of the concrete mix, when tested in accordance with DOTD TR 202, shall be as specified in Table 1.

When both air-entraining and water-reducing admixtures are used, the two materials shall be manufactured by the same company and shall be compatible.

When the ambient air temperature is above 70°F, the water-reducing admixture shall be the set-retarding type; when air temperature is 70°F or below, the water-reducing admixture shall be the normal set type. Set-retarding admixture shall be used in an amount sufficient to produce the necessary retardation; however, the amount used shall not be less than is necessary to conform to Subsection 1011.02.

(c) Water: The amount of water in the mixture, including admixtures and free water, shall not exceed the quantity specified in Table 1. Free water shall include all water entering the mix with the aggregate, except water absorbed by the aggregate.

Because of the absorptive nature of lightweight aggregate and the inability to obtain a true saturated surface dry condition for determining free moisture, a maximum amount of water cannot be specified for Class X concrete. The slump requirement of Table 1 or as specified will be the governing factor in determining maximum allowable water.

When the coarse aggregate portion of the mix is 100 percent crushed aggregate, the water may be increased by 5 percent provided the maximum water listed in Table 1 is not exceeded.

(d) Aggregate:

(1) Coarse Aggregate: Coarse aggregate shall be the grade specified in Table 1 and shall conform to the requirements of Subsection 1003.02(c).

(2) Fine Aggregate: Fine aggregate shall conform to the requirements of Subsection 1003.02(b).

(3) Recycled Portland Cement Concrete: The contractor will be permitted to use recycled portland cement concrete as coarse aggregate in concrete mixtures for minor structures, subject to requirements of Subsection 1003.02(c)(3) and the following requirements. Coarse aggregate for concrete mixtures may consist of 100 percent recycled aggregates or

any combination of recycled and virgin aggregates. The combined coarse aggregates shall conform to the gradation requirements for coarse aggregate in Subsection 1003.02(c); Grades B or D for pavements, and Grades A or B for minor structures. Fine aggregate in the mixture shall be virgin material conforming to Subsection 1003.02(b).

(e) Slump: Mixtures shall produce concrete of suitable workability with not less than the specified cement content and not more than the specified amount of water.

Mixtures shall have slumps within the ranges shown in Table 1 or as specified when tested in accordance with DOTD TR 207. The engineer may authorize an increase in maximum slump for concrete used in the construction of walls and diaphragms less than 8 inches thick, provided the water-cement ratio is not exceeded and conventional forms are used.

(f) Compressive Strength:

(1) Structural Concrete: Structural "Class" concrete mixes shall be formulated to produce concrete which, when molded and cured in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230, shall show an average compressive strength not less than as shown in Table 1 of this Section.

Cylinders by which strength of Class P and Class P(M) concrete is to be determined shall be cured by the same methods used in curing the members they represent.

(2) Minor Structure Concrete: Minor structure "class" concrete mixes shall be formulated to produce concrete which, when molded and cured in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230, shall show an average compressive strength not less than as shown in Table 1 of this Section.

(3) Pavement Concrete: Compressive strength of "Type" concrete and Class A concrete used for pavement, determined from hardened cores taken in accordance with Subsection 601.08 and tested in accordance with DOTD TR 225, shall meet the requirements in Table 1 of this Section. Small quantities of pavement may be accepted by compressive strength of hardened cores or cylinders in accordance with Subsection 601.18.

901.09 EQUIPMENT.

(a) General: Sufficient plant capacity and transporting apparatus to ensure delivery at the required rate shall be provided. Rate of concrete delivery during concreting operations shall provide for proper handling, placing and finishing of concrete and maintain a workable surface. Methods of delivering and handling concrete shall facilitate placing with a minimum of rehandling and without damage to the structure or concrete.

(b) Plant Equipment: Batch plants shall include storage bins or approved alternative equipment accomplishing this function, weigh hoppers, and measuring devices. Equipment shall be properly sealed and vented to minimize dusting and loss of material.

Materials shall be incorporated into the mix by methods which will ensure uniform distribution. The amount of each material used in the mix shall be recorded and certified by the Authorized Concrete Batcher or Certified Concrete Technician.

The plant shall be equipped with adequate water storage and a device for automatically controlling the amount of water used in each batch.

(1) Storage Bins and Silos: For plants with overhead storage bins, which feed directly into the weigh hopper, or storage bins with belt feed to the weigh hopper, the bins shall have adequate separate compartments for fine aggregate and each size of coarse aggregate. Each compartment shall be designed to discharge efficiently and freely into the weigh hopper. Means of control shall be provided so that, as the quantity desired in the weigh hopper is approached, material shall be added slowly and shut off with precision.

Silos shall be weatherproof, sealed, free of holes, and shall prevent contamination. Silos shall be designed to freely discharge and shall be equipped with vibrators to maintain flow of material and prevent accumulation. Silos shall be designed with sufficient capacity for the operation. Silos shall be provided with a positive means of shut off with no leaking into the weigh hopper. A separate silo shall be used for fly ash and cement. If a silo is divided into compartments for cement and fly ash a positive means of separation shall be provided.

(2) Measuring Devices: Materials shall be measured by weighing except where other methods are authorized.

Fine aggregate and each size of coarse aggregate shall be weighed on scales, separately or cumulatively, in the weigh hopper from separate bins. If cement or fly ash is used in bulk, a separate scale system shall be used.

Batch plants may be equipped to proportion materials by approved automatic weighing devices.

Moisture probes shall not be used to determine the moisture content of aggregate for quality control or batch adjustment.

Fly ash may be weighed cumulatively in the same hopper with the cement, provided the cement is weighed first.

Weigh hoppers shall be constructed to eliminate accumulation of materials and to discharge completely. Suitable provisions shall be made for removal of overload from the hopper by the operator.

Scales shall be accurate to 0.5 percent throughout the range of use. Maximum graduation on scales shall be 0.1 percent of the rated scale capacity. When beam type scales are used, poises shall be designed to be locked in any position to prevent accidental change of position, and the weigh beam and a tell-tale device shall be in view of the operator. Plant and laboratory measuring devices shall be subject to approval and shall be tested, inspected, and certified by a qualified independent scale service or the Weights and Measures Division of the Louisiana Department of Agriculture and Forestry at no cost to the Department every 90 calendar days, and more often when the engineer deems it necessary to assure their accuracy.

Individual aggregates shall be batched within 2 percent, and the total weight of aggregate shall be within 1 percent of the required weight.

Cement and fly ash shall be within 1 percent of the required weight. Cement in standard bags need not be weighed; however, when bag cement is used, the quantities of aggregates for each batch shall be sufficient for one or more full bags of cement. Bagged fly ash will not be allowed.

Mixing water shall be measured by volume or weight. Water measuring devices shall be accurate to 1 percent at 1/2 the maximum allowable water per batch and the maximum graduation shall be 1 gallon.

Approved methods and equipment for adding air-entraining admixtures or other admixtures into the batch shall be used. The quantity of admixtures shall be measured into the mixer with an accuracy of 3 percent. Admixtures shall be mechanically dispensed in a liquid state with the mixing water. A separate dispensing device shall be provided for each admixture.

(3) Ticket Printer System: Certified concrete plants may be equipped with an approved automatic ticket printer system for recording required batching information. When an automatic ticket printer system is not used, quantities and batching information shall be determined by visual observation, recorded, and certified correct by the plant's Authorized Concrete Batcher or Certified Concrete Technician.

The approved ticket printer system shall be tamper-proof and shall print time of batching, amount of water, batch weights, moisture content of aggregate, and quantities of admixtures. Moisture content of aggregate or quantities of admixtures may be added to the printed ticket by the Authorized Concrete Batcher or Certified Concrete Technician when the automatic system does not have these capabilities. During a breakdown, quantities shall be determined by visual observation and certified as stated above.

All records of batches shall show batch number, day, month, year, and time of day to the nearest minute for each batch. The maximum quantity of water that can be added at the jobsite shall be shown on the batch ticket. The engineer shall be provided with a legible copy of all batch records identified with lot number and mix design number.

(c) Hauling Equipment: Hauling equipment shall be watertight and shall be capable of discharging concrete at a satisfactorily controlled rate without segregation.

(1) Truck Mixer: Truck mixers shall be the revolving drum type, equipped with pressurized, calibrated tanks for carrying a portion of the mixing water.

Pick-up and throw-over blades in the mixing drum shall be replaced when worn beyond the limit recommended by the manufacturer. The contractor shall have available a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth.

Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified.

Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions may be verified. Counters shall be located to provide safe and convenient inspection.

Each truck mixer shall have attached thereto in a prominent place a metal plate on which is plainly marked the uses for which the equipment is designed, the maximum rated capacity of the drum in terms of concrete volume, and rotation speed for both agitating and mixing speeds.

Truck mixers shall be equipped with means for accurately measuring the amount of water used in each batch.

(2) Agitator Hauling Equipment: Agitators shall be supplied with adequate mixing blades or paddles to agitate the mix and prevent segregation. Covers shall be provided when directed.

Each agitator shall have attached thereto in a prominent place a metal plate on which is plainly marked the uses for which the equipment is designed, the maximum rated capacity in terms of concrete volume, and agitation speed.

(3) Non-Agitator Hauling Equipment: Bodies of nonagitating hauling equipment shall be smooth mortartight, metal containers. Covers shall be provided when directed.

(d) Portable Mixers: Portable mixers shall have a minimum capacity of 1 cubic yard and shall be capable of uniformity mixing and discharging concrete without segregation.

901.10 BATCHING AND MIXING:

(a) General: Concrete shall be thoroughly mixed in a mixer of an approved size and type which will ensure uniform distribution of materials through the mass.

Pick-up and throw-over blades or mixing paddles in the mixing drum or mixing unit shall be replaced when worn beyond the limit recommended by the manufacturer. The contractor shall have available a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth.

Mixing operations shall begin within 30 minutes after cement has been added to aggregate. When cement is charged into a mixer drum containing surface-wet aggregate and the ambient temperature is above 90°F, or when high early strength cement is used, this limit shall be reduced to 15 minutes. When mixing operations are interrupted, the mixer shall be thoroughly cleaned. The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. Materials composing a batch shall be deposited simultaneously in an operating mixer. A portion of mixing water shall enter in advance of cement and aggregates. No mixer having a rated capacity of less than 1 cubic yard shall be used nor shall a mixer be charged in excess of its rated capacity. The minimum size batch shall be 1 cubic yard. Mixers with worn blades or excessive build-up will be rejected. Concrete exposed to salt water shall be mixed for 2 minutes and the water content of the mixture shall be carefully controlled.

(b) Central Plant and Site Mixing: Concrete shall be mixed for at least 50 seconds. Mixing time shall begin after all materials, including water, are in the mixer. Mixing time ends when the discharge chute opens. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. During mixing, the mixer shall be operated at a drum speed for which it has been designed as shown on the manufacturer's name plate on the mixer.

(c) Truck Mixing: Aggregates, cement, and fly ash for concrete shall be measured in accordance with Subsection 901.09 and charged into the drum at the proportioning plant.

Size of batch in truck mixers shall not exceed the maximum rated mixing capacity of mixer as stated by the manufacturer and stamped on a metal plate on the mixer. When a truck mixer is used for complete mixing, each batch shall be mixed for not less than 70 nor more than 130 revolutions of drum at the rate of rotation designated as mixing speed by the equipment manufacturer on the metal plate on the mixer. Any additional mixing shall

be at the speed designated by the equipment manufacturer as agitating speed. All materials, including mixing water, shall be in the mixer drum before actuating the revolution counter or taking an initial reading.

When the prescribed amount of water is added at the batch plant and slump is on the low side at the jobsite it will be permissible to add a minimum of 75 percent of the mixing water at the time cement and aggregates are added at the batch plant and the remaining mixing water at the job site prior to discharging concrete into forms. Water added at the job site may be added in 1 or 2 increments with additional mixing within the range of 20 to 30 revolutions at designated mixer speed for each increment; however, the total of 130 revolutions shall not be exceeded. Water added at the jobsite shall not cause the maximum allowable water-cement ratio of the batch to be exceeded.

If water is allowed to be added to a partial load, only a proportional amount of the allowable water will be added. When the slump is more than the maximum specification limit, the batch will be rejected; additional mixing or agitation to reduce the slump will not be allowed even though the maximum time limit or number of revolutions have not been exceeded.

Slump tests, acceptance cylinders, and temperature measurements will not be made until all mixing water has been added to the batch.

(d) Partial Mixing at Central Plant: When partial mixing is allowed at a central plant, the mixing time at the central plant may be reduced to 30 seconds. Additional required mixing shall be completed in a truck mixer at mixing speed. Mixing time in the truck mixer shall be a minimum of 10 and a maximum of 70 revolutions.

(e) Time Limitations: The maximum allowable time from the addition of cement to the mix to complete discharge of the concrete shall be 90 minutes when transport is by truck mixer or agitator. The maximum allowable time from the addition of cement to the mix to complete discharge of the concrete shall be 45 minutes when transport is by non-agitator truck. In hot weather or under other conditions contributing to rapid loss of plasticity of concrete, maximum allowable time may be reduced by the engineer.

(f) Hauling Equipment: Wet batches of concrete may be transported in a truck mixer, agitator or other approved equipment. Non-agitator trucks will not be allowed for structural concrete, but will be permitted for pavement concrete when air-entrainment admixture is used. Maximum volume of mixed concrete transported in an agitator and agitation speed shall be in accordance with the manufacturer's specified rating.

(g) Portable Mixing: Portable mixers shall be approved in writing for mixing 1 cubic yard of concrete or less per day for minor structure concrete.

(h) Delivery: Sufficient plant capacity and transporting apparatus to insure delivery at the required rate shall be provided. Rate of concrete delivery during concreting operations shall be such as to provide for proper handling, placing and finishing of concrete and maintain a workable surface. Methods of delivering and handling concrete shall be such as will facilitate placing with a minimum of rehandling and without damage to the structure or concrete.

901.11 TEMPERATURE LIMITATIONS.

(a) General: Air temperature and mix temperature shall be determined at the point of placement in the shade away from artificial heat.

(b) Hot Weather Limitations: Hot weather limitations shall apply to concrete for:

(1) Bridge Decks and Mass Concrete: Hot weather concreting practices will be required when the job site temperature in the shade and away from artificial heat is 80°F and rising. When internal temperature of plastic concrete reaches 85°F, the contractor shall prevent the temperature of succeeding batches from going beyond 90°F by approved methods. If necessary, forms shall be precooled by approved methods immediately prior to concrete placement.

(2) Pavement Concrete: Internal temperature of the plastic concrete shall not exceed 95°F at the time of placement.

(c) Cold Weather Limitations: Mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F. Production shall not begin until the temperature at the point of placement is within the above limitations.

When concrete placement at lower air temperatures is authorized in writing, aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to prevent occurrence of overheated areas. If the air temperature is less than 35°F at the time of placing concrete, the engineer may require water or aggregates to be heated to not less than 70°F nor more than 150°F.

Concrete shall not be placed if the temperature is forecasted by the U. S. Weather Service to be 25°F or less within the 24 hour period following placement.

901.12 ACCEPTANCE AND PAYMENT SCHEDULE. Acceptance and payment schedules in Table 2 will apply to all cast-in-place structural portland cement concrete. Acceptance and payment schedules in Table 3 will apply to all minor structure portland cement concrete. Portland cement concrete pavement acceptance and payment schedules are given in Table 1 of Subsection 601.18. These schedules do not apply to precast concrete.

TABLE 1
MASTER PROPORTION TABLE

	Average Compressive Strength psi at 28 days	Grade of Coarse Aggregate	Minimum Bags of Cement (94 lb) per Cu Yd of Concrete[i]	Maximum Water per Bag of Cement[a] [l] (Gallons)	Total Air Content (Percent by volume)[d]	Slump Range[j] (Inches)		
						Non-Vibrated	Vibrated	Slip Form Paving[b]
Structural Class[k]								
AA(M)	4,400	A	6.5	5.0	5ō1	2-5	2-4	N.A.
AA	4,200	A	6.5	5.0	5ō1	2-5	2-4	N.A.
A(M)	4,400	A	6.0	6.0	5ō2	2-5	2-4	N.A.
A	3,800	A, F[h]	6.0	6.0	5ō2	2-5	2-4	1-2.5
D	3,300	A, B, D	5.0	6.6	5ō2	2-5	1-3	N.A.
F	3,400[e]	A	5.5	5.0	5ō1	2-5	2-4	N.A.
P(M)	6,000[e]	A, F[h]	7.0	5.0	5ō2	N.A.	2-6[g]	N.A.
P	5,000[e]	A, F[h]	6.5	5.0	5ō2	N.A.	2-6[g]	N.A.
S	3,800	A	7.0	6.0	5ō2	6-8	N.A.	N.A.
X	3,800	Y	6.5	c	6-9	N.A.	1-3	N.A.
Minor Structure Class[k] [l]								
M	3,000	A, B	5.8	6.0	5 ō 2	2-5	2-4	1-2.5
R	1,800	A, B, D	4.0	8.0	5 ō 2	2-5	2-4	N.A.
Y	3,000	Y	6.5	c	6-9	N.A.	1-3	N.A.
Pavement Type[k]								
B	4,000[f]	B	5.8	6.0	5 ō 2	N.A.	2-4	1-2.5
C	4,000[f]	B(Crushed Slag)	6.0	6.0	5 ō 2	N.A.	2-4	1-2.5
D	4,000[f]	D	5.4	6.0	5 ō 2	N.A.	2-4	1-2.5

N.A.- Not Applicable

[a] Except for Class AA, AA(M) or F concrete, the maximum water-cement ratio (gal/bag) shall be reduced 5 percent when a water-reducing admixture is used, and 10 percent when an air-entraining admixture, or air-entraining and water-reducing admixtures, is used.

[b] Also slump range for other concrete placed by extrusion methods.

[c] Refer to Subsection 901.08(c).

[d] Total air content ranges when air-entrainment is allowed or specified. Air content shall be designed at midrange.

[e] Minimum compressive strength required.

[f] Average compressive strength for Pavement Type concrete shall be 3,600 psi when air-entrainment is used.

[g] No more than a 2-inch slump differential for any designated pour.

[h] Grade F coarse aggregate shall be used only when specified or permitted. The minimum cement content shall be increased when this aggregate is used.

[i] For mixes including partial replacement of cement with fly ash, the minimum cement and maximum water contents shown apply tothe total cement/fly ash content of the mix. Additional cement may be required to achieve minimum compressive strength.

[j] When a slump range is specified in other Sections, that range shall govern.

[k] See Subsection 901.08(a) for allowable types of cement.

[l] Recycled portland cement concrete will be allowed for minor structure concrete.

TABLE 2
ACCEPTANCE AND PAYMENT SCHEDULES
CAST-IN-PLACE STRUCTURAL CONCRETE

Average Compressive Strength per Lot, psi (28 to 31 days)					
Class A, S or X[1]	Class AA	Class A(M) or AA(M)	Class D	Class F	Percent of Contract Price[3]
3800 & above	4200 & above	4400 & above	3300 & above	3400 & above	100
3400 - 3799	3800 - 4199	4000 - 4399	3000 - 3299	---	98
3000 - 3399	3200 - 3799	3600 - 3999	2500 - 2999	---	90
below 3000	below 3200	below 3600	below 2500	below 3400	50 or remove and replace[2]

[1]Use these values when "Type" concrete is used in approach slab.

[2]When the average compressive strength of any batch in a lot is less than 3600 psi for Class A(M) or AA(M), less than 3200 psi for Class AA, less than 3000 psi for Class A, S or X, less than 2500 psi for Class D, or less than 3400 for Class F, an investigation will be made. If concrete is allowed to remain in place, payment will be based on the average compressive strength for the lot. If concrete is not allowed to remain in place, the identifiable deficient areas shall be removed and replaced at no direct pay.

When the average compressive strength for a lot is less than 3600 psi for Class A(M) or AA(M), less than 3200 psi for Class AA, less than 3000 psi for Class A, S or X, less than 2500 psi for Class D, or less than 3400 psi for Class F, an investigation will be made. If concrete is allowed to remain in place, payment for the lot will be based on 50 percent of the contract price.

Any cores obtained in these investigations will be used for evaluation purposes only and payment will be based on original acceptance samples.

[3]When concrete is part of an item or not a direct pay item, lot sizes, sampling and acceptance testing for the required quantities will be in accordance with Subsection 805.17. The value for each cubic yard required will be assessed at $250 for the purpose of applying payment adjustment percentages. The amount of payment adjustment for the quantity of concrete involved will be deducted from payment.

Acceptance and payment schedules shall apply to the contract item itself for cast-in-place piling.

TABLE 3
ACCEPTANCE AND PAYMENT SCHEDULES
CAST-IN-PLACE MINOR STRUCTURE CONCRETE

Average Compressive Strength, psi (28 to 31 days)		Percent of Contract Price[2]
Class M or Y	Class R	
3000 & Above Below 3000	1800 & Above Below 1800	100 50 or Remove[1]

[1]When the average compressive strength is less than 3,000 psi for Class M or Y, and 1,800 psi for Class R, an investigation will be made. If concrete is allowed to remain in place, payment will be based on 50 percent of the contract price.

Any cores obtained in these investigations will be used for evaluation purposes only. Payment will be based on original acceptance samples.

[2]When concrete is part of an item or not a direct pay item, sampling and acceptance testing for the required quantities shall be in accordance with this Section. The value for each cubic yard of concrete required will be assessed at $250 for the purpose of applying payment adjustment percentages. The amount of payment adjustment for the quantity of concrete involved will be deducted from payment.

PART X — MATERIALS

Part X
Materials
Preface

SAMPLING, TESTING AND CERTIFICATION: Except as otherwise specified herein, sampling, testing, and certification shall be in accordance with the following documents. In general, the following priority list will apply.

Sampling and testing frequencies given in the following documents are the minimum required. Additional sampling or testing will be performed as directed to ensure material quality.

When no procedure is referenced, the Materials Engineer Administrator will decide the appropriate sampling, testing, or certification methods to be used.

FIRST - Louisiana Department of Transportation and Development (DOTD) Materials Sampling Manual and DOTD Testing Procedures Manuals (TR).

SECOND - Standards published by the American Association of State Highway and Transportation Officials (AASHTO).

THIRD - Standards published by the American Society for Testing and Materials (ASTM).

QUALIFIED PRODUCTS LIST: When specified, materials shall be approved products listed in the Qualified Products List (QPL) as described in Subsection 101.50.

Section 1001
Hydraulic Cement

1001.01 PORTLAND CEMENT. Portland cement shall be from an approved source listed in QPL 7 and shall conform to AASHTO M 85 with the following exceptions:

(a) Type I(B) and I(C) cement are defined as Type I cement with fineness requirements modified as follows:

	Fineness (sq m/kg)	
Turbidimeter Test	Type I(B)	Type I(C)
Average value, max.	200	255
Max. value, any one sample	210	265
Air Permeability Test		
Average value, max.	360	460
Max. value, any one sample	380	480

(b) Alkali content calculated as sodium oxide equivalent shall not exceed 0.60 percent by weight for all types of cement.

1001.02 PORTLAND-POZZOLAN CEMENT. Portland-pozzolan cement shall be from an approved source listed in QPL 7, shall conform to ASTM C 595, Type IP, and shall contain 20±5 percent by weight fly ash (or bottom ash provided it is interground with the cement clinker). The alkali content of portland-pozzolan cement calculated as sodium oxide equivalent shall not exceed 0.60 percent by weight. Fly ash or bottom ash shall conform to ASTM C 618, Class C or F, except that loss on ignition shall not exceed 6 percent by weight.

1001.03 MASONRY CEMENT. Masonry cement shall conform to ASTM C 91.

Section 1002
Asphaltic Materials and Additives

1002.01 GENERAL. Asphalt shall be prepared by the refining of petroleum. Asphalt shall be uniform in character, free from water, and shall not foam when heated to 350°F. Asphalt shall be from an approved source listed in QPL 41.

Refinery or supplier storage tanks, piping, retorts, booster tanks, and other equipment used in delivering, storing or handling asphaltic materials shall be kept clean and in good operating condition and shall be operated as to avoid contamination of the contents with foreign materials.

Final test results for asphaltic materials will be applied to the proper table in this Section for conformance to specifications. Any deviation from the specifications will result in a payment adjustment as specified.

Samples taken at the refinery or supplier shall conform to specification requirements. When the refinery or supplier sample fails to meet these requirements, the material will be rejected and shall not be shipped to the jobsite.

When asphaltic materials sampled at the point of delivery do not conform to requirements for 100 percent pay, and in the opinion of the engineer have resulted in an unsatisfactory product, the materials shall be removed and replaced or otherwise corrected at no direct pay. The adjustment in pay for asphaltic materials shall be applied only to samples taken at the point of delivery. When test results are such that a payment adjustment would result from more than 1 test value, the payment adjustment for the greatest reduction shall apply.

1002.02 ASPHALTIC MATERIAL ADDITIVES.

(a) Anti-Strip: Anti-strip additives for asphaltic materials shall be approved products listed in QPL 57 and will be tested in accordance with DOTD TR 317.

(b) Silicone: Silicone additives for asphaltic materials shall be approved products listed in QPL 22.

TABLE 1
ASPHALT CEMENT, MODIFIED AASHTO GRADES AC-20 AND AC-30

Applicable to Asphaltic Concrete		AC-20[1]			AC-30[1]		
		Percent of Contract Unit Price/Unit of Measurement of Asphaltic Concrete					
		Specifications	Deviations		Specifications	Deviations	
		100	95	90 or Remove[2]	100	95	90 or Remove[2]
Applicable to Asphalt Cement as a Separate Item		Percent of Contract Unit Price/Unit of Measurement of Asphalt Cement/Shipment					
		Specifications	Deviations		Specifications	Deviations	
	Test Method	100	80	50 or Remove[2]	100	80	50 or Remove[2]
Penetration, 25°C (77°F), 100 g, 5 s	AASHTO T 49	65+[3]	---	59-	55+[4]	---	49-
Viscosity, 135°C (275°F), SSF[5]	ASTM E 102	150+	---	---	175+	---	---
Viscosity, 135°C (275°F), cSt	AASHTO T 201	300+	250-299	249-	350+	300-349	299-
Viscosity, 60°C (140°F), poises	AASHTO T 202	2,000±400	---	1,599- 2,401+	3,000±600	---	2,399- 3,601+
Solubility, %	AASHTO T 44	99.0+	---	---	99.0+	---	---
Flash Point, COC, °C(°F)	AASHTO T 48	232(450)+	---	231(445)-	232(450)+	---	230(445)-
Tests on Residue from Thin Film Oven Test:							
Viscosity, 60°C (140°F), poises	AASHTO T 202	8,000-	---	8,001+	12,000-	---	12,001+
Ductility, 25°C (77°F), 5 cm/min	AASHTO T 51	100+	70-99	69-	100+	70-99	69-
% Loss @ 325°F, 5 h	AASHTO T 179	0.5-	---	0.6+	0.5-	---	0.6+
Spot Test (Standard Naphtha Solvent)	AASHTO T 102	Neg.	---	Pos.	Neg.	---	Pos.

[1]All values are inclusive.
[2]At the option of the engineer.
[3]For samples obtained at point of delivery, the penetration requirements shall be 60 Min.
[4]For samples obtained at point of delivery, the penetration requirement shall be 50 Min.
[5]For samples obtained at point of delivery, the viscosity @ 275°F may be determined using ASTM E 102.

TABLE 2
ASPHALT CEMENT, MODIFIED AASHTO GRADES AC-5 AND AC-10

		AC-5[1]			AC-10[1]		
Applicable to Asphaltic Concrete		Percent of Contract Unit Price/Unit of Measurement of Asphaltic Concrete					
		Specifications	Deviations		Specifications	Deviations	
		100	95	90 or Remove[2]	100	95	90 or Remove[2]
Applicable to Asphalt Cement As a Separate Item		Percent of Contract Unit Price/Unit of Measurement of Asphalt Cement/Shipment					
		Specifications	Deviations		Specifications	Deviations	
	Test Method	100	80	50 or Remove[2]	100	80	50 or Remove[2]
Penetration, 25°C (77°F), 100 g, 5 s	AASHTO T 49	140+[3]	---	129-	85+[4]	---	79-
Viscosity, 135°C (275°F), SSF[5]	ASTM E 102	88+	---	---	125+	---	---
Viscosity, 135°C (275°F), cSt	AASHTO T 201	175+	125-174	124-	250+	200-249	199-
Viscosity, 60°C (140°F), poises	AASHTO T 202	500±100	---	399- 601+	1000±200	---	799- 1201+
Solubility, %	AASHTO T 44	99.0+	---	---	99.0+	---	---
Flash Point, COC, °C(°F)	AASHTO T 48	178(350)+	---	176(345)-	218(425)+	---	216(420)-
Tests on Residue from Thin Film Oven Test:							
Viscosity, 60°C (140°F), poises	AASHTO T 202	2,000-	---	2001+	4,000-	---	4,001+
Ductility, 25°C (77°F), 5 cm/min	AASHTO T 51	100+	70-99	69-	100+	70-99	69-
% loss @ 325°F, 5 h	AASHTO T 179	1.0-	---	1.1	0.5-	---	0.6
Spot Test (Standard Naphtha Solvent)	AASHTO T 102	Neg.	---	Pos.	Neg.	---	Pos.

[1]All values are inclusive.
[2]At the option of the engineer.
[3]For samples obtained at point of delivery, the penetration requirements shall be 130 Min.
[4]For samples obtained at point of delivery, the penetration requirement shall be 80 Min.
[5]For samples obtained at point of delivery, the viscosity @ 275°F may be determined using ASTM E 102.

TABLE 3
ANIONIC EMULSIFIED ASPHALT

		Percent of Contract Unit Price/Gallon or Shipment[1]					
		SS-1			SS-1h		
		Specifications		Deviations	Specifications		Deviations
	Test Method	100	80	50 or Remove[2]	100	80	50 or Remove[2]
Viscosity, 25°C (77°F), SSF	AASHTO T 59	20-100	10-19 101-150	9- 151+	20-100	10-19 101-150	9- 151+
Residue by Distillation, % by wt.	AASHTO T 59	57+	52-56	51-	57+	52-56	51-
Sieve Test (Retained on No. 20)	AASHTO T 59	0.1-	---	---	0.1-	---	---
Cement Mixing	AASHTO T 59	2-	---	---	2-	---	---
Settlement, 5-day, %	AASHTO T 59	5.0-	---	---	5.0-	---	---
Tests on Residue							
Penetration, 25°C (77°F), 100 g, 5 s	AASHTO T 49	100-200	88-99 201-212	87- 213+	40-90	30-39 91-100	29- 101+
Solubility, %	AASHTO T 44	97.5+	---	---	97.5+	---	---
Ductility, 25°C (77°F), 5 cm/min	AASHTO T 51	40+	26-39	25-	40+	26-39	25-

[1]When material is incidental to pay item, use invoice price per gallon.
[2]At the option of the engineer.

TABLE 4
EMULSIFIED LATEX MODIFIED ASPHALT (CRS-2L)[1]

		Percent of Contract Unit Price/Gallon/Shipment[2]		
		Specifications	Deviations	
	TEST METHOD	100	80	50 or Remove[3]
Particle Charge Test	DOTD TR 311	Positive	---	Negative
Viscosity, Saybolt, 122°F, SSF	AASHTO T 59	200-400	156-199 401-444	155- 445+
Sieve Test, Retained on No. 20, %	AASHTO T 59	0.1-	---	---
Residue, %	AASHTO T 59	65+	61-64	60-
Tests on Residue by Evaporation:				
Penetration, 25°C, 100 g, 5 s	AASHTO T 49	100+	84-99	83-
Ductility, 4°C, 5 cm/min, cm	AASHTO T 51	50+	41-49	40-
Softening Point, (Ring & Ball), °C	AASHTO T 53	43.0+	37.1-42.9	37.0-
Force Ductility, 4°C, 5 cm/min, 1000% elongation, lb	DOTD TR 324	0.75+	---	0.74-

[1]The latex shall be a styrene-butadiene rubber which shall be incorporated into the base asphalt prior to emulsification at a rate of not less than 3.0 percent residual solids by weight of asphalt cement.
[2]When the unit of pay is not based on the gallon, the deduction will be applied to the contract unit price.
[3]At the Department's option.

TABLE 5
CATIONIC EMULSIFIED ASPHALT (CRS-2, CMS-2 AND CSS-1h)

		Percent of Contract Unit Price/Gallon or Shipment[1]								
		CRS-2			CMS-2			CSS-1h		
		Specifications		Deviations	Specifications		Deviations	Specifications		Deviations
	Test Method	100	80	50 or Remove[2]	100	80	50 or Remove[2]	100	80	50 or Remove[2]
Viscosity, 50°C (122°F), SSF	AASHTO T 59	100-400	56-99 401-444	55- 445+	50-450	26-49 451-499	25- 500+	---	---	---
Viscosity, 25°C (77°F), SSF	AASHTO T 59	---	---	---	---	---	---	20-100	10-19 101-150	9- 151+
Residue by Distillation, % by wt.	AASHTO T 59	65+	61-64	60-	65+	61-64	60-	57+	52-56	51-
Oil Distillate by Volume, %	AASHTO T 59	3.0-	---	---	12.0-	---	---	---	---	---
Particle Charge	DOTD TR 311	Pos.	---	Neg.	Pos.	---	Neg.	Pos.	---	Neg.
Sieve Test (Retained on No. 20),%	AASHTO T 59	0.1-	---	---	0.1-	---	---	0.1-	---	---
Settlement, 5 Days, %	AASHTO T 59	5.0-	---	---	5.0-	---	---	5.0-	---	---
Tests on Residue										
Penetration, 25°C (77°F) 100 g, 5 s	AASHTO T 49	100-250	84-99 251-266	83- 267+	100-250	84-99 251-266	83- 267+	40-90	30-90 91-100	29- 101+
Solubility, %	AASHTO T 44	97.5+	---	---	97.5+	---	---	97.5+	---	---
Ductility, 25°C (77°F) 5 cm/min	AASHTO T 51	80+	66-79	65-	40+	26-39	25-	40+	26-39	25-
Viscosity, 135°C (275°F), cSt	AASHTO T 201	175+	125-174	124-	---	---	---	---	---	---

[1]When the unit of pay is not based on the gallon, the deduction will be applied to the contract unit price.
[2]At the option of the engineer.

TABLE 6
EMULSIFIED POLYMERIZED ASPHALT (CRS-2P)[1]

		Percent of Contract Unit Price/Gallon or Shipment[2]		
		Specifications	Deviations	
	Test Method	100	80	50 or Remove[3]
Viscosity, SSF, @ 50°C	AASHTO T 59	100-400	56-99 401-444	55- 445+
Storage Stability Test, 24 h, %	AASHTO T 59	1.0-	---	---
Settlement, 5 day, %	AASHTO T 59	5.0-	---	---
Classification Test	AASHTO T 59	Pass	---	Fail
Particle Charge Test	DOTD TR 311	Pos.	---	Neg.
Sieve Test, Retained on No. 20, %	AASHTO T 59	0.1-	---	---
Distillation:	AASHTO T 59			
Oil distillate by vol of emulsion, %		3.0-	---	---
Residue from distillation, %		65+	61-64	60-
Tests on Residue:				
Penetration, 25°C, 100 g, 5 s	AASHTO T 49	100-200	80-99 201-225	79- 226+
Ductility, 25°C, 5 cm/min, cm	AASHTO T 51[4]	125+	101-124	100-
Ductility, 4°C, 5 cm/min, cm	AASHTO T 51[4]	30+	21-29	20-
Softening Point (Ring & Ball), °C	AASHTO T 53	38.0-52.0	32.1-37.9 52.1-58.9	32.0- 59.0+
Solubility, %	AASHTO T 44	97.5+	---	---
Tensile Stress, 4°C, 500 mm/min, @ 800% elongation, kg/cm^2	ASTM D 412[4]	2.0+	---	1.9-
Elastic Recovery, 10°, 5 cm/min, after 20 cm elongation, %	DOTD TR 325[4]	58+	51-57	50-

[1]The addition of latex, rubber or other additives to emulsified polymerized asphalt will not be allowed.
[2]When the unit of pay is not based on the gallon, the deduction will be applied to the contract unit price.
[3]At the Department's option.
[4]The residue asphalt for running ductility tests, tensile stress test and elastic recovery test shall be obtained by means of residue by evaporation (Oven) rather than residue by distillation (Aluminum-alloy Still). The material supplier shall certify by independent testing that the Tensile Stress requirements have been attained.

TABLE 7
MC CUTBACK ASPHALT

		Percent of Contract Unit Price/Gallon or Shipment[1]								
		MC-30			MC-70			MC-250		
		Specifications		Deviations	Specifications		Deviations	Specifications		Deviations
	Test Method	100	80	50 or Remove[2]	100	80	50 or Remove[2]	100	80	50 or Remove[2]
Flash Point, Open Tag, °C(°F)	AASHTO T 79	38(100)+	---	---	38(100)+	---	---	66(150)+	---	---
Viscosity, SSF	AASHTO T 72									
25°C (77°F)		75-150	58-74 151-167	57- 168+	---	---	---	---	---	---
60°C (140°F)		---	---	---	35-70	24-34 71-81	23- 82+	25-250	100-124 251-275	99- 276+
Distillation Test, Distillate Percentage by Volume of Total Distillate to 360°C (680°F)	AASHTO T 78									
to 225°C (437°F)		0.0-25.0	---	---	0.0-20.0	---	---	.0-10.0	---	---
to 260°C (500°F)		40.0-70.0	---	---	20.0-60.0	---	---	.0-55.0	---	---
to 316°C (600°F)		75.0-93.0	---	---	65.0-90.0	---	---	.0-87.0	---	---
Residue from Distillation to 360°C (680°F), Volume Percentage of Sample by Difference		50.0+	45.1-49.9	45.0-	55.0+	50.1-54.9	50.0-	67.0+	62.1-66.9	62.0-
Tests on Residue										
Penetration 25°C (77°F),100 g, 5 s	AASHTO T 49	120-250	102-119 251-268	101- 269+	120-250	102-119 251-268	101- 269+	20-250	102-119 251-268	101- 269+
Solubility, %	AASHTO T 44	99.0+	98.6-98.9	98.5-	99.0+	98.6-98.9	98.5-	99.0+	98.6-98.9	98.5-
Ductility, 25°C (77°F) for Residues to 200 Penetration, 5 cm/min	AASHTO T 51	100+	76-99	75-	100+	76-99	75-	100+	76-99	75-
Ductility, 15.5°C (60°F) for Residues of 200-300 Penetration, 5 cm/min	AASHTO T 51	100+	76-99	75-	100+	76-99	75-	100+	76-99	75-

[1]When material is incidental to the pay item, use invoice price per gallon.
[2]At the option of the engineer.

TABLE 8
RC CUTBACK ASPHALT

		Percent of Contract Unit Price/Gallon or Shipment[1]								
		RC-70			RC-250			RC-800		
		Specifications	Deviations		Specifications	Deviations		Specifications	Deviations	
	Test Method	100	80	50	100	80	50	100	80	50
Flash Point, Open Tag, °C, (°F)	AASHTO T 79	---	---	---	27(80)+	---	---	27(80)+	---	---
Viscosity, SSF 60°C (140°F)	AASHTO T 72	35-70	24-34 71-81	23- 82+	125-250	100-124 251-275	99- 276+	400-800	---	---
Distillation Test, Distillate Percentage by Volume of Total Distillate to 360°C (680°F)	AASHTO T 78	---	---	---	---	---	---	---	---	---
to 190°C (374°F)		10.0+	---	---	---	---	---	---	---	---
to 225°C (437°F)		50.0+	---	---	35.0+	---	---	15.0+	---	---
to 260°C (500°F)		70.0+	---	---	60.0+	---	---	45.0+	---	---
to 316°C (600°F)		85.0+	---	---	80.0+	---	---	75.0+	---	---
Residue from Distillation to 360°C (680°F), Volume Percentage of Sample by Difference		55.0+	50.1-54.9	50.0-	65.0+	60.1-64.9	60.0-	75.0+	70.1-74.9	70.0-
Tests on Residue										
Penetration 25°C (77°F), 100 g, 5 s	AASHTO T 49	80-120	66-79 121-134	65- 135+	80-120	66-79 121-134	65- 135+	80-120	66-79 121-134	65- 135+
Solubility, %	AASHTO T 44	99.0+	98.6-98.9	98.5-	99.0+	98.6-98.9	98.5-	99.0+	98.6-98.9	98.5-
Ductility, 25°C (77°F), 5 cm/min	AASHTO T 51	100+	76-99	75-	100+	76-99	75-	100+	76-99	75-

[1]If material is incidental to pay item, use invoice price per gallon.

TABLE 9
CATIONIC EMULSIFIED PETROLEUM RESIN (EPR-1)

		Percent of Contract Unit Price/Gallon/Shipment		
		Specifications	Deviations	
	TEST METHOD	100	80	50 or Remove[2]
Viscosity, 25°C (77°F), SSF	AASHTO T 59	15-100	10-15	9-
			101-150	151+
Residue by Evaporation, % by wt.	AASHTO T 59	57+	52-56	51-
Particle Charge	DOTD TR 311	Pos.	---	Neg.
Sieve Test (Retained on No. 20), %	AASHTO T 59	0.1-	---	---
Settlement, 5 Days, %	AASHTO T 59	5.0-	---	---

[1]When the unit of pay is not based on the gallon, the deduction will be converted to an equivalent deduction in terms of unit of pay.
[2]At the the option of the engineer.

TABLE 10
AEP EMULSIFIED ASPHALT

		Percent of Contract Unit Price/Gallon/Shipment[1]		
		Specifications	Deviations	
	TEST METHOD	100	80	50 or Remove[2]
Viscosity, 50°C (122°F), SSF	AASHTO T 59	15-150	10-15	9-
			151-200	201+
Residue by Distillation, % by wt.	AASHTO T 59	50+	46-49	45-
Oil Distillate by Volume, %	AASHTO T 59	25.0-	---	---
Sieve Test (Retained on No. 20), %	AASHTO T 59	0.1-	---	---
Storage Stability, 24 h, %	AASHTO T 59	0.1-	---	---
Settlement, 5 Days, %	AAHSTO T 59	5.0-	---	---
Test on Residue				
Penetration, 25°C (77°F), 100 g, 5 s	AASHTO T 49	250+	---	---
Solubility, %	AASHTO T 44	97.5+	---	---

[1]If material is incidental to the pay item, use invoice price per gallon.
[2]At the option of the engineer.

Section 1003
Aggregates

1003.01 GENERAL: Aggregates shall be from an approved source. For a source to be approved, each sample shall conform to the requirements specified below and in the appropriate subsection. In addition to the test methods given in each subsection, the following methods shall be used in testing aggregates.

Property	Test Method
Deleterious Materials	DOTD TR 119
Foreign Matter in Shell	DOTD TR 109
Unit Weight	AASHTO T 19
Specific Gravity & Absorption of Fine Aggregate	AASHTO T 84
Specific Gravity and Absorption of Coarse Aggregate	AASHTO T 85
Polish Value	AASHTO T 278
Amount of Material Finer than the No. 200 Sieve	DOTD TR 112
Sieve Analysis (Gradation)	DOTD TR 113
Specific Gravity of Aggregate for Asphaltic Mixtures	DOTD TR 300
Liquid Limit and Plasticity Index	DOTD TR 428

When the No. 200 sieve is included in the gradation requirements, the results obtained by washing in accordance with DOTD TR 112 shall be added to that obtained by dry sieving in accordance with DOTD TR 113, unless otherwise specified.

(a) Source Approval:

(1) Soundness: The soundness loss of recycled portland cement concrete and aggregates listed in QPL 2 shall not exceed 15 percent when subjected to 5 cycles of the magnesium sulfate soundness test in accordance with AASHTO T 104.

(2) Abrasion: Coarse aggregate listed in QPL 2, and recycled portland cement concrete, except lightweight aggregate shall show an abrasion loss of not more than 40 percent when tested in accordance with AASHTO T 96.

Lightweight aggregate shall be expanded clay or expanded shale and shall show an abrasion loss of not more than 40 percent when tested in accordance with DOTD TR 111.

(3) Recycled portland cement concrete shall be approved in dedicated stockpiles and shall be free of asphaltic concrete overlay material, reinforcing steel, joint material, and other debris. After processing, recycled portland cement concrete shall conform to the requirements specified in the appropriate Subsections. When a stockpile has been approved no other material shall be added without prior approval.

(4) Reclaimed asphaltic pavement shall be cold planed in accordance with Section 509 or crushed. Reclaimed asphaltic concrete shall be approved either at the time of removal from the roadway or in stockpiles. Stockpiled materials shall be uniform and reasonably free of lightweight aggregate, asphaltic concrete friction course, debris, soil, and other foreign matter.

(5) During source approval, aggregates for use in portland cement concrete will be tested in accordance with ASTM C 33 Appendix XI for alkali reactivity properties. Aggregates found to be potentially reactive with cement alkalies will be restricted for use with cement or a combination of cement and fly ash containing 0.6 percent or less alkalies (sodium oxide equivalent).

Fine aggregate for portland cement concrete that produces a color darker than the Organic Color No. 3 when tested in accordance with AASHTO T 21, will be subjected to the mortar strength test in accordance with AASHTO T 71. The minimum compressive strength shall be at least 95 percent of the reference mortar compressive strength.

(b) Acceptance Testing: Acceptance of aggregates shall be based on compliance with the requirements shown in the following subsections provided the aggregates consistently conform to the requirements for source approval in Heading (a).

1003.02 AGGREGATES FOR PORTLAND CEMENT CONCRETE AND MORTAR.

Coarse and fine aggregates for use in concrete shall conform to the requirements of Subsection 1003.01.

(a) Fine Aggregate: Sand shall be a natural sand from a source listed in QPL 2. The percentages of deleterious materials shall not exceed the following values:

Property	Percent, Max
Coal and Lignite	0.25
Clay Lumps	0.05
Clay Lumps and Friable Particles	3.0

Fine aggregate shall conform to the following gradation:

Concrete Sand

U. S. Sieve	% Passing
3/8"	100
No. 4	95-100
No. 16	45-90
No. 50	7-30
No. 100	0-7
No. 200	0-3

Mortar Sand

U. S. Sieve	% Passing
No. 4	100
No. 8	95-100
No. 100	0-25
No. 200	0-10

(b) Coarse Aggregate: Coarse aggregates used in portland cement concrete for bridge decks shall have a Friction Rating of I, II, or III as defined in Subsection 1003.06(a). The maximum amounts by weight of deleterious materials for coarse aggregate shall be as follows:

Property	Percent, Max.
Clay Lumps	0.05
Total Clay Lumps and Friable Particles	3.0
Iron Ore	2.0[1]
Coal and Lignite	1.0[1]
Flat or Elongated Particles	15.0
Wood (Wet)	0.05
Total Clay Lumps and Friable Particles, Coal and Lignite, and Wood	5.0

[1]Aggregate used in railings shall be free from coal, lignite and iron ore.

(1) Uncrushed Coarse Aggregate: Uncrushed coarse aggregate shall conform to the following gradations:

PERCENT PASSING

U.S. Sieve	Grade A	Grade B	Grade D	Grade F
2 1/2"	---	---	100	---
2"	---	100	90-100	---
1 1/2"	100	85-100	---	---
1"	90-100	---	35-80	---
3/4"	---	35-85	---	100
1/2"	25-60	- - -	---	90-100
No. 4	0-10	0-6	0-6	15-60
No. 8	0-5	---	---	0-15
No. 16	---	---	---	0-5
No. 200	0-1	0-1	0-1	0-1

(2) Crushed Coarse Aggregate: Crushed coarse aggregate shall conform to the uncrushed coarse aggregate gradations except that when the material finer than the No. 200 sieve consists of the dust fraction from crushing, essentially free of clay or shell, this percentage shall be 0-2 percent. When the total material passing the No. 200 sieve from the coarse and fine aggregates does not exceed 5 percent, the percent passing the No. 200 from the crushed coarse aggregate may be increased to 3 percent.

(3) Lightweight Coarse Aggregate: Lightweight coarse aggregates shall conform to the following gradation for Grade Y aggregate:

U. S. Sieve	Percent Passing
3/4"	100
1/2"	90-100
3/8"	40-80
No. 4	0-15
No. 8	0-5

The unit weight (AASHTO T 19) of lightweight coarse aggregate shall not exceed 55 pounds per cubic foot, dry loose measurement. If the unit weight of any shipment of lightweight coarse aggregate differs by more than 10 percent from that of the sample submitted for acceptance tests, the shipment may be rejected.

When tested in accordance with ASTM C 330, the drying shrinkage of 3-by-3-by-11 1/4-inch Class X concrete specimens shall not exceed 0.07 percent.

(4) Recycled Portland Cement Concrete: Recycled portland cement concrete shall conform to the requirements for crushed coarse aggregate in Heading (2).

1003.03 BASE COURSE AGGREGATES.

(a) Sand Clay Gravel: This aggregate shall conform to the requirements of Subsection 1003.01, and shall be composed of a uniform mixture of sand, clay, and siliceous gravel, stone or recycled portland cement concrete.

The mixture, as determined by visual inspection, shall be reasonably free from foreign matter. The mixture shall conform to the following gradation:

U. S. Sieve	(Untreated) Percent Passing	(Cement Treated or Stabilized) Percent Passing
1 1/2"	85-100	95-100
No. 4	40-60	40-65
No. 40	20-45	20-50
No. 200	10-20	10-25

Material passing the No. 40 sieve shall conform to the following requirements:

	Untreated	Cement Treated or Stabilized
Liquid Limit (Max.)	25	35
Plasticity Index (Max.)	6	12

Stone and recycled portland cement concrete in the mixture shall conform to Subsection 1003.01.

(b) Shell: This aggregate shall be either reef shell or a mixture of clam and reef shell; however, not more than 70 percent by weight of the mixture shall be clam shell (DOTD TR 110). The material shall contain not more than 5 percent foreign matter (DOTD TR 109).

(c) Sand-Shell: This aggregate shall be a mixture of 65 percent shell and 35 percent sand by volume as verified by proof of material deliveries.

(1) Shell: Shell in the mixture shall be either clam shell or reef shell or any combination thereof. The material shall contain not more than 5 percent foreign matter (DOTD TR 109).

(2) Sand: Sand in the mixture shall be siliceous material containing not more than 4 percent organic matter (DOTD TR 413) and conforming to the following gradation:

U. S. Sieve	Percent Passing
No. 4	85-100
No. 40	65-100
No. 200	0-35

Sand shall conform to the following requirements:

Liquid Limit (Max.)	25
Plasticity Index (Max.)	6

(d) Stone: This material shall consist of 100 percent stone and shall conform to the following gradation:

U. S. Sieve	Percent Passing
1 1/2"	100
1"	90-100
3/4"	70-100
No. 4	35-65
No. 40	12-32
No. 200	5-12

The fraction of stone passing the No. 40 sieve shall be non-plastic.

(e) Recycled Portland Cement Concrete: Recycled portland cement concrete shall be 100 percent crushed portland cement concrete or will be permitted in combination with an approved stone for base course. After being crushed, the recycled portland cement concrete or the combination of stone and recycled portland cement concrete shall conform to the following gradation.

U. S. Sieve	Percent Passing
1 1/2"	100
1"	90-100
3/4"	70-100
No. 4	35-65
No. 40	12-32
No. 200	5-12

The fraction of recycled portland cement concrete passing the No. 40 sieve shall be non-plastic.

(f) Crushed Slag: The material shall be 100 percent slag and shall conform to the requirements of Heading (d). The fraction of crushed slag passing the No. 40 sieve shall be non-plastic.

1003.04 AGGREGATES FOR SURFACE COURSE. Aggregates for surface course shall conform to the requirements of Subsection 1003.01.

(a) Stone: This material shall consist of 100 percent stone and shall conform to the following gradations:

U. S. Sieve	Percent Passing
1 1/2"	100
3/4"	50-100
No. 4	35-65
No. 40	10-32
No. 200	3-15

The fraction of stone passing the No. 40 sieve shall be non-plastic.

(b) Sand Clay Gravel: This material shall be a mixture of sand, clay, and siliceous gravel, stone or recycled portland cement concrete. The mixture shall be reasonably free from foreign matter as determined by visual inspection.

The mixture, prior to treatment shall conform to the following gradation:

U. S. Sieve	Percent Passing Untreated	Percent Passing Lime Treated
1 1/2"	95-100	95-100
No. 4	40-65	40-65
No. 40	20-50	---
No. 200	10-25	10-25

The fraction passing the No. 40 sieve shall conform to the following requirements:

	Untreated	Lime Treated
Liquid Limit (Max.)	35	40
Plasticity Index	4-12	4-20

Stone and recycled portland cement concrete in the mixture shall conform to Subsection 1003.01.

(c) Shell: This material shall be either reef shell or a mixture of clam and reef shell, except that not more than 50 percent by weight of the mixture shall be clam shell (DOTD TR 110). The material shall contain not more than 15 percent foreign matter (DOTD TR 109) and shall meet the following gradation:

U. S. Sieve	Percent Passing
2"	100
No. 4	30-75

(d) Recycled Portland Cement Concrete: Recycled portland cement concrete shall be 100 percent crushed portland cement concrete and will be permitted in combination with other approved stone for surface courses. After being crushed the recycled portland cement concrete or a combination of stone and recycled portland cement concrete shall conform to the following gradation.

U. S. Sieve	Percent Passing
1 1/2"	100
3/4"	50-100
No. 4	35-65
No. 40	10-32
No. 200	3-15

(e) Reclaimed Asphaltic Pavement (RAP): The reclaimed asphaltic pavement material shall conform to Subsection 1003.01 and the following gradation:

U. S. Sieve	Percent Passing
2 1/2"	100
No. 4	35-75

(f) Crushed Slag: This material shall be 100 percent crushed slag and shall conform to the requirements of Heading (a).

1003.05 AGGREGATES FOR ASPHALTIC SURFACE TREATMENT. Aggregates for asphaltic surface treatment shall conform to Subsection 1003.01 and shall be either crushed gravel, crushed stone, crushed slag or lightweight aggregate and shall be assigned a Friction Rating in accordance with Subsection 1003.06(a). Aggregates shall conform to the gradation requirements in Table 8.

Crushed gravel Size 1 and Size 2 shall have 60 percent minimum crushed retained on the No. 4 sieve. Crushed gravel Size 3 shall have 75 percent crushed retained on the No. 4 sieve. The percent crushed shall be determined in accordance with DOTD TR 306.

The maximum amounts of deleterious materials shall be as follows:

Property	Percent (Max.)
Clay Lumps	0.05
Total Clay Lumps and Friable Particles	3.0
Iron Ore	2.0
Glassy Particles in Slag	10.0
Flat or Elongated Particles	15.0
Coal and Lignite	1.0
Wood (Wet)	0.05
Total Clay Lumps and Friable Particles, Coal and Lignite, and Wood	5.0

TABLE 11
ASPHALTIC SURFACE TREATMENT AGGREGATES
PERCENT PASSING

	Size 1		Size 2	Size 3
U. S. Sieve	Slag or Stone Aggregate	Crushed Gravel or Lightweight Aggregate	All Aggregate	All Aggregate
1 1/2"	100	100	---	---
1"	90-100	95-100	---	---
3/4"	20-55	60-90	100	---
1/2"	0-10	---	90-100	100
3/8"	0-5	0-15	40-70	85-100
No. 4	---	0-5	0-15	10-40
No. 8	---	---	0-5	0-10
No. 16	---	---	---	0-5
No. 200	0-1	0-1	0-1	0-1

1003.06 AGGREGATES FOR ASPHALTIC MIXTURES.

(a) Asphaltic Concrete: Aggregates for asphaltic mixtures shall conform to the requirements of Subsection 1003.01 except that reclaimed asphaltic pavement, recycled portland cement concrete, crushed shell, sand gravel, and fine sand are not required to be from sources listed on QPL 2 but shall be from approved sources.

(1) Gravel, Stone and Crushed Slag: These aggregates shall conform to Subsection 1003.05 for deleterious substances.

These aggregates shall be assigned a Friction Rating as follows:

FRICTION RATING	DESCRIPTION
I	Aggregates that have a Polish Value of greater than 37 and demonstrate the ability to retain acceptable friction numbers for the life of the pavement.
II	Aggregates that have a Polish Value of 35 to 37 and demonstrate the ability to retain acceptable friction numbers for the life of the pavement.
III	Aggregates that have a Polish Value of 30 to 34 and demonstrate the ability to retain acceptable friction numbers for the life of the pavement.
IV	Aggregates with a Polish Value of 20 to 29.

(2) Coarse Sand: Coarse sand shall be natural occurring sand processed to meet asphaltic mixture requirements, shall be graded from coarse to fine, and shall be free from vegetative and other foreign matter.

(3) Fine Sand: Fine sand shall be natural occurring sand processed to meet asphaltic mixture requirements, and shall be free from vegetative and other foreign matter.

The fine sand shall be nonplastic and no clay balls or clay lumps shall be incorporated into the asphaltic mixture. The gradation shall have a maximum of 35 percent passing the No. 200 sieve. Clay lumps shall not exceed 1.00 percent by weight when sampled from the stockpile and tested in accordance with DOTD TR 119.

(4) Natural Sand: Natural sand shall be coarse sand or a combination of coarse sand and fine sand which is used in the asphaltic concrete mixture. Natural sand shall consist of clean, hard, durable, siliceous grains graded from coarse to fine and shall be reasonably free from vegetative matter or other deleterious materials.

The sand equivalent of the fraction passing the No. 4 sieve of the natural sand in the asphaltic concrete mixture shall not be less than 35 when tested in accordance with DOTD TR 120.

(5) Crushed Shell: Shell material shall consist of clam or reef shell. Foreign matter (DOTD TR 109) such as silt and clay shall not exceed 5 percent, and such material shall be dispersed throughout the mass.

(6) Screenings: Screenings, when used, shall be made by crushing aggregates which conformed to the requirements for coarse aggregates in Subsection 1003.01. Screenings shall meet the following gradation requirements.

U. S. Sieve	Percent Passing
3/8"	100
No. 4	80-100

(7) Expanded Clay Coarse Aggregate: Expanded clay coarse aggregate shall consist of angular fragments of uniform density free from an excess of foreign matter. These aggregates shall conform to Subsection 1003.05 for deleterious materials.

(8) Pit Run Sand-Gravel: Pit run sand-gravel may be used in Type 5 mixes provided the material is separated into 2 sizes prior to final mixing. The separation shall be done by using a No. 4 screen or other approved sizes. For batch plants, the screening process shall be adequate to satisfy this requirement. Pit run sand-gravel shall be non-plastic. No clay balls or clay lumps shall be incorporated into the asphaltic mixture. Clay lumps shall not exceed 1.00 percent by weight when tested in accordance with DOTD TR 119.

(9) Recycled Portland Cement Concrete: Recycled portland cement concrete source shall meet the requirements of Subsection 1003.02(b)(4). The maximum amount of deleterious materials shall conform to Subsection 1003.05.

(10) Reclaimed Asphaltic Pavement (RAP): Reclaimed asphaltic material shall conform to Subsection 1003.01.

(11) Mineral Filler: Mineral filler shall be an approved product listed on QPL 10 and shall consist of limestone dust, pulverized hydrated lime, shell dust, portland cement, or cement stack dust. Mineral dust collected in bag houses or by other dust collectors at asphaltic concrete plants is not classified as mineral filler. Cement stack dust shall consist of material collected from waste rotary kiln gases discharged through a collector of a cement plant. Mineral filler shall conform to the following gradation:

U. S. Sieve	Percent Passing
No. 30	100
No. 80	95-100
No. 200	70-100
No. 270	60-100

Mixtures of aggregate, filler and asphalt, in proportions to meet the requirements of mixes being used, shall have an index of retained Marshall Stability (DOTD TR 313) of at least 85 percent, and a maximum of 1.0 percent volumetric swell (DOTD TR 313).

(b) Asphalt Treated Drainage Blanket: Coarse aggregates shall be crushed gravel, stone, or crushed slag conforming to the requirements of Subsection 1003.01 and the requirements of Subsection 1003.05 for deleterious material. These aggregates shall conform to Heading (a)(1) of this Subsection. Aggregates with a Friction Rating of I, II, III or IV may be used.

1003.07 GRANULAR MATERIAL. Granular material shall be nonplastic and siliceous material, shall conform to Subsection 1003.01, and the following gradation:

U. S. Sieve	Percent Passing
1/2"	100
No. 10	75-100
No. 200	0-10

1003.08 BEDDING MATERIAL. Bedding materials shall consist of stone, recycled portland cement concrete, expanded clay, shell, or a mixture of either recycled portland cement concrete, gravel, crushed slag, stone, or shell with granular material conforming to Subsection 1003.01.

(a) Stone or Recycled Portland Cement Concrete: Stone or recycled portland cement concrete shall conform to Subsection 1003.03 or 1003.04.

(b) Expanded Clay: Expanded clay shall conform to the following gradation:

U. S. Sieve	Percent Passing
3/8"	100
No. 4	50-100
No. 8	15-60
No. 50	0-15
No. 100	0-10

(c) Shell: Shell shall conform to Subsection 1003.04(c).

(d) Sand-Aggregate: The sand-aggregate material shall be a natural or artificial mixture of sand and gravel, crushed slag, recycled portland cement concrete, or other approved aggregate listed in this Subsection. Material passing the No. 40 sieve shall be nonplastic. The mixture shall be free of foreign matter as determined by visual inspection and shall conform to the following gradation prior to placement.

U. S. Sieve	Percent Passing
1 1/2"	95-100
No. 4	30-50
No. 10	20-45
No. 200	0-10

(e) Mixtures: Recycled portland cement concrete, gravel, stone, crushed slag or shell shall be mixed with 35±5 percent granular material by volume. The mixture shall be verified by proof of material deliveries.

(1) Gravel: Gravel shall conform to the following gradation.

U. S. Sieve	Percent Passing
1 1/2"	95-100
No. 4	0-15
No. 200	0-2

(2) Recycled Portland Cement Concrete, Crushed Slag, or Stone: Recycled portland cement concrete, crushed slag or stone shall conform to the following gradation:

U. S. Sieve	Percent Passing
1 1/2"	95-100
3/4"	40-85
No. 4	0-15

(3) Shell: Shell may be either whole or crushed or a combination thereof, and shall consist of clam or reef shell or any combination thereof. Foreign matter content (DOTD TR 109) of the shell shall not exceed 10 percent.

(4) Granular Material: Granular Material shall conform to Subsection 1003.07.

1003.09 NONPLASTIC EMBANKMENT.

(a) Materials: Nonplastic embankment materials shall be sand, or shell. The maximum organic content shall be 4.0 percent.

(1) Sand: Sand embankment shall consist of nonplastic material with at least 75 percent passing the No. 4 sieve and containing not more than 15 percent passing the No. 200 sieve when tested in accordance with DOTD TR 112 and DOTD TR 113.

(2) Shell: Shell embankment materials shall be clam shell or reef shell or any combination thereof. The material shall be reasonably free of fragmented reef shell. Foreign matter content and material passing the No. 200 sieve shall not exceed 15 percent when tested in accordance with DOTD TR 109.

Section 1004
Masonry Units

1004.01 SEWER BRICK. Sewer brick shall be made from clay, shale or concrete.

Brick made from clay or shale for use in junction boxes, catch basins, arches, manholes and for backings shall conform to AASHTO M 91, Manhole Brick, Grade MM.

Concrete brick shall conform to ASTM C 139, except that the minimum thickness of each unit shall not be less than 3 5/8 inches.

1004.02 BUILDING BRICK.

(a) Building brick made from clay or shale for use in brick masonry shall conform to AASHTO M 114, Grade SW.

(b) Concrete building brick for use in masonry buildings shall conform to ASTM C 55, Grade N-II.

1004.03 CONCRETE BUILDING BLOCK. Concrete hollow load-bearing building block shall conform to ASTM C 90, Grade N-II.

1004.04 CELLULAR CONCRETE BLOCKS. Cellular concrete blocks shall be manufactured by machines employing high vibratory compaction. The blocks shall conform to ASTM C 145, Grade N-II, except the oven-dry weight of concrete shall be at least 130 pounds per cubic foot based on bulk specific gravity. Permissible block dimension variations will be as directed.

Section 1005
Joint Materials for Pavements and Structures

1005.01 PREFORMED JOINT FILLERS.

(a) Preformed Resilient Bituminous Types: Fillers shall consist of preformed strips which have been formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly saturated with a suitable bituminous binder, or strips which have been formed from clean, granulated cork particles securely bound together by a suitable bituminous binder and encased between two layers of felt.

The type shall be as specified and shall conform to AASHTO M 213.

(b) Wood Fillers: Bottom boards shall be clear heart redwood. Top boards shall be any type of wood which is free from defects and meets dimensional requirements. Occasional medium surface checks will be permitted provided the board is free of defects that will impair its usefulness.

Boards shall not vary from specified dimensions in excess of the following tolerances:

	Tolerance (Inches)
Thickness	-0, +1/16
Depth	±1/8
Length	±1/4

The load required to compress the material in an oven-dry condition to 50 percent of its original thickness shall not exceed 1800 psi.

(c) Preformed Bituminous Type: Bituminous preformed expansion joint filler shall consist of bituminous (asphalt or tar) mastic composition, formed and encased between two layers of bituminous impregnated felt. The preformed filler shall conform to ASTM D 994.

(d) Preformed Asphalt Ribbon: This filler shall consist of preformed strips of bitumen and inert filler material conforming to the following requirements:

Thickness, inches	1/8-3/16
Depth tolerance, inches	±1/8
Weight, lb/hundred sq ft, Min.	50
Tensile Strength, lb/inch width, Min.	50
Bitumen, % by wt (ASTM D 545), Min.	60

The tensile strength is determined by pulling a 1-by-6-inch sample at a 20-inch/minute separation rate.

This material shall be resistant to cracking, tearing or permanent deformation under normal handling and installation procedures. It shall be sufficiently rigid to enable it to form a straight joint.

(e) Preformed Closed Cell Polyethylene Joint Filler: The joint filler shall be formed by the expansion of polyethylene base resin, extruded as a multicellular, closed cell, homogeneous section of foamed

polyethylene. This material shall be used with an adhesive-lubricant. Joint fillers and adhesive-lubricants shall be approved products listed in QPL 18.

The joint filler shall conform to the following requirements:

Property	Test Method	Requirements
Density, pcf	ASTM D 3574	1.1-3.0
Water Absorption, % by volume, Max.	ASTM C 272[1]	1.0
Compression, psi	ASTM D 1056	
@ 20% deflection, Min.		3.0
@ 80% deflection, Max.		125.0
Extrusion @ 80% deflection, inches, Max.	ASTM D 545	0.12

[1]The requirement that materials which trap water in flutes be dipped in absolute alcohol shall be omitted. Instead, the joint filler shall be dried quickly by blotting with absorbent paper.

1005.02 POURED AND EXTRUDED JOINT SEALANT.

(a) Hot Poured Rubberized Asphaltic Type: This material shall conform to ASTM D 3405. The sealant and backer materials shall be approved products listed in QPL 67. Backer material shall be heat resistant, capable of withstanding temperatures up to 410°F.

(b) Polyurethane Sealants: This joint system shall be either a 1- or 2-component, pourable or extrudable sealant, with required primers and backer material. It shall cure to a solid rubber-like material able to withstand both tension and compression.

Polyurethane polymer sealant with required primers and backer materials shall be approved products listed in QPL 5.

The container shall be labeled with the name and type of material, batch number, manufacture date, and expiration date.

The material shall conform to the following requirements.

Property	Test Method	Requirements
Flow, inches, Max	AASHTO T 187[1]	0.2
Tack-Free Time, h, Max.	Fed. Spec. TT-S-00227	72
Bond, in. sep., Max.	DOTD TR 635	0.25
Resilience, %, Min.	DOTD TR 623	75
Ball Penetration	DOTD TR 623	5-20
Resilience (after heat aging) %, Min.	DOTD TR 623	75
Weatherometer, 600 h, Min.	DOTD TR 611	Pass
Ozone Resistance (Exposure to 100 pphm ozone for 100 h @ 104°F, sample under 20% strain or bent loop)	ASTM D 1149	No Cracks
Weight loss, %, Max.	Fed. Spec. TT-S-00227	10
Infrared Charts	DOTD TR 610	
Activator		Pass
Base		Pass

[1]The flow test will be conducted according to AASHTO T 187 except that samples shall be placed in an oven maintained at 150±2°F for 24 hours.

(c) Silicone Sealant: This joint system shall be a one-component extrudable sealant and backer material with primer, if required. The

silicone polymer shall cure to a solid rubber-like material able to withstand both tension and compression.

Silicone polymer sealant, backer materials with primers, if required, shall be approved products listed in QPL 42.

The container shall be labeled with the name and type of material, batch number, manufacture date, and expiration date.

The silicone sealant shall conform to Fed. Spec. TT-S-001543 for Class A Sealants as modified by the following test requirements:

Property	Test Method	Requirements
Flow, inches, Max.	AASHTO T 187[1]	0.3
Tack-Free Time at 77°F and 45-55% R.H., minutes	Fed. Spec. TT-S-00227	20-75
Resilience, %, Min.	ASTM D 3583[2]	60
Resilience (after heat aging), %, Min.	ASTM D 3583[2]	60
Durometer, Shore A	ASTM C 661[2]	10-25
Tensile Stress at 150% Elongation, psi, Max.	ASTM D 412, Die C[2]	75
Elongation, %, Min.	ASTM D 412, Die C[2]	1000
Bond, inches separation, Max.	DOTD TR 635	0.25

[1]Flow test will be conducted according to AASHTO T 187, except that samples shall be placed in an oven maintained at 150±2°F for 24 hours or as recommended by the manufacturer

[2]Cured 7 days at 75-90°F and 45-55 percent relative humidity or as recommended by the manufacturer.

1005.03 PREFORMED ELASTOMERIC COMPRESSION JOINT SEALS.

(a) Seals: This joint system shall be an approved product listed in QPL 6.

Uncompressed depth of the seal shall be equal to or greater than the uncompressed width of the seal. Actual width of the seal shall not be less than the nominal width of the seal.

The seal will be tested for compression-deflection in accordance with DOTD TR 612.

(1) Pavement Use: The material shall conform to ASTM D 2628 with the following exceptions:

a. The test for ozone resistance may be determined by the bent loop test method.

b. The seal shall exert a minimum pressure of 3.0 psi (4.0 psi for expansion joints) at 80 percent of nominal width and a maximum of 25.0 psi at 50 percent of nominal width.

(2) Bridge Use: The seal shall conform to ASTM D 3542 and the seal shall exert a minimum pressure of 4.0 psi at 80 percent of nominal width.

(b) Adhesive-Lubricant: The adhesive-lubricant for pavement and bridge use shall conform to ASTM D 4070 and shall be an approved product listed in QPL 8.

1005.04 COMBINATION JOINT FORMER/SEALER.

(a) Description: This joint former/sealer is intended for use in simultaneously forming and sealing a weakened plane in portland cement concrete pavements.

The material shall consist of an elastomeric strip epoxied into a toothed groove formed at the top of each of two rigid plastic side frames or mechanically bonded at the top of the two rigid plastic side frames and covered with a removable plastic top cap. Side frames shall be of such configuration that when the sealer is inserted into plastic concrete and vibrated, a permanent bond forms between side frames and concrete.

(b) Material Requirements:

(1) Elastomer: The elastomer strip portion of the material shall be manufactured from vulcanized elastomeric compound using polymerized chloroprene as the base polymer, and shall conform to the following requirements:

Property	Test Method	Requirements
Tensile Strength, psi, Min.	ASTM D 412	1800
Elongation at Break, %, Min.	ASTM D 412	200
Hardness, Shore A	ASTM D 2240	65±10
Properties after Aging, 70 h @ 212°F	ASTM D 573	
Tensile Strength, % loss, Max.		20
Elongation, % loss, Max.		25
Hardness, pts. increase, Max.		10
Ozone Resistance, 20% strain or bentloop, 300 pphm in air, 70 h @ 104°F	ASTM D 1149	no cracks
Oil Swell, ASTM Oil #3, 70 h @ 212°F, wt change, % Max.	ASTM D 471	45

(2) Bond of Elastomer to Plastic: The force required to shear the elastomer from the plastic shall be a minimum of 5.0 pounds per linear inch of sealer when tested in accordance with DOTD TR 636.

(3) Bond of Plastic to Cement Mortar: This bond will be evaluated and shall meet the following requirements:

The force required to separate the cement mortar from the plastic shall be a minimum of 5.0 pounds per linear inch of sealer when tested in accordance with DOTD TR 636.

1005.05 STRIP SEAL JOINT. Strip seal joints with neoprene strip seal shall be as shown on the plans.

The neoprene strip seal shall be an extruded neoprene material conforming to ASTM D 2628 with the following exceptions:

(1) The test for ozone resistance may be determined by the bent loop method.

(2) The recovery and the compression-deflection tests shall be omitted.

1005.06 REINFORCED ELASTOMERIC JOINT SEALS. This material shall consist of integrally molded units of elastomer and bonded metal components so arranged as to provide for expansion and contraction movements. Metal components bridging the joint gap shall be of sufficient strength to carry wheel loads across the joint. The total system with components shall be an approved product listed in QPL 45.

1005.07 JOINT MATERIALS FOR EXPANSION JOINT-MODIFIED (TYPE EJ-MODIFIED): This material shall be a preformed polyurethane foam joint filler made with a semi-open, flexible polyurethane foam which is molded to such cross sectional shape that it can be easily installed in the pavement joint with parallel sides and which will be sufficiently self-locking to

prevent the material from floating out of the joint. The molded polyurethane foam shall be free of defects and internal voids greater than 1/2 inch. The molded polyurethane foam shall show no evidence of deterioration when immersed in a 50 percent, by volume solution of mineral spirits and linseed oil for 24 hours. When the joint filler is used to form the joint, the self-locking feature will not be required and the joint filler will extend full depth.

The properties of the polyurethane foam when determined on skin-free specimens shall conform to the following requirements:

Property	Test Method	Requirements
Density, pcf	ASTM D 3574	7-11
Compression, psi	ASTM D 3574	
25% Deflection		3-7
65% Deflection		8-16
Recovery, % of original, Min.	ASTM D 3574[1]	95
Tensile Strength, psi, Min.	ASTM D 3574	25
Water Absorption, % vol, Max. (1" thick specimen)	AASHTO T 42	30

[1]65 percent deflection, after 1 minute relaxation from deflection return.

Lubricant-adhesive recommended by the joint filler manufacturer shall be used and applied according to the manufacturer's directions.

1005.08 WATERSTOPS.

(a) Copper waterstops shall conform to ASTM B 370, soft temper.

(b) Polyvinyl chloride (PVC) waterstops shall conform to U. S. Army Corps of Engineers Specification CRD-C 572.

(c) Rubber waterstops shall conform to U. S. Army Corps of Engineers Specification CRD-C 513.

Details of installation and splicing, when not shown on the plans, shall be submitted to the DOTD Materials Engineer Administrator for approval. When polyvinyl chloride waterstops are used, the contractor shall submit a Certificate of Compliance indicating conformance to these specifications.

Section 1006
Concrete and Plastic Pipe

1006.01 GENERAL.

(a) Portland-pozzolan cement conforming to Subsection 1001.02 may be used in the manufacture of concrete pipe and pipe arch.

(b) Any admixture for portland cement concrete listed in QPL 58 is allowed for use in concrete pipe manufacture except for chloride-type accelerators and high range water reducers.

(c) Compressive strength specimens for concrete pipe shall be made and cured in accordance with DOTD TR 227 and tested in accordance with DOTD TR 230.

(d) Concrete pipe shall be cured by one of the methods listed in ASTM C 76 as approved by the Materials and Testing Section.

1006.02 CONCRETE SEWER PIPE. Nonreinforced (plain) concrete sewer pipe shall conform to ASTM C 14, Class III. Joints shall conform to Subsection 1006.05.

1006.03 REINFORCED CONCRETE PIPE. Reinforced concrete pipe shall conform to ASTM C 76, amended as follows:

(a) Unless otherwise specified, Class III, Wall A, B or C pipe shall be furnished.

(b) When extra strength pipe is required, either Class IV or Class V pipe shall be furnished as specified. Either Wall A, B or C may be furnished.

(c) For pipe sizes not included in ASTM C 76, the area of reinforcement shall be approved in accordance with ASTM C 655. The producer shall provide fabrication drawings and design calculations reflecting conformance with these specifications prior to pipe fabrication.

(d) No modified designs will be allowed.

(e) Joints shall conform to Subsection 1006.05.

1006.04 REINFORCED CONCRETE PIPE ARCH. Reinforced concrete pipe arch shall conform to ASTM C 506, amended as follows:

(a) Unless otherwise specified, Class A-III pipe arch shall be furnished.

(b) No modified designs will be allowed.

(c) For pipe arch sizes not included in ASTM C 506, the area of reinforcement shall be approved in accordance with ASTM C 655. The producer shall provide fabrication drawings and design calculations reflecting conformance to these specifications prior to pipe fabrication.

(d) Joints shall conform to Subsection 1006.05.

1006.05 CONCRETE PIPE JOINTS. Joints for concrete pipe and pipe arch shall conform to AASHTO M 198 with the following modifications. Gasket material shall conform to Subsection 1006.06. All joint systems will be approved by the Materials Engineer Administrator.

(a) Type 3 Joints (T3):

(1) Pipe for Type 3 joints shall have a maximum taper of 12° and a maximum differential between the joint taper of the bell and spigot (tongue and groove) of 1° with the following exception. A maximum allowable differential between the bell and spigot (tongue and groove) may be 2° provided the taper is 6° or less and it will pass the 10 psi hydrostatic pressure test. The 10-psi pressure hydrostatic test requirement will apply to all pipe with diameters greater than 15 inches when the groove (bell) depth and tongue (spigot) length is less than 2 1/2 inches, and will apply to all pipe with diameters of 15 inches or less when the groove depth and tongue length is less than 2 inches.

(2) Joints for use with rubber gaskets which have a taper less than 6° will not require the hydrostatic pressure test, except as provided in Paragraph (1). If the joint taper is 6° to 8° inclusive , its use will be permitted provided the joint will pass the 10-psi hydrostatic pressure test.

(3) Joints for use with flexible plastic gaskets which have a taper of 10° or less will not require the hydrostatic pressure test except as provided in paragraph (1). When the joint taper is 10° to 12° inclusive, its use will be permitted provided the joint will pass the 10-psi hydrostatic pressure test.

(b) Type 2 Joints (T2): Pipe for Type 2 joints shall have joints approved by the Materials and Testing Section, shall use approved rubber or flexible plastic gaskets and shall pass the 5-psi hydrostatic pressure test.

(c) Type 1 Joints (T1): Pipe for Type 1 joints shall be soil tight, approved, and shall use approved rubber or flexible plastic gaskets.

(d) Repair of Joints: Joint repairs shall conform to ASTM C 443.

1006.06 GASKET MATERIALS. Gasket material sizes shall be as approved by the Materials and Testing Section.

(a) Rubber Gaskets: Rubber gaskets for pipe joints shall conform to AASHTO M 198, Type A. The rubber gaskets and lubricant shall be approved products listed in QPL 4. Each rubber gasket shall be identified with a batch or lot number.

(b) Flexible Plastic Gaskets: Flexible plastic gaskets for pipe joints shall conform to AASHTO M 198, Type B. Flexible plastic gasket material and primer shall be approved products listed in QPL 4.

1006.07 PLASTIC CULVERT PIPE: Plastic culvert pipe and joint systems shall be approved products listed in QPL 66.

(a) Plastic culvert pipe shall be one of the following:

(1) Ribbed Polyvinyl Chloride Culvert Pipe (RPVCCP): Ribbed Polyvinyl Chloride Culvert Pipe shall conform to ASTM F 794, Series 46.

(2) Polyvinyl Chloride Culvert Pipe (Smooth Wall) (PVCCP): Polyvinyl Chloride Culvert pipe shall conform to AASHTO M 278 for pipe 15 inches and less, and ASTM F 679 for pipe larger than 15 inches in diameter.

(3) Corrugated Polyethylene Culvert Pipe (Double Wall) (CPECP): Corrugated Polyethylene Culvert pipe (Double Wall) shall conform to AASHTO M 294, Type S. The resin shall have a minimum cell classification of 315412C in accordance with ASTM D 3350.

(4) Ribbed Polyethylene Culvert Pipe (RPECP): Ribbed polyethylene culvert pipe shall conform to ASTM F 894, RSC 160. The resin shall have a minimum cell classification of 334433C in accordance with ASTM D 3350.

(5) Polyethylene Ribbed Culvert Pipe (PERCP): Polyethylene Ribbed Culvert Pipe shall conform to ASTM F 894, RSC 100. The resin shall have a minimum cell classification of 334433C in accordance with ASTM D 3350.

(6) Polyvinyl Chloride Ribbed Culvert Pipe (PVCRCP): Polyvinyl Chloride Ribbed Culvert Pipe shall conform to AASHTO M 304 with UV inhibitors.

(b) Joints shall be approved by the Materials and Testing Section and shall conform to the following:

(1) Joint gasket materials shall conform to Subsection 1006.06.

(2) Type 3 Joints (T3): These joints shall pass the 10 psi hydrostatic pressure test.

(3) Type 2 Joints (T2): These joints shall pass the 5 psi hydrostatic pressure test.

(4) Type 1 Joints (T1): These joints shall provide a soil tight joint.

(5) Joints with split coupling bands: Split coupling bands shall be one piece and composed of the same material as the pipe. The bands shall be the same thickness as the base pipe. The width of the band shall be equal to half the diameter of the pipe but shall be a minimum of 12 inches wide. The band shall be secured to the pipe with a minimum of five stainless steel or other approved corrosion resistant circumferential bands.

1006.08 PLASTIC UNDERDRAIN PIPE. Plastic pipe for underdrains shall be perforated or nonperforated, as specified.

The pipe shall be one of the following:

(a) Acrylonitrile-Butadiene-Styrene (ABS): Acrylonitrile-Butadiene-Styrene shall conform to ASTM D 2751, SDR 35. Perforations, if specified, shall conform to AASHTO M 252.

(b) Corrugated Polyethylene (PE): Corrugated Polyethylene shall conform to AASHTO M 252 Type C. Perforations, if specified, shall conform to AASHTO M 252.

(c) Polyvinyl Chloride (PVC): Polyvinyl Chloride shall conform to AASHTO M 278 or ASTM D 3034 SDR 35. Perforations, if specified, shall conform to AASHTO M 252.

(d) Polyethylene Pipe (Smooth Wall): Polyethylene pipe (smooth wall) shall conform to ASTM F 714, DR 11 with a minimum cell classification of 335434C in accordance with ASTM D 3350. Perforations, if specified, shall conform to AASHTO M 252.

(e) Corrugated Polyethylene Culvert Pipe (Double Wall)(CPECP): Corrugated Polyethylene Culvert Pipe shall be AASHTO M 252 and AASHTO M 294, Type S.

1006.09 PLASTIC YARD DRAIN PIPE.

(a) Plastic pipe for yard drains shall be one of the following:

(1) Acrylonitrile-Butadiene-Styrene (ABS): Acrylonitrile-Butadiene-Styrene pipe shall conform to ASTM D 2680 for composite-wall pipe or ASTM D 2751, SDR 23.5 for solid wall pipe.

(2) Polyvinyl Chloride (PVC): Polyvinyl Chloride shall conform to AASHTO M 278 or ASTM D 3034, SDR 35.

(3) Polyethylene Pipe (Smooth Wall): Polyethylene pipe (smooth wall) shall conform to Subsection 1006.08(d).

(4) Corrugated Polyethylene Pipe (Double Wall)(CPECP): Corrugated Polyethylene Culvert Pipe (Double Wall) shall conform to both AASHTO M 252 and AASHTO M 294, Type S. The resin shall have a minimum cell classification of 315412C in accordance with ASTM D 3350.

(5) Ribbed Polyvinyl Chloride Pipe (RPVCCP): Ribbed Polyvinyl Chloride Culvert Pipe shall conform to ASTM F 794.

(b) Joints: Gaskets for joining plastic yard drain pipe shall conform to the physical requirements of Subsection 1006.06.

Section 1007
Metal Pipe

1007.01 CORRUGATED STEEL PIPE AND PIPE ARCH. These conduits shall conform to the requirements of Type I (culvert pipes, circular section) and Type II (culvert pipes, other than circular section) of AASHTO M 36 amended as follows:

(a) Pipe and pipe arch shall be galvanized in accordance with AASHTO M 218.

(b) Elbows, tees and other in-line fittings shall be fabricated from sheets of the same thickness and coating material as the pipe or pipe arch to which they are joined. Flared end sections shall be as specified.

(c) Shop-formed elliptical pipe and shop-strutted pipe shall be furnished when specified.

(d) For helical pipe, no coil splices at pipe manufacturing plants will be allowed for pipe 30 inches in diameter or less.

(e) Helical pipe shall have annular ends and shall have the ends of seams welded a minimum of 2 inches. Helical pipe ends shall be rerolled a minimum of two full standard corrugations to the same corrugation depth as the pipe when used with the appropriate jointing system.

(f) Pipe Arch Dimensions shall conform to Table 12 of this Section.

(g) Pipe joints shall conform to Subsection 1007.10 and shall be as shown on the plans.

(h) A minimum of two approved lifting lugs shall be provided on pipe larger than 30 inches in diameter, pipe arch larger than 30 inches in equivalent diameter, and any diameter of pipe or pipe arch longer than 30 feet.

(i) Damaged metallic coating shall either be recoated or shall be repaired with an approved cold galvanizing repair compound listed in QPL 23.

1007.02 BITUMINOUS COATED CORRUGATED STEEL PIPE AND PIPE ARCH. These conduits shall be coated in accordance with AASHTO M 190 amended as follows:

(a) AASHTO M 36 is amended in accordance with Subsection 1007.01.

(b) Coating shall be Type A, fully bituminous coated.

(c) Pipe joints shall conform to Subsection 1007.10 and shall be as shown on the plans.

1007.03 FIBER BONDED BITUMINOUS COATED CORRUGATED STEEL PIPE AND PIPE ARCH. These conduits shall be fabricated from bonded steel sheets. Fiber bonded sheets shall conform to ASTM A 885. Base metal and fabrication of conduits and coupling bands shall conform to Subsection 1007.01, except the galvanized coating shall be a minimum of 0.80 oz/sq ft.

Steel sheets shall be coated on both sides with a layer of aramid fibers applied by pressing a sheet of fiber into the molten metallic bonding medium. Finished sheets and fabricated pipe shall be free from

blisters, cracks in the bonding, unbonded areas and other defects. The fiber bonded sheet and pipe before bituminous coating shall be protected from ultraviolet light exposure.

After fabrication, fiber bonded pipe and pipe arch shall be fully bituminous coated with a Type A coating in accordance with AASHTO M 190.

Fiber bonded corrugated steel pipe and pipe arch shall be fabricated by the riveting process.

1007.04 BITUMINOUS COATED CORRUGATED STEEL UNDERDRAIN PIPE. Pipe and coupling bands shall conform to the requirements of Type III (underdrain pipes) of AASHTO M 36. The pipe shall be coated with a bituminous material in accordance with AASHTO M 190, Type A coating, except the minimum coating thickness shall be 0.03 inch. The specified minimum diameter of perforations shall apply after coating. Minimum sheet thickness shall be 0.064 inch (16 gage).

1007.05 STRUCTURAL PLATE FOR PIPE, PIPE ARCH AND ARCH. This material shall conform to AASHTO M 167 for steel, and AASHTO M 219 for aluminum.

1007.06 CORRUGATED ALUMINUM PIPE AND PIPE ARCH. These pipe shall conform to AASHTO M 196 with the following exceptions:

(a) Helical pipe shall have annular ends and shall have the ends of seams welded a minimum of 2 inches. Helical pipe ends shall be rerolled a minimum of two full standard corrugations to the same corrugation depth as the pipe when used with the appropriate jointing system.

(b) Pipe Arch Dimensions shall conform to Table 12.

(c) Pipe joints shall conform to Subsection 1007.10 and shall be as shown on the plans.

(d) A minimum of two approved lifting lugs shall be provided on pipe larger than 30 inches diameter, pipe arch larger than 30 inches equivalent diameter, and any diameter of pipe or pipe arch longer than 30 feet.

(e) The pipe shall be fabricated from Alloy 3004-H34.

1007.07 CORRUGATED ALUMINUM UNDERDRAIN PIPE. Pipe and coupling bands shall conform to the requirements of Type III (underdrain pipes) of AASHTO M 196, Alloy 3004-H34. Minimum sheet thickness shall be 0.060 inch (16 gage).

1007.08 POLYMER COATED CORRUGATED STEEL OR ALUMINUM PIPE AND PIPE ARCH. These conduits shall conform to the requirements of Type I (culvert pipes, circular section) and Type II (culvert pipes, other than circular section) of AASHTO M 245 amended as follows:

(a) Corrugated steel pipe and pipe arch shall be galvanized in accordance with Subsection 1007.01. Corrugated aluminum pipe and pipe arch shall conform to Subsection 1007.06.

(b) Fabrication of polymer coated pipe shall be by the helical lock-seam process.

(c) Thickness of polymer coating on the finished pipe shall be a minimum 0.010 inch on the interior and exterior surfaces.

(d) Polymer coated steel and aluminum pipe and approved polymer repair materials shall be listed in QPL 43.

(e) Exposed edges and damaged polymer coating shall be repaired with an approved material to a minimum thickness of 0.010 inch.

(f) Elbows, tees and other in-line fittings shall be fabricated from sheets of the same thickness and coating material as the pipe or pipe arch to which they are joined. Flared end sections shall be as specified.

1007.09 PIPE ARCH DIMENSIONS. Pipe arch dimensions shall conform to Table 12. Pipe arch tolerances shall conform to the plans.

TABLE 12
METAL PIPE ARCH DIMENSIONS
(Inches)

	Steel & Aluminum	Steel
Round Equivalent	2 2/3 by 1/2 in. Corrugation	3 by 1 in. or 5 by 1 in. Corrugation
15	17x13	---
18	21x15	---
21	24x18	---
24	28x20	---
30	35x24	---
36	42x29	40x31
42	49x33	46x36
48	57x38	53x41
54	64x43	60x46
60	71x47	66x51
66	77x52	73x55
72	83x57	81x59
78	---	87x63
84	---	95x67
90	---	103x71
96	---	112x75
102	---	117x79
108	---	128x83
114	---	137x87
120	---	142x91

1007.10 PIPE JOINTS. Coupling bands for joining metal conduit shall be approved by the DOTD Materials Engineer Administrator and shall conform to AASHTO M 36 for steel conduit and AASHTO M 196 for aluminum conduit with the following modifications:

(a) Coupling Bands: Bands shall be of an approved design and shall be fabricated from metal sheets of the same material as the conduit. The band thickness shall be the same as the conduit thickness with a maximum of 12 gage. Coating shall be the same as used on the conduit. Minimum band width shall be 12 inches.

(b) Rubber Gaskets. Rubber gaskets shall conform to Subsection 1006.06(a). Gasket cross section shall be 13/16-inch for pipe 36 inches in diameter and 7/8-inch for pipe greater than 36 inches in diameter for 1/2-inch deep corrugations and 1 3/8-inches for 1-inch deep corrugations.

(c) Flexible Plastic Gaskets. Flexible plastic gaskets shall conform to Subsection 1006.06(b). Gasket material shall be a minimum of 1 inch for 1/2-inch corrugation depth, and a minimum of 1 1/2 inches for 1-inch corrugation depth.

(d) Hardware: Hardware shall be galvanized in accordance with ASTM A 153 or B 633, Class Fe/Zn 25 or an approved mechanical galvanizing process conforming to ASTM B 695 that provides the same coating thickness.

(e) Steel Banding Rods: Steel banding rods shall conform to ASTM A A 709, Grade 36. Welding of rods will not be permitted. No more than two splices will be allowed.

(f) Type 3 (T3) Joints: These joints shall pass the 10-psi hydrostatic pressure test. Joint details shall be as shown on the plans.

(g) Type 2 (T2) Joints. These joints may pass the 5-psi hydrostatic pressure test. Joint details shall be as shown on the plans.

(h) Type 1 (T1) Joints. These joints may be a Type 2, 3 or 4 joint or other approved joint system. At least one line of approved gasket material shall be required under the band on each pipe end.

1007.11 CAST IRON SOIL PIPE AND FITTINGS: Cast iron soil pipe and fittings shall conform to ASTM A 74. Joints shall be made with rubber gaskets conforming to ASTM C 564.

1007.12 DUCTILE IRON PIPE: Ductile iron pipe shall conform to ANSI A 21.51.

1007.13 BLACK AND GALVANIZED WELDED AND SEAMLESS STEEL PIPE. Steel pipe for ordinary uses shall conform to ASTM A 53.

Section 1008
Paints

1008.01 GENERAL.

(a) Packaging: Paints shall be delivered in 5-gallon, full lid, shipping containers conforming to Interstate Commerce Commission (ICC) requirements. Used containers will not be permitted unless they have been satisfactorily reconditioned and thoroughly cleaned.

(b) Identification: Each paint container shall bear a label with the following information: name and address of manufacturer, trade name or trademark, kind of paint, color of paint, number of gallons, batch number and date of production.

(c) Storage: After 1 year from date of manufacture, the material shall not show skinning, settling, color change, thickening or livering that cannot be eliminated by normal mixing procedures. After 1 year, the paint shall be retested prior to use and shall show no change from when originally approved. No material shall be used after the manufacturer's recommended shelf life.

1008.02 3-COAT ORGANIC ZINC PRIMER AND TOPCOAT SYSTEM. The paint (two primer coats, one topcoat and thinners) shall be an approved product listed in QPL 37. Each system shall be tested for a minimum of 1500 hours in a Salt Spray (Fog) apparatus, a Fluorescent UV-Condensation Exposure apparatus and/or an Operating Light-Exposure apparatus (Carbon Arc Type) with water in accordance with ASTM B 117, G 53 and G 23. The paint system shall show no rusting, blistering, checking, cracking, delamination, or undercutting and only slight chalking or discoloration.

Standard x-ray and infrared curves will be made of all approved coatings. When the project sample deviates from these curves, the material represented by the sample will be rejected.

The following specification is not a formula. The manufacturer assumes all responsibility in formulating products which meet these specification requirements in laboratory testing, field application and performance.

Each paint system shall conform to the following requirements.

(a) Organic Zinc Primer (2 coats): The generic type of the vehicle shall be epoxy polyamide (Catalyzed).

(1) Base Composition:

Property	Test Methods	% By Weight
Pigment, Min.	ASTM D 2698	80
Zinc Dust, ASTM D 520, Type I, Min.		97
Thixatropes, Tinting Pigments, anti-settling additives, gassing inhibitors, etc., Max.		3
Vehicle, Max.	ASTM D 2698	20
Epoxy Resin	ASTM D 2369 & D 2698	18-26
Film Forming Additives, Max.		1.1
Solvent Blend (Ethylene glycol monoethyl ether and ethylene glycol monoethyl ether acetate are prohibited)		72.9-82.0

Epoxy Equivalent of the epoxy resin system shall be 450-550 when tested in accordance with DOTD TR 518.

Material shall not settle to the point that it cannot be easily reblended and shall not show signs of gassing. Thixatropes which become part of the vehicle solids will be calculated as resin solids in epoxy equivalent determinations.

(2) Curing Agent: The curing agent shall be a clear, nonpigmented solution consisting of the following:

Property	Test Methods	Requirements
Polyamide, % by Weight,	ASTM D 2369	25-29
Solvent Mixture (Ethylene glycol monoethyl ether and ethylene glycol monoethyl ether acetate are prohibited)		
Xylene, % by Weight, Min.		36

Amine value of the polyamide shall be 200-250 when tested in accordance with DOTD TR 519. Thinners shall be from the same manufacturer as the paint.

(3) Mixed Primer:

Property	Test Methods	Requirements
Volatiles, % by wt, Max.	ASTM D 2369	20
Solids, % by wt, Min.	ASTM D 2369	80
Wt./gallon, lb, Min.	ASTM D 1475	21.0
Dry to touch, minutes, Max.	ASTM D 1640	30
Dry through, hours, Max.	ASTM D 1640	8
Sag Test (Leneta Anti-Sag) mils, Min.	Federal Test Method 4494	10

The dried finish of painted surfaces shall be free of lumps, agglomerates or other surface imperfections.

The manufacturer shall produce the primers as a 2-component system consisting of a base and a cure. Thinning shall be in accordance with the manufacturer's recommendations, but not exceeding 12 percent by volume.

(4) Tinting: Primer shall be tinted for color contrast as follows:

1st Coat - Red
2nd Coat - Green

(b) Vinyl Topcoat:

(1) Composition, % by Weight:

Property	Test Methods	Requirements
Vinyl Resin (VAGH & VMCH equal parts), Min.		15.00
Epoxy resin (Epon 828), Max.		0.07
Dioctylphthalate (DOP), Max.		3.83
Pigment, Aluminum	ASTM D 2398	
ASTM D 962, Type I Class B leafing, Max.		6.52
or Type II Class B leafing, Max.		10.03
Thixatropes, wetting agents, scavengers, film forming additives, etc., Max.		3.0
Solvents, Min. (Ethylene glycol monoethyl ether and ethylene glycol monoethyl ether acetate are prohibited)		71.0

(2) Property	Test Methods	Requirements
Volatiles, % by wt., Max.	ASTM D 2369	76
Solids, % by wt., Min.	ASTM D 2369	24
Wt./gallon, lb	ASTM D 1475	7.8-8.5
Dry to touch, minutes, Max.	ASTM D 1640	30
Dry through, hours, Max.	ASTM D 1640	3
Viscosity, Krebs Unit	ASTM D 562	70-100
Storage, yr, Min.		1
Viscosity Stability Test, Krebs Unit increase in 4 months storage, Max. (Not to exceed viscosity requirement)		15
Sag Test (Leneta Anti-Sag) mils, Min.	Fed. Test Method 4494	10
Grind, Hegman, Min.	ASTM D 1210	6

Thinning shall be in accordance with the manufacturer's recommendations, but not exceeding 10 percent by volume. Thinners shall be from the same manufacturer as the paint.

1008.03 ASPHALTIC VARNISH.

(a) Material: Asphaltic varnish shall be composed of hard native asphalts or asphaltites (gilsonite, for example), run (fluxed) and blended with properly treated drying oils, and thinned with suitable solvents with the necessary amount of dryers.

(b) Appearance: The film shall be smooth and homogeneous when a thoroughly mixed sample is poured and examined on a clean, clear, glass plate and placed in a vertical position until the excess varnish has drained off. The film will be examined by transmitted light.

(c) Color: Color shall be jet black when examined by reflected light.

(d) Nonvolatile Matter: Nonvolatile matter shall be not less than 40 percent by weight when tested in accordance with ASTM D 2369.

(e) Drying of film:

(1) Set to Touch: Film shall set to touch in not more than 8 hours when tested in accordance with ASTM D 1640.

(2) Dry Through: Film shall dry through in not more than 36 hours when tested in accordance with ASTM D 1640.

(f) Working Properties and Appearance of Dried Film: Varnish shall have good brushing, flowing, covering and leveling properties. Dried film shall be jet black, smooth and free from brush marks, blisters, pinholes and other defects.

(g) Water Resistance: Film shall show no whitening, dulling or other defects after a dried film is immersed in water for 18 hours and air dried for 2 hours.

1008.04 COAL TAR EPOXY-POLYAMIDE PAINT. This paint shall conform to SSPC Paint No. 16.

1008.05 METAL WORK PAINT: These specifications cover material requirements for metal work paint to be used on manhole and catch basin covers and related items. Metal work paint shall be formulated from climate resistant resin and pure petroleum solvents.

Metal work paint shall conform to the following requirements.

Property	Test Method	Min.	Max.
Color	By reflected light	Jet Black	
Wt,lb/gal	ASTM D 1475	6.9	---
Viscosity, KU @ 77°F	ASTM D 562	94	105
Solids, % by Weight	ASTM D 2369	50	---
Dry touch, minutes	ASTM D 1640	---	30
Dry through, hours	ASTM D 1640	---	3

Infrared spectrum and x-ray diffraction shall match standard curves.

1008.06 COLD GALVANIZED REPAIR COMPOUND: This material shall be used for the spot repair of galvanized surfaces and shall be an approved product listed in QPL 23. The material shall be supplied in aerosol cans or friction top cans. The cans shall be labeled with the manufacturer's name, product name, and batch number. The pigment shall contain a minimum of 90 percent metallic zinc.

Test panels coated with the compound shall be tested in a salt fog apparatus in accordance with ASTM B 117 for 1500 hours. The panels shall show no sign of rust, blistering, undercutting, delamination, or other deleterious properties when evaluated in accordance with DOTD TR 503.

Section 1009
Reinforcing Steel and Wire Rope

1009.01 REINFORCING STEEL. Reinforcing steel for concrete shall conform to the following unless otherwise specified. Deformed bars No. 3 thru No. 6 shall be either Grade 40 or 60; No. 7 and larger shall be Grade 60. No. 2 bars need not be deformed. All deformed bars shall conform to Headings (a), (b) or (c) below. Wire conforming to Heading (d) below may be used in lieu of No. 2 bars when furnished in size W 5.

(a) Billet-Steel Deformed and Plain Bars shall conform to ASTM A 615.

(b) Rail-Steel Deformed and Plain Bars shall conform to ASTM A 616.

(c) Axle-Steel Deformed and Plain Bars shall conform to ASTM A 617.

(d) Cold-Drawn Steel Wire, ASTM A 82 with the following amendment: For material testing over 110,000 psi tensile strength in high strength applications such as spirals and ties, the 25 percent minimum reduction in area shall be reduced 5 percent for each 10,000 psi increment of tensile strength exceeding 110,000 psi.

(e) Welded Steel Wire Fabric shall conform to ASTM A 185.

(f) Epoxy Coated Reinforcing Steel shall conform to AASHTO M 284 and shall be an approved product listed on QPL 51.

1009.02 SPIRAL REINFORCING. Spiral reinforcing shall conform to Subsection 1009.01(a), (b), (c) or (d).

1009.03 TIE BARS. Tie bars shall conform to Subsection 1009.01 (a), (b) or (c). Tie bars to be bent and restraightened during construction shall be Grade 40.

1009.04 DOWEL BARS. Dowel bars may be placed in approved dowel bar assemblies in accordance with the plans.

Dowel bars shall be plain steel bars conforming to Subsection 1009.01 (a), (b) or (c). Dowels shall have a uniformly round cross section and shall be saw cut, smooth and free of burrs, projections and deformations.

Dowel bars shall be undercoated with an adhesive and given an outer coat of polypropylene or polyethylene in accordance with AASHTO M 254 Type A. The coated dowel bar shall conform to AASHTO M 254.

1009.05 STEEL STRAND FOR PRETENSIONING. Strand for pretensioning shall conform to ASTM A 416. The strand manufacturer shall submit to the Construction Section three copies of Certificates of Analysis of all test results as stipulated in ASTM A 416, and as part of this document, shall provide the modulus of elasticity of that particular mill heat of strand. The Department reserves the right to conduct inspections at the site of manufacture and to have all tests witnessed by its inspector.

The data from the manufacturer's typical curve shall be used when computing the required elongation for each strand.

Low relaxation strands shall be clearly identified by color markings on both the reel and the cable at intervals not exceeding 100 feet or as approved. These markings shall be consistent and shall be identified to the Construction Section prior to shipping.

1009.06 BARS FOR POST-TENSIONING. Bars shall be steel conforming to ASTM A 722 having a minimum modulus of elasticity of 25,000,000 psi, and shall be equipped with wedge-type end anchorages which will develop the minimum specified ultimate bar stress on the nominal bar area.

1009.07 PARALLEL WIRE ASSEMBLIES FOR POST-TENSIONING. Assemblies shall consist of parallel wire of the specified number and size. Wire shall be high tensile strength, hard-drawn, stress-relieved and uncoated, delivered in coils of 54 inches minimum diameter. Wire shall conform to ASTM A 421, Type WA.

1009.08 ANCHORAGES FOR POST-TENSIONED TENDONS.

(a) Bars: Wedge-type anchorages shall be used for bars. Wedge devices shall develop the minimum ultimate stress specified for the nominal bar area. Wedge anchorages shall bear against anchorage plates fabricated of hot-rolled steel having characteristics not less than as specified for No. 1040 of the AISI specifications.

(b) Parallel Wire Assemblies: Wedge-type anchorages of the sandwich plate or conical type shall be used. Anchorage device shall be capable of developing the ultimate strength of the total number of wires anchored. Conical-type anchorages shall be embedded within ends of concrete members. Anchorages shall bear against embedded grids of reinforcing steel of approved type.

(c) Alternate Anchorage Types: Alternate anchorage types conforming to the physical requirements specified above for wedge-type anchorages will be considered. Anchorages shall either develop the specified ultimate strength of reinforcing tendons, or the allowable stress on the tendon will be based on anchorage strength.

Alternate type anchorages shall show evidence of being capable of withstanding at least 3 million cycles of twice the maximum live load stress variation.

1009.09 ANCHORAGES AND HARDWARE FOR PRETENSIONING. Anchorages, including holddown and miscellaneous hardware, shall be sampled in accordance with the Materials Sampling Manual and submitted to the Construction Section for approval by evaluation or testing.

1009.10 WIRE ROPE. Wire rope shall conform to Federal Specifications RR-W-410D and the following requirements.

The type and classification of wire rope shall conform to one shown in Table 13.

When wire joints are necessary, they shall be electrically butt welded; and in the stranding operation, no two joints in any strand shall be closer than 25 feet apart, except for filler wires.

Table 13
General Wire Rope Classification and Usage

Type	Classification	Usage
I	1. (6x7)	Haulage rope, for use where strength and durability are desirable, but not much bending is required. May be used as single line for pulling load, but not suitable for sheave work.
	2. (6x19)	Most widely used for cranes, derricks, dredges, draglines and scrapers. This classification is very rugged, withstands abrasion well and is generally suited for all-around use.
	3. (6x37)	For hoisting rope where maximum flexibility is required; for instance, hoisting rope that runs over small sheave on draglines.
II	2. (8x19)	High speed elevator rope.
III(Marine)	1. (6x6)	Deck lashing ropes.
	2. (6x12)	Running ropes.
	3. (6x24)	Mooring lines.
	4. (6x3x7)	Spring lay.
	5. (6x3x19)	Spring lay.
	6. (6x42)	Tiller or hand control rope.
IV(Special)	2. (18x7)	Nonrotating (for drill rigs)

1009.11 COUNTERWEIGHT ROPES. Counterweight ropes shall conform to Table 11 and shall be improved plow steel, uncoated, preformed 6x25 filler wire construction with hard fiber core and right regular lay. Each strand shall consist of 19 main wires and 6 filler wires fabricated in one operation, with all wires interlocking. Lay of wires in strands shall be such as to make wires approximately parallel to the axis of the rope where they would come in contact with a circular cylinder circumscribed on the rope.

Fiber cores shall be prelubricated by the cordage manufacturer. Component parts of wire rope, fiber cores, wires and strands shall be lubricated during fabrication with an approved lubricant containing a rust inhibitor.

Every effort shall be made to fabricate wire ropes of uniform physical properties, and counterweight wire ropes operating as a group in one equalizing system shall be cut from one continuous manufactured length. No splicing of wire rope or its component strands will be permitted. Wire from which wire ropes are made shall be tested in the presence of the engineer, except that filler wires may be made to the manufacturer's standards.

Wire rope shall be prestressed and measured for length by the manufacturer prior to delivery. The contractor shall notify the engineer at least 10 calendar days in advance of prestressing operations so the Department may have its inspector present for the operations.

Counterweight ropes shall be prestressed. The prestressing load shall be 35 percent of the listed breaking strengths of the wire ropes. Loading shall be applied three times to the wire ropes. The cycle of loading shall be between the limits of 5 to 35 percent. The maximum loading shall be held on the wire rope for 15 minutes each.

The length of each wire rope from centerline of open socket pins or from the bearing of closed sockets shall be measured under a tension of 12 percent of the listed breaking strengths. A metal tag having the length stamped thereon shall be securely attached to the wire rope. Length of each rope shall also be stamped on each socket. After wire rope has been measured as noted herein, it shall have a stripe painted on one side along its entire length to assure the twist of the wire rope during erection of the bridge. The rope number shall be stamped on each socket, counterweight and span lifting point. While being measured, each rope shall be twisted to correct lay and shall be supported throughout its length in a straight line at maximum 25-foot intervals.

Lengths of wire rope in excess of 100 feet shall not vary from specified length by more than 0.0002 times the specified length. For wire rope lengths of 100 feet or less, the tolerance from specified length shall be ±1/4 inch.

Sockets and socket pins used with wire ropes shall be forged, without welds, from solid steel and shall conform to ASTM A 688, Class D, normalized except that sockets for ropes 2 1/2 inches or greater diameter may be cast steel conforming to ASTM A 148, Grade 80-50. The socket shall be attached to the wire rope by using zinc of a quality not less than defined for Intermediate Grade in ASTM B 6. Wire rope shall not slip appreciably in its connection.

Full-sized specimens of rope shall be fitted with sockets, attached not less than 25 rope diameters but not more than 12 feet apart, and shall be tested to destruction. Sockets used for these tests shall not be used in the structure.

Movement of the zinc cone in the socket basket when the wire rope is stressed to 80 percent of listed breaking strength shall not exceed 1/6 the nominal diameter of the wire rope. If a greater movement occurs, the method of attachment shall be changed until a satisfactory method is found. The number of test specimens shall not exceed 10 percent of the total number of finished lengths of rope to be made, nor shall there be less than two specimens taken from each original length of rope.

The manufacturer shall provide proper facilities for making the tests and shall make them at no direct pay. The contractor shall furnish the engineer with certified test reports for all required tests.

If a socket breaks during tests of the wire rope, two other sockets shall be selected and attached to another piece of rope, and the test repeated. This process shall be continued until reliability of the sockets is established, in which case the lot shall be accepted. If, however, 10 percent or more of the sockets tested break at a load less than the specified minimum strength of the rope, the entire lot will be rejected.

The engineer reserves the right to test each wire rope at the Department's expense after sockets are attached, by a load equal to 1/2

the listed breaking strength of the wire rope. If the assembly shows weakness, it will be rejected and replaced.

Wire ropes shall be suitably marked or tagged for identification for proper erection.

Wire rope shall be shipped on reels or in coils. The minimum reel diameter or the inside diameter of coils shall not be less than 25 times the minimum diameter of the wire rope.

Wire ropes shipped on reels shall be removed by revolving the reels, and wire ropes shipped in coils shall be mounted on a turntable for uncoiling. In uncoiling and erecting, wire ropes shall be carefully handled to avoid kinks, sharp bends or twisting.

TABLE 14
COUNTERWEIGHT ROPE

Rope Diameter		Approximate Circumference, in.	Maximum Strand Pitch, in.	Approximate Weight, lb/ft	Minimum Breaking Strength on Bright (Uncoated) Wire Ropes, lb
Nominal					
Minimum, in.	Maximum, in.				
1/4	9/32	3/4	1 11/16	0.105	5,343
5/16	11/32	1	2 1/8	0.164	8,307
3/8	13/32	1 1/8	2 17/32	0.236	11,895
7/16	15/32	1 3/8	2 31/32	0.32	16,127
1/2	17/32	1 5/8	3 3/8	0.42	20,865
9/16	19/32	1 3/4	3 13/16	0.53	26,325
5/8	21/32	2	4 7/32	0.66	32,565
3/4	25/32	2 3/8	5 1/16	0.95	46,410
7/8	59/64	2 3/4	5 29/32	1.29	62,790
1	1 3/64	3 1/8	6 3/4	1.68	81,510
1 1/8	1 11/64	3 1/2	7 19/32	2.13	102,570
1 1/4	1 5/16	3 7/8	8 7/16	2.63	125,970
1 3/8	1 7/16	4 3/8	9 9/32	3.18	151,515
1 1/2	1 9/16	4 3/4	10 1/8	3.78	179,400
1 5/8	1 23/32	5 1/8	10 31/32	4.44	208,650
1 3/4	1 27/32	5 1/2	11 13/16	5.15	241,800
1 7/8	1 31/32	5 7/8	12 21/32	5.91	274,950
2	2 3/32	6 1/4	13 1/2	6.72	312,000
2 1/8	2 7/32	6 5/8	14 11/32	7.59	349,050
2 1/4	2 11/32	7 1/8	15 3/16	8.51	390,000
2 1/2	2 5/8	7 7/8	16 7/8	10.5	475,800
2 3/4	2 7/8	8 5/8	18 9/16	12.7	569,400

Section 1010
Fence and Guard Rail

1010.01 BARBED WIRE. Barbed wire shall be either steel or aluminum alloy and shall be 12 1/2 gage.

(a) Steel Barbed Wire: Steel barbed wire shall conform to ASTM A 121.

(b) Aluminum Alloy Barbed Wire: Aluminum alloy barbed wire shall conform to ASTM B 211, Alloy 5052-0 for line wire and Alloy 5052-H38 for barbs.

1010.02 WOVEN WIRE. Woven wire shall conform to one of the following Design Numbers and Grades of ASTM A 116.

Design No.	Grade
939-6-11	60
939-6-12 1/2	60
939-6-14 1/2	125
939-6-12 1/2	125

1010.03 POSTS AND BRACES FOR FIELD AND LINE TYPE FENCE. Posts and braces shall be either steel or treated timber.

(a) Treated Timber Posts and Braces: Braces shall be either round or square. Posts shall be round.

Treated timber posts and braces shall conform to Section 1014.

(b) Steel Posts and Braces: Steel posts and braces shall be equipped with corrugations, knobs, notches, holes or studs so placed and constructed as to engage a substantial number of fence wires in proper position. Posts may be punched with holes in such position and of such size as will not unduly impair the strength of the posts. Posts with punched tabs used for fastening wires are not acceptable. Corner, end and bracing posts shall be supplied with necessary holes and with galvanized bolts of standard commercial quality or other satisfactory substitute, such as castings, for fastening braces to the posts.

Line posts, anchor plates and braces shall conform to ASTM A 702, except that a hardness test may not be substituted for the tensile test. Steel posts, anchor plates and braces shall be galvanized in accordance with ASTM A 123.

1010.04 STAPLES AND NAILS. Staples and nails shall be made of galvanized steel wire. Minimum galvanized coating shall be not less than 0.20 ounce per square foot when tested in accordance with ASTM A 90.

1010.05 METAL FASTENERS FOR STEEL POSTS. Metal fasteners for steel posts shall be galvanized steel-wire fasteners or clamps and shall be satisfactory for use with the type of steel post furnished. Wire shall be not less than 0.120 inch diameter. Galvanized coating shall not be

less than 0.20 ounce per square foot when tested in accordance with ASTM A 90.

1010.06 GATES FOR FIELD AND LINE TYPE FENCE.

(a) Gates: Steel sheets used in fabricating gates shall be galvanized in accordance with ASTM A 525, G 90 Coating Designation (1.25 Commercial).

(b) Posts:

(1) Treated Timber: Treated timber posts shall conform to Section 1014.

(2) Metal: Metal posts shall be made of galvanized steel pipe, standard weight, conforming to ASTM A 53.

(c) Hardware: Hinges, washers, nails, staples, welded chains and latches shall be galvanized, of acceptable quality, and of satisfactory type for use with the gate and posts selected.

(d) Gate Stops:

(1) Treated Timber: Gate stops shall be timber conforming to Subsection 1010.03(a) treated in the same manner as posts.

(2) Metal: Gate stops shall be acceptable galvanized steel suitable for welding to the post.

(e) Stop Posts: Stop posts for double swinging driveway gates shall be treated timber conforming to Section 1014.

1010.07 CHAIN LINK FENCE, GATES AND APPURTENANCES.

Materials shall conform to AASHTO M 181 except for the following.

(a) Wire ties, fabric ties, hog rings and tension wire for Type I, II or III fencing shall be either aluminum alloy, galvanized ductile steel or aluminum-coated ductile steel wire.

(1) Wire Ties: Wire ties, fabric ties and hog rings shall have 20,000 psi minimum tensile strength, and 10 percent minimum elongation. Steel shall be coated with at least 0.60 ounce of zinc or 0.40 ounce of aluminum alloy per square foot of uncoated wire surface. Wire ties shall be AWG No. 9. Fabric ties and hog rings shall be AWG No. 12.

(2) Tension Wire:

a. Galvanized and aluminum-coated steel tension wire shall be AWG No. 9 wire having at least 75,000 psi tensile strength with at least 0.70 ounce of zinc or 0.40 ounce of aluminum alloy per square foot of uncoated wire surface.

b. Aluminum alloy tension wire shall be AWG No. 6 wire having at least 42,000 psi tensile strength, 35,000 psi yield strength, and 10 percent elongation.

(b) Barbed wire used with chain link fence shall conform to Subsection 1010.01.

(c) Padlocks shall be solid jacket, extruded brass metal with interchangeable cores and 1 3/4-inch cases. All padlocks shall be keyed alike. Two keys shall be furnished for each padlock.

1010.08 METAL BEAM FOR HIGHWAY GUARD RAIL. Rail elements shall be corrugated sheet steel beams. Guard rail elements, terminal sections and fittings shall be interchangeable with similar parts, regardless of source or manufacturer.

Guard rail, terminal sections and appurtenances shall conform to AASHTO M 180.

The fabricator shall annually file a Brand Registration and Guarantee with the DOTD Materials Engineer Administrator in accordance with AASHTO M 180.

1010.09 GUARD RAIL POSTS AND SPACER BLOCKS. Railing posts shall be either timber or steel. When the choice of post is at the option of the contractor, there shall be only one kind furnished on the project. Spacer blocks shall be of the same material as the post.

(a) Timber Posts and Spacer Blocks: Timber and treatment shall conform to Section 1014.

(b) Steel Posts and Spacer Blocks: Steel posts and spacer blocks shall conform to ASTM A 709, Grade 36 or A 769 (Grade 40) galvanized in accordance with ASTM A 123. Certificates of Analysis (Mill Test Reports) together with a Fabricator's Material Statement and Certificate of Compliance shall be furnished in accordance with Subsection 1013.01. Welding, if required, shall be in accordance with Section 815.

(c) Concrete for anchorages shall conform to Section 901 Class M. Reinforcement for anchorages shall conform to Section 1009.

1010.10 GUARD RAIL HARDWARE. Splices, end connections, anchor rods and accessories shall be of such strength as to develop the full design strength of the rail elements.

Bolts shall conform to ASTM A 307 and nuts shall conform to ASTM A 563, Grade A.

Fittings, bolts, washers and other accessories for steel guard rail shall be galvanized after fabrication in accordance with ASTM A 123 or A 153, or by an approved mechanical galvanizing process conforming to ASTM B 695 that provides the same coating thickness. All galvanizing shall be done after fabrication.

1010.11 WIRE ROPE AND FITTINGS FOR HIGHWAY GUARD RAIL. Wire rope or wire cable and fittings shall conform to AASHTO M 30.

Section 1011
Concrete Curing Materials, Admixtures and Special Finishes

1011.01 CURING MATERIALS.

(a) Liquid Membrane-Forming Compounds: This material shall conform to AASHTO M 148 and be an approved product listed in QPL 65. The types shall be Type 2 white-pigmented or Type 1-D, clear or translucent with a fugitive dye, as specified.

(b) Burlap Cloth made from Jute or Kenaf shall conform to AASHTO M 182, Class 3.

(c) Waterproof Paper shall conform to AASHTO M 171.

(d) White Polyethylene Sheeting shall conform to AASHTO M 171.

(e) Combined Burlap and White Polyethylene Sheeting shall conform to AASHTO M 171.

1011.02 ADMIXTURES.

(a) Physical Requirements: Concrete admixtures shall be an approved product listed in QPL 58 and shall conform to the requirements in Table 15 of this Section when tested in accordance with DOTD TR 224.

(b) Chemical Requirements: Unless a chloride type admixture is specified, the contribution of chloride ion resulting from the addition of admixtures to the concrete shall not exceed 0.02 pound per cubic yard of concrete.

(c) Acceptance Testing: The admixture shall be tested by analytical infrared (IR) spectroscopy in accordance with DOTD TR 610. The percent solids by weight shall be determined in accordance with DOTD TR 524. The IR spectrum shall compare favorably to the standard IR spectrum of the original material tested and listed in QPL 58. The percent solids content shall not deviate more than ±10 percent from that of the original approved material which was determined by the Materials and Testing Section to be the average of the upper and lower percent solids published by the manufacturer for the specific product.

Tests to determine rate of hardening, compressive strength or other properties may be made at any time during the work to ensure continued compliance with these specifications.

1011.03 SPECIAL SURFACE FINISH FOR CONCRETE:

This material shall be an approved product listed in QPL 14. The material shall provide a uniform, fine-textured finish conforming to these specifications. Method and rate of application shall be as recommended by the manufacturer, except that application rate shall not exceed 60 square feet per mixed gallon.

The material shall consist of a water-based one-component coating system containing pigments, texturizers, resins and water, and shall be supplied in containers not smaller than 5 gallons. The coating shall contain fungicides to adequately prevent the growth of mildew, mold, etc. No field additions to the coating will be permitted.

When tested in accordance with DOTD TR 620, the material shall conform to the following requirements:

(a) The average number of cycles to failure shall be not less than 50 cycles when tested in accordance with DOTD TR 231. Test specimens shall show no flaking, cracking, spalling or loss of bond.

(b) The material shall show satisfactory appearance when exposed to 500 hours of accelerated weathering in accordance with DOTD TR 611.

(c) Color and texture of the material when applied to the test panel shall closely match that of the standard"Louisiana Gray" color chip on file at the Materials and Testing Section.

TABLE 15
Physical Requirements for Admixtures

Property	Test Method	Water-Reducing			High Range Water Reducing		
		Air Entraining	Normal Set	Set Retarding	Normal Set	Set Retarding	Set Accelerating
Unit Water Content,							
Max. % of Control		90	95	95	88	88	---
Min. % of Control		---	89	89	---	---	---
Air Content, %, Total	DOTD TR 202	5 ± 1	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3
Time of Setting, allowable deviation from control, hr:min.	AASHTO T 197						
Initial: at least		---	---	1:30 later	---	1:30 later	1:00 earlier
not more than		---	1:00 earlier or 1:30 later	3:30 later	1:00 earlier or 1:30 later	3:30 later	3:30 earlier
Final: at least		---	---	---	---	---	1:00 earlier
not more than		---	1:00 earlier or 1:30 later	3:30 later	1:00 earlier or 1:30 later	3:30 later	---
Compressive Strength, Min. % of Control	DOTD TR 230						
1 Day		---	---	---	140	125	125
3 Days		---	---	---	125	125	100
7 Days		85	105	105	115	115	100
28 Days		85	105	105	110	110	100
6 Months		---	---	---	100	100	---
1 year		---	---	---	100	100	---
Flexural Strength, Min. % of Control	AASHTO T 97						
3 Days		---	---	---	110	110	---
7 Days		---	---	---	100	100	100
28 Days		---	---	---	100	100	100
Relative Durability Factor, Min. % of Control	AASHTO T 161	---	---	---	100	100	100

Section 1012
Bridge Railings and Barriers

1012.01 CONCRETE. Concrete for bridge railings and barriers shall be Class AA conforming to Section 901.

1012.02 REINFORCING STEEL. Reinforcing steel shall be deformed bars conforming to Subsection 1009.01.

1012.03 STRUCTURAL STEEL. Structural steel for railings and railing posts shall be ASTM A 709, Grade 36 steel conforming to Subsection 1013.01, except that the maximum tensile strength requirement will be waived.

1012.04 ALUMINUM PIPE RAILINGS.

(a) Aluminum Alloy Pipe: Aluminum alloy pipe shall be standard pipe ANSI Schedule 40, and shall conform to ASTM B 241, Alloy 6061-T6 or 6063-T6.

(b) Cast Aluminum Railing Posts: The chemical composition of castings shall conform to the limits listed in Table 16:

TABLE 16
Chemical Composition[1]
(Percent by Weight)

Cu	Fe	Si	Mn	Mg	Zn	Ti	Other (each)	Other (Total)
0.10	0.20	6.5-7.5	0.10	0.05	0.10	0.20	0.05	0.15

[1]All values maximum unless shown as a range.

Minimum mechanical properties of test bars machined either vertically or horizontally from the high stressed area of the post tension flange (lower 14 inches), but not at the junction of the rib and tension flange, shall be as shown in Table 17:

Table 17
Mechanical Properties

	Tension Flange
Ultimate Tensile Strength, psi, Min.	20,000
Elongation (% in 2 in. or 4D), Min.	20

(1) Test Specimens: Tension test specimens shall be machined from integrally cast test coupons extending from one side of the base of the posts sufficiently large to permit obtaining a 0.350-inch diameter test specimen as defined in ASTM E 8.

(2) Number of Tests: A minimum of 1 percent of the posts in any lot shall be sampled for tensile testing. A lot shall consist of not more than 1,000 pounds of clean castings when produced from a batch-type furnace charged with one heat of ingot of known analysis, or not more than 2,000 pounds of clean castings when produced from one continuous furnace in not more than 8 consecutive hours.

(c) Aluminum Alloy Swedge Bolts and Nuts: Swedge bolts and nuts shall be made from rods conforming to ASTM B 211, Alloy 6061-T6 or 2024-T4. Bolts shall conform to ANSI B 18.2.1, with threads conforming to the Unified Standard Class 2A. Nuts shall conform to ANSI B 18.2.2, with threads conforming to the Unified Standard, Class 2B. Finished bolts and nuts shall be supplied in either T6 or T4 temper and shall be given an anodic coating at least 0.0002 inch thick and dichromate sealed.

(d) Aluminum Alloy Washers: Washers shall be made of sheet conforming to ASTM B 209, Alloy 2024-T4.

(e) Aluminum Alloy Shims: Shims shall be made of sheet or plate conforming to ASTM B 209, Alloy 1100-0.

Access door cover and rail caps shall conform to ASTM B 221, Alloy 6061-T6 or B 108, Alloy A 444.0-T4 conforming to the chemical and physical requirements of Tables 13 and 14 herein.

(f) Screws: Machine screws for fastening access door covers to railing posts, and socket head cup point set screws for fastening pipe rail to railing posts and pipe caps to railing, shall be stainless steel and furnished by the supplier.

1012.05 GALVANIZED STEEL PIPE RAILINGS.

(a) Galvanized Steel Pipe: Galvanized steel pipe shall be standard weight conforming to ASTM A 53.

(b) Fittings and Castings: Fittings and castings for steel pipe shall be malleable iron or cast steel conforming to ASTM A 47, Grade 35018 or A 27, Grade 70-36. Fittings and castings shall be galvanized in accordance with ASTM A 153. Repairs to galvanized surfaces shall be made in accordance with Subsection 811.15.

Three copies of Certificates of Analysis giving chemical and physical test results shall be forwarded for approval to the Construction Section for each heat or foundry pour of iron or steel post castings, with Certificates of Compliance as to the ounces per square foot of galvanized coating applied.

(c) Bolts, Nuts and Washers: Bolts, nuts and washers (except high strength bolts) shall conform to ASTM A 307, Grade A.

High strength bolts shall conform to ASTM A 325. Bolts, nuts and washers shall be galvanized in accordance with ASTM A 153 or by an approved mechanical galvanizing process conforming to ASTM B 695 that provides the same coating thickness.

(d) Screws: Machine screws for fastening access door covers to railing posts, and socket head cup point set screws for fastening pipe rail to railing posts and pipe caps to railing, shall be stainless steel and furnished by the supplier.

Section 1013
Metals

1013.01 STRUCTURAL STEEL. The contractor shall obtain all applicable physical and chemical tests and furnish the Construction Section five copies of the Certificates of Analysis (Mill Test Reports) together with a Fabricator's Material Statement and Certificate of Compliance. This form will be furnished by the Department upon request.

Structural steel shall conform to the following ASTM specifications as amended by this Subsection.

Structural Carbon Steel	ASTM A 709, Grade 36
High-Strength, Low-Alloy Structural Steel	ASTM A 709, Grade 50
High-Strength, Low Alloy, Corrosion Resistant Structural Steel	ASTM A 709, Grade 50 W
Quenched-Tempered, Low-Alloy Structural Steel	ASTM A 709, Grade 70 W
High-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding	ASTM A 709, Grade 100

Longitudinal Charpy V-Notch Testing: When specified, the main load-carrying structural member components that are subject to tensile stress shall meet the longitudinal Charpy V-Notch test specified in Tables 18, 19, 20 and 21. Sampling and testing procedures shall be in accordance with ASTM A 673 and ASTM A 370 and the following requirements: the (H) frequency of heat testing shall be used for all steels except that for ASTM A 709, Grade 100 steel the (P) frequency of piece testing shall be used.

1013.02 RIVET STEEL.

(a) Structural Rivet Steel shall conform to ASTM A 502, Grade 1.

(b) High Strength Rivet Steel shall conform to ASTM A 502, Grade 2.

1013.03 COPPER BEARING STEEL. When copper bearing steel is specified, the steel shall contain at least 0.2 percent copper.

1013.04 STEEL FORGINGS AND STEEL SHAFTING.

(a) Carbon and Alloy Steel Forgings: Steel forgings shall conform to ASTM A 668. Class C forgings shall be furnished except in cases specified below:

(1) Forged Shafts: Forged shafts shall conform to ASTM A 668, Class F.

(2) Forged Trunnions: Forged trunnions shall conform to ASTM A 668, Class G.

(b) Alloy Steel Forgings for Pinions and Reduction Gears: Alloy steel forgings for pinions and reduction gears shall conform to ASTM A 291, Class 3 or 3A.

(c) Cold Finished Steel Shafting: Cold finished carbon steel shafting shall conform to ASTM A 108. Cold finished alloy steel shafting shall conform to ASTM A 331.

Table 18
A 709, Grade 36

Thickness	Specified Minimum Average Energy Absorbed (ft-lb @ 70°F)
Up to 4 in.	15

Table 19
A 709, Grade 50 and 50 W Structural Steel[1]

Thickness	Specified Minimum Average Energy Absorbed (ft-lb @ 70°F)
Up to 4 in. mechanically fastened	15
Up to 2 in. welded	15
Over 2 in. to 4 in. welded	20

[1]If the yield point of the material exceeds 65,000 psi, the temperature for the CVN value for acceptability shall be reduced by 15°F for each increment of 10,000 psi above 65,000 psi.

Table 20
A 709, Grade 70W Structural Steel

Thickness	Specified Minimum Average Energy Absorbed (ft-lb @ 30°F)
Up to 4 inches mechanically fastened	20
Up to 2 1/2 inches welded	20
Over 2 1/2 inches welded	25

Table 21
A 709, Grade 100 Structural Steel

Thickness	Specified Minimum Average Energy Absorbed (ft-lb @ 30°F)
Up to 4 inches mechanically fastened	25
Up to 2 1/2 inches welded	25
Over 2 1/2 inches welded	35

1013.05 STEEL CASTINGS.

(a) Steel castings for highway bridges shall conform to ASTM A 27, Grade 70-36.

(b) High strength steel castings shall conform to ASTM A 148.

(c) Chromium alloy steel castings shall conform to ASTM A 743, Grade CA-15.

1013.06 CASTINGS. Castings shall be true to pattern in form and dimensions and free from pouring faults, sponginess, cracks, blowholes and

other defects in positions affecting their strength and value for the service intended. Castings shall be boldly filleted at angles, and rises shall be sharp and perfect. Castings shall be sandblasted or otherwise effectively cleaned of scale and sanded to a smooth, clean and uniform surface.

(a) Gray Iron Castings shall conform to ASTM A 48, Class 30.

(b) Malleable Castings shall conform to ASTM A 47, Grade 35018.

(c) Ductile Iron Castings shall conform to ASTM A 536, Grade 60-40-18. Castings weighing more than 1,000 pounds shall be ultrasonically tested for voids. If voids are found, the casting will be rejected.

1013.07 BRONZE OR COPPER ALLOY BEARING AND EXPANSION PLATES.

(a) Bronze Bearing and Expansion Plates shall conform to ASTM B 22, Alloy C 91100.

(b) Rolled Copper-Alloy Bearing and Expansion Plates shall conform to ASTM B 100, Alloy C 51000.

1013.08 BOLTS, NUTS AND WASHERS.

(a) Carbon Steel Bolts, Nuts, and Washers, Except High Strength Bolts: Bolts shall conform to ASTM A 307, Grade A or Grade B. Nuts shall conform to ASTM A 563. Circular washers shall conform to ASTM F 436.

(b) High Strength Bolts, Nuts and Circular Washers: Bolts, nuts and washers shall have plain surface finish unless otherwise specified.

(1) High strength bolts shall conform to ASTM A 325 or ASTM A 490, as specified. For ASTM A 325 bolts, Type 1 bolts shall be used; except that Type 3 bolts shall be used with unpainted ASTM A 709, Grade 50W steel.

(2) For Type 1 bolts, the nuts shall conform to ASTM A 563, Grade DH or ASTM A 194, Grade 2H. For Type 3 bolts, the nuts shall conform to ASTM A 563, Grade DH3.

(3) Circular washers for high strength bolts shall conform to ASTM F 436.

(c) Lock-Pin and Collar Fasteners: Subject to approval, high strength steel lock-pin and collar fasteners, including washers, may be used as an alternate for high strength bolts or rivets. Shank and head of high strength steel lock-pin and collar fasteners shall meet the chemical and mechanical requirements of ASTM A 325 or ASTM A 490, as specified. Each fastener shall provide a solid shank body of sufficient diameter to provide tensile and shear strength equivalent to the bolt or rivet specified. Each fastener shall have a cold-forged head on one end of approved type and dimensions, a shank length suitable for material thickness fastening and locking grooves, breakneck groove, and pull grooves (all annular grooves) on the opposite end. Each fastener shall provide a steel locking collar of proper size for the shank diameter used, which by suitable installation tools, is cold-swaged into the locking grooves forming a head for the grooved end of the fastener after the pull groove section has been removed. The steel locking collar shall be a standard product of an established manufacturer of lock-pin and collar fasteners.

1013.09 STEEL BEARING PILES. Steel bearing piles shall conform to ASTM A 709, Grade 36.

1013.10 SHEET PILES. Steel sheet piles shall conform to ASTM A 328. Aluminum sheet piles shall conform to ASTM B 221, Alloy 6061-T6 or Alloy 6063-T6 or ASTM B 209 Alloy 3064-H34.

1013.11 STEEL PIPE PILES. Steel pipe piles shall conform to ASTM A 252, Grade 2.

1013.12 SHEET COPPER. Sheet copper shall conform to ASTM B 152.

1013.13 SHEET LEAD. Sheet lead shall conform to ASTM B 29.

1013.14 SHEET ZINC. Sheet zinc shall conform to ASTM B 69, Type II.

1013.15 COLD-ROLLED STEEL. Cold-rolled steel shall conform to ASTM A 108.

1013.16 BRONZE.

(a) Center discs for movable bridges shall conform to ASTM B 22, Alloy C91300.

(b) Trunnion and similar bearings for movable bridges shall conform to ASTM B 22, Alloy C91100.

(c) Shafts and ordinary bearings shall conform to ASTM B 22, Alloy C90500.

(d) Gears, nuts transmitting motion, and other parts involving stresses other than compression shall conform to ASTM B 22, Alloy C90500.

1013.17 BABBITT METAL. Babbitt Metal shall conform to ASTM B 23, Alloy 3.

1013.18 STEEL FOR CENTER DISCS (Movable Bridges). Steel for center discs shall conform to ASTM A 668, Class F.

1013.19 STEEL FOR KEYS (Movable Bridges). Steel for keys shall conform to Subsection 1013.15 or ASTM A 668, Class D.

1013.20 SEAMLESS STEEL PIPE AND TUBING FOR HYDRAULIC LINES. Carbon steel pipe for hydraulic lines shall conform to ASTM A 106, Grade B. Fittings for hydraulic lines shall conform to ASTM A 105.

Stainless steel tubing shall be seamless austenitic stainless steel and shall conform to ASTM A 269.

1013.21 STEEL FOR OPEN GRID BRIDGE FLOORING. Steel shall conform to Subsection 1013.01.

1013.22 DUCTILE CAST IRON BEARINGS. Ductile cast iron bearings shall conform to ASTM A 536.

1013.23 SHEAR CONNECTORS.

Shear connector studs shall be Type B studs conforming to ANSI/AASHTO/AWS D 1.5-88, Bridge Welding Code.

1013.24 CONCRETE ANCHOR STUDS. Concrete anchor studs used for end dam plates, bearing plates or other concrete anchorage shall be Type A Studs conforming to the ANSI/AASHTO/AWS D1.5-88, Bridge Welding Code.

Section 1014
Timber and Timber Preservatives

1014.01 STRUCTURAL TIMBER AND LUMBER. Species and grade of structural timber and lumber shall conform to AASHTO M 168 and the following requirements.

(a) Southern Pine: Referring to the latest Standard Grading Rules for Southern Pine Lumber, as published by the Southern Pine Inspection Bureau (SPIB), Southern Pine lumber shall be furnished in grades with definite unit working stresses assigned as indicated for grade of lumber required.

(1) Caps, stringers, decking and bridge rails shall be Grade No. 1 Dense SR Timbers.

(2) Items other than caps, stringers, decking and bridge rail shall be Grade No. 1 SR Timbers.

(b) Douglas Fir: Referring to the latest Standard Grading Rules for Western Lumber, Douglas Fir lumber shall be furnished in accordance with the following:

(1) Caps, stringers, decking and bridge rail shall conform to Section 70.10, Select Structural. Design values shall be in accordance with Table 4, page 176, Recommended Design Values in Pounds Per Square Inch.

(2) Items other than caps, stringers, decking and bridge rail shall conform to Section 70.11, Grade 1. Design values shall be in accordance with Table 4, page 176, Recommended Design Values in Pounds Per Square Inch.

1014.02 TIMBER PILES, POLES, POSTS AND BRACES.

(a) Timber Piles: Timber piles shall be Southern Yellow Pine or Douglas Fir and shall conform to ASTM D 25, except that Table 22 herein shall be used in lieu of Tables I and II in ASTM D 25.

(b) Timber Poles: Timber poles shall be Southern Pine or Douglas Fir and shall conform to ANSI D 1.5.

(c) Timber Posts and Braces: Posts and braces shall be cut from sound trees (not limbs) and shall contain no unsound knots. Sound knots will be permitted if the diameter of the knot does not exceed 1/3 the diameter of the piece at the point where it occurs. Posts and braces shall be free from decayed wood, rot and red heart. Ring shakes and season checks which penetrate more than 1/4 inch will be cause for rejection. Posts and braces shall show at least four annular rings per inch and at least 1/3 summer wood.

Fence posts shall be peeled for their full length and bark and inner skin removed. Knots shall be trimmed close to the body of the post before treatment. A line drawn from center of top to center of butt shall not fall outside the body of the posts nor at any point be more than 2 inches from the geometric center of the post. Posts and braces shall be free from short or reverse bends. Excessive bow, camber, twist

or other such defects in posts and brace will be cause for rejection. Ends shall be sawed square.

Guard rail posts and spacer blocks shall be treated timber of Southern Pine Grade No. 1 S.R. or Douglas Fir Dense Construction quality. Posts and spacer blocks shall be fabricated before treatment.

TABLE 22
CIRCUMFERENCES AND DIAMETERS OF TIMBER PILE[1]

Length, feet	3 Feet from Butt (inches) Min. Circumference	Min. Diameter (Approx.)	Max. Circumference	Max. Diameter (Approx.)	At Tip, Min. (inches) Circumference	Diameter (Approx.)
Under 40	38	12	63	20	25	8
40 to 54 Incl.	38	12	63	20	22	7
55 to 74 Incl.	41	13	63	20	22	7
75 to 90 Incl.	41	13	63	20	19	6
Over 90	41	13	63	20	16	5

[1]Measurements shall be taken with the bark removed. Diameter at 3 feet from butt shall not exceed 20 inches.

1014.03 TIMBER PRESERVATIVES. The type preservatives to be used are as follows:

(a) Creosote: Creosote for land and fresh water use shall conform to AWPA P1/P13.

(b) Creosote Solutions: Creosote solutions for fresh and coastal water use shall conform to AWPA P2.

(c) Pentachlorophenol-Petroleum Solution: Pentachlorophenol-Petroleum Solution shall conform to AWPA P8 and P9.

(d) Chromated Copper Arsenate (CCA): Chromated copper arsenate shall conform to AWPA P5, Type B or C.

(e) Creosote for Field Repairs: Creosote for field repair shall conform to AWPA M4.

1014.04 TREATMENT.

(a) General: Materials shall be treated according to current AWPA Standard Specifications for Preservative Treatment by Pressure Processes, modified as follows:

Timber and Lumber	C1 and C2
Piles	C1 and C3
Poles	C1 and C4
Round Posts	C1 and C5
Square Sawed Posts	C1 and C2
Fire Retardant Lumber	C1 and C20

Kiln-dried timber shall be steamed prior to treatment for a minimum of 2 hours.

(b) Amount of Preservative: The amount of preservative shall be the minimum specified in Table 23 herein determined by assay. The assay zone shall be as specified in AWPA Standards, with the exception of bridge decking and timbers which will require an assay zone of 0 to 1 1/2 inches from the surface of the material. All penetration requirements of AWPA Standards shall be met. Treating reports shall be made available to the Department's inspector upon request, and at the Department's discretion may be used for acceptance of small miscellaneous charges of material.

(c) Painting: When painting of treated material is required, one of the following preservatives shall be used.

(1) Chromated Copper Arsenate (CCA) Type B or C conforming to AWPA P5.

(2) Pentachlorophenol conforming to AWPA P8.

Hydrocarbon solvents for oil-borne preservatives shall conform to AWPA P9, Type B (Volatile Petroleum Solvent, LPG) or Type D (Chlorinated Hydrocarbon Solvent-Inhibited Grade of Methylene Chloride).

Minimum net retention of preservative by assay shall be 0.50 pounds per cubic foot.

1014.05 TIMBER CONNECTORS, HARDWARE AND STRUCTURAL SHAPES. Timber connectors, hardware and structural shapes shall conform to Subsections 1018.07 and 1018.08.

1014.06 QUALITY ASSURANCE: Inspection shall be in accordance with AWPA M2. Quality control shall be in accordance with AWPA M3. Care of the treated wood products shall be in accordance with AWPA M4.

Table 23
Minimum Retention OF Preservative
Pounds Per Cubic Foot (PCF) Of Wood

Material and Usage	Creosote	Creosote-Solutions	Pentachlorophenol	CCA[1]
Timber & Lumber (General Use)	12.0	N/A	0.60	0.60
Bridge Timber & Lumber for Land and Fresh Water:				
Southern Pine or Douglas Fir	16.0	16.0	N/A	N/A
Bridge Timber & Lumber For Coastal Water:				
Southern Pine or Douglas Fir	20.0	20.0	N/A	N/A
Piles for Land or Fresh Water:[3]				
Southern Pine	N/A	16.0	N/A	N/A
Douglas Fir	N/A	17.0	N/A	N/A
Piles for Coastal Water:				
Southern Pine or Douglas Fir	N/A	20.0	N/A	N/A
Foundation Piles Land or Fresh Water:				
Southern Pine	N/A	12.0	N/A	N/A
Douglas Fir	N/A	17.0	N/A	N/A
Foundation Piles Coastal Water:				
Southern Pine or Douglas Fir	N/A	20.0	N/A	N/A
Poles: Southern Pine	12.0	N/A	0.60	N/A
Douglas Fir	15.0	N/A	0.80	N/A
Fence, Gate Posts and Braces	8.0	8.0	0.40	0.40
Guard Rail Posts and Spacer Blocks	12.0[2]	N/A	0.60	0.60
Bridge Rails and Dead End Road Installations	12.0[2]	N/A	0.60	0.60

[1]Material treated with Chromated Copper Arsenate (CCA) shall be conditioned by kiln drying prior to treatment.
[2]Timber guard rail posts, spacer blocks, bridge rails, poles and dead end road installations treated with creosote shall be steam flushed for a minimum of 1 hour at 240°F after treatment.
[3]Shall include piles for pile supported approach slabs.

Section 1015
Signs and Pavement Markings

1015.01 GENERAL REQUIREMENTS. The materials shall conform to these specifications, the plans and the MUTCD. When directed, the contractor shall furnish and prepare samples for testing in accordance with Department instructions.

1015.02 METALS.

(a) Ferrous Metals:

(1) Structural Steel: Structural steel for posts, stringers, framing and miscellaneous steel shall conform to ASTM A 709, Grade 36. Steel shall be galvanized in accordance with Subsection 811.15.

(2) Steel Pipe: Steel pipe or tubing for structures shall be Schedule 40 (STD) conforming to ASTM A 53, Type E or Type S Grade B, or hot formed tubing conforming to ASTM A 36 and ASTM A 501.

(3) Steel Posts for Small Signs, Markers and Delineators: Posts shall be steel of the flanged channel type shown on the plans, galvanized after fabrication in accordance with Subsection 811.15. Before fabrication, posts shall be within 3.5 percent of the specified weight.

Posts shall be fabricated from steel conforming to either ASTM A 499, Grade 60 with chemical properties conforming to ASTM A 1 for 91-lb/yd or heavier rail steel, or ASTM A 576, Grade 1080 with 0.10 percent - 0.20 percent silicon. Holes 3/8 inch in diameter shall be drilled or punched through the middle of each post on one inch centers for at least 36 inches from the top of each post.

(b) Aluminum Alloy: Structural members shall be aluminum conforming to ASTM B 221 or ASTM B 429, Alloy 6061-T6. Miscellaneous aluminum shall conform to ASTM B 209, Alloy 6061-T6.

(c) Fittings:

(1) Structural Bolts, Nuts and Washers: High strength bolts shall be ASTM A 325, and other bolts shall be ASTM A 307, Grade A or Grade B. Bolts shall have hexagonal heads and be supplied with two flat and one lock washer and hexagonal-head nut. Bevel washers, where required, shall be wrought steel. Bolts, nuts and washers shall be galvanized in accordance with ASTM A 153 or ASTM B 633, Class Fe/Zn 25, or by an approved mechanical galvanizing process conforming to ASTM B 695 that provides the same coating thickness.

Anchor bolts shall be ASTM A 709, Grade 36 steel except the maximum tensile strength shall be 88,000 psi and galvanized in accordance with Subsection 811.15 unless otherwise specified.

Stainless steel bolts shall conform to ASTM A 320, Grade B 8, annealed or approved equal.

(2) Fasteners: Fasteners used in fabricating sign faces, including splice plates for joining two panels, sills and border angles, and attaching route marker shields shall be 3/16 inch solid-pin rivets, shall have brasier heads and shall be manufactured from aluminum alloy

conforming to ASTM B 316, Alloy 2024-T4. Collars shall be of the type and alloy recommended by the manufacturer.

Fasteners used in attaching demountable legend to sign faces (except for shields) shall be 1/8 inch diameter blind rivets manufactured from aluminum alloy conforming to ASTM B 316, Alloy 1100-H14.

Fasteners for delineator, hazard marker and milepost assemblies shall be vandal resistant and will be subject to approval prior to use.

1015.03 FLEXIBLE POSTS. Flexible posts for small signs, markers and delineators shall be approved products listed in QPL 39.

1015.04 SIGN PANELS.

(a) Permanent Sign Panels: Panels shall be aluminum sheets or plates conforming to ASTM B 209, Alloy 6061-T6 or Alloy 5052-H38.

(b) Temporary Sign Panels: Panels shall be made from sheet aluminum, sheet steel or wood.

(1) Aluminum: Aluminum sheeting shall be 0.080 inch thickness conforming to ASTM B 209, Alloy 6061-T6 or Alloy 5052-H38.

(2) Steel: Steel panels shall be 16 gage continuous coat galvanized steel sheeting conforming to ASTM A 525, Coating G 90.

(3) Wood: Plywood sheeting of exterior type Grades either High Density Overlay or Medium Density Overlay, are acceptable for use provided the following requirements are met.

Panels shall be a minimum of 5/8 inch thick and shall conform to the latest American Plywood Association specifications and be identified with the APA edge mark or back stamp to verify inspection and testing. Prior to application of reflective sheeting, the surface shall be abraded with steel wool or fine sandpaper, and wiped thoroughly clean. The surface shall be allowed to dry a minimum of 8 hours prior to application of sheeting. Cut edges of plywood panels shall be sealed with an approved aluminum pigmented polyurethane sealer.

1015.05 REFLECTIVE SHEETING. Reflective sheeting shall be one of the following types as specified on the plans and conforming to ASTM D 4956 except as modified herein. The sheeting shall be an approved product listed in QPL 13.

Type I - A medium-intensity retroreflective sheeting referred to as "engineering grade" and typically enclosed lens glass-bead sheeting.

Type II - A medium-high-intensity retroreflective sheeting sometimes referred to as "super engineering grade" and typically enclosed lens glass-bead sheeting.

Type III- A high-intensity retroreflective sheeting, that is typically encapsulated glass-bead retroreflective material.

Type IV - A high-intensity retroreflective sheeting. This sheeting is typically an unmetallized microprismatic retroreflective element material.

Type V - A super-high-intensity retroreflective sheeting. This sheeting is typically a metallized microprismatic retroreflective element material.

Type VI - An elastomeric-high-intensity retroreflective sheeting without adhesive. This sheeting is typically a vinyl microprismatic retroreflective material.

(a) Adhesive Classes: The adhesive required for retroreflective sheeting shall be Class 1 (pressure sensitive) or Class 2 (heat activated) as specified in ASTM D 4956.

(b) Identification Marks: Type II sheeting shall be distinguished by integral identification marks that cannot be removed or affected by physical or chemical methods without causing damage to the sheeting. The markings shall be inconspicuously placed on 12-inch centers and shall be visible from a distance of not more than 3 feet.

(c) Table 4 of ASTM D 4956 is modified to include brown sheeting as follows:

Observation Angle	Entrance Angle	Brown
0.2°	-4°	12
0.2°	+30°	8.5
0.5°	-4°	5.0
0.5°	+30°	3.5

(d) Durability: Reflective sheeting, when processed, applied and cleaned in accordance with the manufacturer's recommendations shall perform outdoors in accordance with the following standards.

(1) Type I sheeting shall perform satisfactorily for at least 7 years (5 years for orange) and retain 40 percent of the minimum brightness in Table 1 of ASTM D 4956.

(2) Type II sheeting shall perform satisfactorily for at least 10 years (3 years for orange) and retain 50 percent of the minimum brightness in Table 3 of ASTM D 4956.

(3) Type III sheeting shall perform satisfactorily for at least 10 years (3 years for orange) and retain 70 percent of the minimum brightness in Table 4 of ASTM D 4956.

(e) Temporary Signs, Barricades, Channelizing Devices, Drums and Cones:

Reflective sheeting for temporary signs, barricades and channelizing devices, except drums and cones, shall meet the requirements of ASTM D 4956, Type II or Type III.

Reflective sheeting for drums shall be a minimum of 6 inches wide and shall meet the requirements of ASTM D 4956, Type III, and the Supplementary Requirement S2 for Reboundable Sheeting with the following modifications pertaining to artificial weathering. The reboundable reflective sheeting shall be tested for weather resistance by a 45° southern outdoor exposure for 6 months as opposed to the accelerated weathering specified in Subsections 8.6 and S2.2.4 of ASTM D 4956.

Reflective sheeting for cones shall conform to ASTM D 4956, Type VI.

1015.06 NONREFLECTIVE SHEETING.

(a) General Requirements: Nonreflective sheeting film shall consist of an extensible, pigmented, weather-resistant plastic film. Face side of film shall be supported and protected by a paper liner which is readily removable after application without the necessity of soaking in water or other solvents. Colors shall be matched visually and be within the limits shown in Table 10 of ASTM D 4956.

(b) Adhesive Requirements: Sheeting shall have a precoated pressure-sensitive adhesive backing or a tack-free heat-activated adhesive backing, either of which may be applied without additional coats on either sheeting or application surface. Adhesive shall conform to ASTM D 4956, Class 1 (pressure sensitive) or Class 2 (heat activated).

(c) Physical Characteristics: The film shall be readily cut by normal fabricating methods without cracking, checking or flaking. Applied film shall be free from ragged edges, cracks and blisters. The material shall have demonstrated its ability to withstand normal weathering without checking, cracking or excessive color loss.

1015.07 SIGN ENAMELS, PAINTS AND SILK SCREEN PASTE.

(a) Sign Enamels and Paints: These shall be applied in accordance with the sheeting manufacturer's recommendations. Final appearance as well as materials used shall be subject to approval.

(b) Silk Screen Paste: Constituents used in manufacture of silk screen paste shall meet approval of the engineer. Silk screen paste shall be mixed at the factory, well ground to a uniform consistency and smooth texture, and shall be free from water and other foreign matter. It shall dry within 18 hours to a film that does not run, streak, or sag. Paste which has livered, hardened or thickened in the container, or in which pigment has settled out so that it cannot be readily broken up with a paddle to a uniform usable consistency, will be rejected. Paste and thinner shall be used in accordance with the sheeting manufacturer's recommendations.

Paste shall have proper pigmentation and consistency for use in silk screen equipment. The material shall produce the desired color and the same brightness values as required for reflective sheeting of the same type and color when applied on reflective sheeting background. Paste shall meet the quality and test requirements for appearance, coarse particles, and moisture and water resistance as specified for sign paints.

1015.08 TEMPORARY PAVEMENT MARKINGS.

(a) Temporary Tape: Temporary tape shall conform to ASTM D 4592, Type I (removable) or Type II (non-removable) and shall be an approved product listed in QPL-60.

(b) Painted Stripe: Paint shall be an approved traffic paint conforming to Subsection 1015.12. Glass beads for drop-on application shall conform to Subsection 1015.13.

1015.09 RAISED PAVEMENT MARKERS. Markers shall be either nonreflectorized or reflectorized, as specified. Markers shall be approved products listed in QPL 9. Infrared curves of materials used in markers shall match approved curves on file at the Department's Materials and Testing Section.

(a) Nonreflectorized Markers:

(1) Description: Nonreflectorized markers shall consist of an acrylonitrile-butadiene-styrene polymer or other approved material, and shall be 4-by-6-inches.

(2) Physical Requirements: Markers shall conform to the following requirements when tested in accordance with DOTD TR 621.

Property	Requirement
Heat Resistance	No change in shape or appearance
Impact Resistance	No break, chip or crack
Load Resistance	No break, chip, crack or permanent deformation

(b) Reflectorized Markers: Reflectorized markers shall conform to ASTM D 4280. The type and color shall be in accordance with the plans and the MUTCD.

(c) Adhesive:

(1) Epoxy Adhesive: Epoxy adhesive shall be Type V epoxy resin system conforming to Subsection 1017.02.

(2) Bituminous Adhesive: The adhesive shall be an asphaltic material with a homogeneously mixed mineral filler suitable for bonding pavement markers to asphaltic concrete pavements when the road surface and marker temperatures are 40°F to 160°F. The composition of the adhesive shall be such that its properties will not deteriorate when heated to and applied at temperatures up to 425°F using either air or oil-jacketed melters. Bituminous adhesive shall be an approved product listed in QPL 59.

a. Adhesive Properties:

		Requirements	
	Test Method	Min.	Max.
Softening Point, °F	ASTM D 36	200	---
Penetration, 100 25°C (77°F), 100 g, 5 s	ASTM D 5	10	20
Flow, inch	AASHTO T 187[1]	---	0.2
Heat Stability Flow, inch	AASHTO T 187[2]	---	0.2
Viscosity, 400°F, poises	ASTM D 2669[3]	---	75
Flash Point, COC, °F	ASTM D 92	550	---

[1]Flow shall be determined according to Section 6, Flow, of ASTM D 3407 except that the oven temperature shall be 158±2°F and sample preparation shall be according to Section 7.1 of ASTM D 5.

[2]Heat stability flow shall be determined according to flow except that 1000 grams of adhesive shall be placed in a covered quart can, heated to 425°F and maintained at this temperature for 4 hours prior to preparing the sample panel.

[3]Viscosity shall be determined according to ASTM D 2669 using a spindle speed of 10 rpm. The adhesive shall be heated to approximately 410°F and allowed to cool. Viscosity shall be determined at 400±1°F.

b. Asphalt Properties[4]:

	Test Method	Requirements Min.	Max.
Penetration, 100 25°C (77°F), 100 g, 5 s	ASTM D 5	25	---
Viscosity, 275°F, poises	ASTM D 2171	12	---
Viscosity Ratio, 275°F, Aged/Original		---	2.2

[4]Asphalt properties determined on the filler-free material derived from the extraction and Abson recovery process:

c. Filler Properties[5]:

	Test Method	Requirements Min.	Max.
Filler Content, % by wt	AASHTO T 44	50	75
Filler Fineness, % passing by wt	ASTM C 430[6]		
Sieve No. 100		100	---
Sieve No. 200		95	---
Sieve No. 325		75	---

[5]Filler properties determined on material derived from the extraction.

[6]Filler fineness shall be determined according to ASTM C 430 using Sieve Nos. 100, 200 and 325. This method shall be modified by the use of a water-soluble, nonionic wetting agent, to aid the wetting action. Concentration of the surfactant solution shall be approximately 1 percent by weight. The 1 gram dry sample shall be thoroughly wetted in the surfactant solution and allowed to soak for 30 minutes. The filler shall be transferred completely into the sieve cup and water-spray applied for 2 minutes. Surfactant solution may be added as needed and physical means used to disperse any clumped particles. The sample shall then be dried and handled as directed in ASTM C 430.

1015.10 THERMOPLASTIC PAVEMENT MARKINGS.

(a) Description: This specification covers hot-sprayed or hot-extruded reflective thermoplastic compound for pavement markings on asphaltic or portland cement concrete pavement. Material shall be so manufactured as to be applied by spray or extrusion to pavement in molten form, with internal and surface application of glass spheres, and upon cooling to normal pavement temperature, shall produce an adherent, reflectorized pavement marking of specified thickness and width, capable of resisting deformation.

Materials shall be approved products listed in QPL 63 and shall conform to AASHTO M 249 except as modified herein. Material shall not scorch, break down, or deteriorate when held at the plastic temperature specified in Subsection 732(03)(d)(1) for 4 hours or when reheated four times to the plastic temperature. Temperature-vs-viscosity characteristics of plastic material shall remain constant when reheated four times, and shall be the same from batch to batch. There shall be no obvious change in color of material as the result of reheating four times or from batch to batch.

(1) Suitability for Application: Thermoplastic material shall be a product especially compounded for pavement markings. Markings shall maintain their original dimension and placement and shall not smear or

spread under normal traffic at temperatures below 140°F. Markings shall have a uniform cross section. Pigment shall be evenly dispersed throughout the material. Density and character of material shall be uniform throughout its thickness. The exposed surface shall be free from tack and shall not be slippery when wet. Material shall not lift from pavement in freezing weather. Cold ductility of material shall be such as to permit normal movement with the pavement surface without chipping or cracking.

(2) Bond Strength: Bond strength shall be not less than 100 psi when tested in accordance with DOTD TR 622.

(3) Indentation Resistance: When tested in accordance with ASTM D 2240, material shall conform to the following requirements. After heating material for 4 hours at 400°F and cooling to test temperature, minimum durometer hardness using a 1 kilogram weight for 15 seconds shall be:

Durometer Type	Hardness	Test Temperature
A2	90	77±3

1015.11 PREFORMED PLASTIC PAVEMENT MARKINGS.

(a) Description: Type I preformed pavement marking material shall be preformed plastic consisting of white or yellow pigmented plastic with reflective glass beads uniformly distributed throughout the cross-sectional area and shall be capable of being affixed to asphaltic or portland cement concrete pavement by either a pressure-sensitive precoated adhesive or a liquid contact cement. The material shall be provided in a form that will facilitate rapid application and protection during shipment and storage. Solvents, adhesives and necessary equipment for proper application shall be in accordance with marking manufacturer's instructions. The material shall be manufactured and packaged in such manner to permit storage at normal shelf temperatures for periods of up to one year after purchase. Contact elements, where used, shall have shelf life of 6 months. The material shall mold itself to pavement contours, breaks, faults, and the like by action of traffic at normal pavement temperatures.

The pavement marking film shall be capable of use for patching worn areas of the same type film in accordance with marking manufacturer's instructions.

The product shall be from a manufacturer of reflectorized preformed pavement markings who can submit evidence of successful product use under similar climatic conditions present in Louisiana. Preformed plastic pavement markings shall be approved products listed in QPL 64.

(b) Material Composition: The retroreflective pliant polymer pavement marking film shall consist of a mixture of high quality polymeric materials and pigments with 1.50 to 1.60 refractive index glass beads uniformly distributed throughout its cross-sectional area, and with a reflective layer of beads bonded to the top surface. Composition shall be as follows:

Material	Min. % by Weight
Resins and Plasticizers	20
Pigments	30
Graded Glass Beads	33

The remaining percentage shall be comprised of the above materials in various proportions. The material shall be capable of adhering to asphaltic or portland cement concrete by means of a pressure sensitive, precoated adhesive or by a liquid contact cement applied at the time of installation.

(c) Physical Requirements:

(1) Bend Test: Plastic shall be of such structure that at a temperature of 80°F, a 3-by-6-inch piece (with backing) placed on a 1 inch diameter mandrel, may be bent over the mandrel until the end faces are parallel and one inch apart. There shall be no fracture lines apparent in the uppermost surface by visual inspection.

(2) Adhesive Backing Release Material Removal: Release material shall be completely removed when tested as specified. Cut a specimen to the dimensions 1/2-by-6-inches. Remove release material for one inch of the length and attach the nonadhesive side to a vertical surface with a suitable clamp at the point where release material was removed. Attach a clamp, which has a supported 1-pound weight attached to it, to the end of the partly removed release material. Release the weight. Examine the specimen for any remaining release material.

(3) Tensile Strength: The film shall have a minimum tensile strength of 2.5 lbf/inch of width of of cross section when tested according to ASTM D 3759 except that a 1-by-6-inch sample shall be tested at a temperature between 70°F and 80°F using a jaw speed of 10 to 12 inches per minute.

(4) Pigmentation: Pigments shall be selected and blended to provide a white or yellow marking film which conforms to standard highway colors through the expected life of the film. White film shall have a minimum Whiteness Index of 40 when tested in accordance with ASTM E 313.

(5) Glass Beads: Glass beads shall be colorless and have a Refractive Index of 1.50 to 1.60 when tested using the liquid immersion method at 25°C. Size and quality of beads shall be such that performance requirements for the retroreflective pliant polymer film will be met.

(6) Friction Resistance: The surface of the retroreflective pliant polymer shall provide a minimum Frictional Resistance Value of 35 British Polish Number (BPN) when tested according to ASTM E 303.

(7) Abrasion Resistance: The plastic marking shall have a maximum loss in weight of 0.25 gram in 500 revolutions when abraded according to Federal Test Method Standard No. 141A (Method 6192), using CS-10 Calabrade wheels with a 500-gram load on each wheel.

(8) Retroreflective Requirements: The material shall have the minimum brightness values shown below at 0.2° and 0.5° observation angles expressed as millicandelas per square meter per lux. Measurements shall be conducted in accordance with ASTM D 4061.

Observation Angle	Entrance Angle	Specific Luminance	
		White	Yellow
0.2°	86°	500	400

(9) Thickness: Retroreflective pliant polymer film without adhesive shall have a minimum thickness of 60 mils.

(10) Adhesive Shear Strength: Specimens shall be tested in accordance with ASTM D 638 modified to test the adhesive shear strength. Cut plastic specimens to a dimension of 1-by-6 inches and apply to the adhesive face a piece 1-by-3 inches of carborundum extra coarse emery

cloth, or its equivalent, so that there is 1 square inch overlap between the plastic specimen and carborundum. Apply a pressure of 50 psi over the overlaid area for 30 seconds. Place each end of the test piece in a tensile test machine. Test the specimen for adhesive shear strength by applying a load at rate of 0.25 inch per minute. The average load required to break the adhesive bond shall not be less than 7 pounds. The test shall be conducted at a temperature of 70°F to 80°F.

(11) Adhesive Stability Test: The precoated adhesive backing shall be pressure sensitive and shall remain stable with a controlled degree of flexibility and flow. The specimen shall be tested in accordance with ASTM D 816, Method B modified to hold a static load of 4 pounds for 30 minutes. The slippage between the plastic panel and emery cloth shall not exceed 1 inch. This test shall be conducted at 70°F to 80°F.

(d) Performance: The retroreflective pliant polymer, when applied according to the manufacturer's recommendations, shall provide a neat, durable marking that will not flow or distort due to temperature. The pliant polymer shall provide a cushioned resilient substrate that reduces bead crushing and loss. The film shall be weather-resistant, and through normal traffic wear shall show no appreciable fading, lifting or shrinkage throughout the useful life of the marking. It shall also show no significant tearing, roll back or other signs of poor adhesion.

1015.12 TRAFFIC PAINT. The contractor shall have the option of furnishing either aklyd traffic paint or water-borne traffic paint; however, the same type paint shall be used throughout the project. Each paint container shall bear a label with the name and address of manufacturer, trade name or trade mark, type of paint, number of gallons, batch number and date of manufacture.

Paints shall be approved products listed in QPL 36, shall show no excessive settling, caking or increase in viscosity during 6 months of storage, and shall be readily stirred to a suitable consistency for standard spray gun application.

(a) Alkyd Traffic Paint. This material shall be a rapid-setting compound suitable for use with hot application equipment. The material shall meet the following requirements:

PROPERTY	TEST METHOD	REQUIREMENTS MIN.	MAX.
Weight, lb/gal	ASTM D 1475	12.0	---
Viscosity @ 25°C, Krebs Units	ASTM D 562	85	115
Drying Time, s	ASTM D 711	---	180
Directional Reflectance, %	ASTM E 97		
White		80	---
Yellow		50	---
Bleeding	Fed. Spec. TT-P-115	Pass	
Total Solids, % by weight	ASTM D 1644, Method A	70	---
Film Shrinkage	1	Pass	
Hiding Power	2	Pass	
Pigment, %	ASTM D 2371	50	55
Nonvolatiles in Vehicle, % by wt	ASTM D 215	35	---
Flexibility	Fed. Spec. TT-P-1952	Pass	
Pigment Composition	3	Pass	

[1]Film Shrinkage: With a film applicator, cast a wet film with a thickness of 30 mils over a smooth glass plate. Allow sample to cure at room condition for 4 to 5 hours. Using a micrometer, measure the plate thickness before the film is cast using five measurements to obtain an average. The cured film shall have a minimum thickness of 12 mils.

[2]Hiding Power: The paint shall have a wet hiding power of at least 350 square feet per gallon. The compound shall have sufficient hiding power to cover any pavement when applied at a wet film thickness of 15 mils.

[3]Pigment Composition: White paint shall contain at least 1.5 pounds of titanium dioxide pigment per gallon with at least 92 percent TiO_2 content. The TiO_2 shall conform to ASTM D 476. Yellow paint shall contain at least 1.3 pounds of medium chrome yellow pigment per gallon (ASTM D 211, Type III).

(b) Water Borne Traffic Paint: This material shall be a rapid setting waterborne compound suitable for use with hot application equipment. The material shall meet the following requirements:

PROPERTY	TEST METHOD	REQUIREMENTS MIN.	MAX.
Weight, lb/gal	ASTM D 1475	12.0	---
Viscosity, at 25°C Krebs Unit	ASTM D 562	75	90
Drying to No Pickup, min.	ASTM D 711	---	10
Dry through, min.	ASTM D 1640	---	20
Volume Solids	---	58	---
Total Solids, % by wt	ASTM D 2369	70	---
Pigment, % by wt	ASTM D 3723	45	55
Nonvolatile Vehicle, % by wt	Fed. Test 141B	40	---
Bleed Ratio	Fed. Spec. TT-P-1952	0.96	---
Daylight Reflectance, %	Fed. Test 141B		
White		85	---
Yellow		54	---
Hiding Power (Contrast Ratio) at 10 mils	Fed. Test 141B	0.96	---
Flexibility	Fed. Spec. TT-P-1952		Pass
Drying Time, min.	[1]	---	3
Fineness of Grind	ASTM D 1210	3	---
Freeze-Thaw	ASTM D 2243		Pass
Heat Stability	Fed. Spec. TT-P-1952		Pass
Shelf Life, Months	[2]	12	---
Color	[3]		Pass
Volatile Organic Compounds (g/L)		---	250
Pigment Composition	[4]		Pass

[1]Drying time to no track - Paint applied at 15 mils wet on the road surface with paint heated to 120-150°F shall not show tracking when a standard size automobile crosses in a passing maneuver at 3 minutes.

[2]The paint shall show no excessive setting, caking or increase in viscosity during 12 month storage and shall be readily stirred to a consistency for use in the striping equipment.

[3]Color - yellow shall match Federal Test Standard No. 595, Color 13538, White shall be a clean, bright, untinted binder.

[4]The white paint shall contain a minimum of 1.0 pound per gallon of titanium dioxide conforming to ASTM D 476.

1015.13 GLASS BEADS FOR DROP-ON APPLICATION: Glass beads shall be colorless, clean and transparent, and free from milkiness or excessive air bubbles. The contractor may furnish moisture-proof beads.

(a) Shape: At least 70 percent of the beads on each screen shall be true spheres as determined by microscopic examination.

(b) Refractive Index: Glass beads shall have a Refractive Index of 1.50 to 1.60 when tested using the liquid immersion method at 25°C. Size and quality of beads shall be such that performance requirements for the retroreflective pliant polymer film will be met.

(c) Gradation: Beads shall conform to the following gradation when tested in accordance with DOTD TR 634:

U. S. Sieve	Percent Retained
No. 20	0
No. 30	10-20
No. 50	30-75
No. 80	9-32[1]

[1]No more than 15 percent shall pass the No. 80 sieve.

(d) Acid Resistance: Approximately 100 beads shall be placed on a microscope slide and immersed in a three normal sulphuric acid solution ($3N\text{-}H_2SO_4$). After 10 minutes of immersion, not more than 20 percent of the beads by count shall show a hazed surface, and there shall be no popping or bursting of beads.

(e) Sodium Sulfide Resistance: Place approximately 1 gram of beads in a glass container with suitable stopper and cover with a solution of 50 percent sodium sulfide (Na_2S), 48 percent distilled water, and 2 percent Aerosal OL or similar wetting agent. Shake container frequently and examine beads after 1 hour. Beads shall show no darkening.

(f) Packaging: Glass beads shall be furnished in 50 pound capacity multi-wall, waterproof shipping bags or 50 pound capacity polyethylene-lined burlap bags conforming to ICC Standards.

Section 1016
Precast Reinforced Concrete Drainage Units

1016.01 GENERAL. This specification covers the manufacture of precast reinforced concrete box culverts, manhole sections, catch basins and junction boxes.

(a) Portland-Pozzolan Cement: Portland-pozzolan cement conforming to Subsection 1001.02 may be used in the manufacture of precast units.

(b) Admixtures: Any admixture for portland cement concrete listed in QPL 58 is allowed for use in the manufacture of precast units except for chloride-type accelerators and high range water reducers.

(c) Strength: Compressive strength specimens for precast units shall be made and cured in accordance with DOTD TR 226 or DOTD TR 227, and tested in accordance with DOTD TR 230.

(d) Pipe Connections: For grout connections, each opening shall be 4±1/2 inches larger than the outside diameter of the pipe for which it is provided. Units shall be cast with the specified number and size of pipe openings to incorporate the unit into the drainage system.

Other methods for connecting pipe to precast units using resilient connectors shall conform to ASTM C 923.

(e) Marking: The name or trademark of the manufacturer, date of casting, and the structure number or station number as shown on the plans shall be stenciled on each unit on the inside and outside of the unit in such manner as to be legible at time of delivery.

1016.02 PRECAST REINFORCED CONCRETE BOX CULVERTS. Precast reinforced concrete box culverts shall conform to ASTM C 789 or ASTM C 850, whichever is applicable, amended as follows:

(a) Table 1 shall be used.

(b) No modified designs will be allowed.

(c) Joints shall conform to Subsection 1006.05. Rubber gaskets will be allowed only in an approved joint system.

(d) Inside horizontal and vertical dimensions shall not vary by more than ±1 percent with a maximum of ±1/2 inch from design dimensions.

(e) Sides of each box section shall not vary from being perpendicular to the top and bottom by more than 1/2-inch when measured diagonally between opposite interior corners of each end.

(f) Culvert units shall be cured by one of the methods listed in ASTM C 789 or ASTM C 850. The method shall be approved by the Construction Section.

1016.03 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS: Precast reinforced concrete manhole sections shall be of the type specified and shall conform to ASTM C 478, amended as follows:

(a) Joints and gasket material shall conform to Subsection 1006.05(a).

(b) Frames, grates and covers shall conform to Subsection 1018.04.

(c) Special designs will be subject to approval by the Hydraulics Engineer and shall meet all the above requirements.

(d) No modified designs will be allowed.

1016.04 PRECAST REINFORCED CONCRETE CATCH BASINS AND JUNCTION BOXES. Precast reinforced concrete catch basins and junction boxes shall conform to the dimensions shown on the plans or other design approved by the Hydraulics Engineer, and shall meet the following requirements:

(a) Materials: The materials shall conform to the following Sections and Subsection:

Portland Cement Concrete, Class M	901
Reinforcing Steel	1009
Frames, Grates and Covers	1018.04

Portland cement concrete shall attain a minimum compressive strength of 4000 psi before acceptance and shipping of the units.

(b) Casting Concrete: When multiple castings are to be made using the same forms, the engineer may require the use of metal forms. Concrete in each sectional unit shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by hand-tamping as necessary to force the concrete into the corners of forms and prevent formation of stone pockets or cleavage planes.

(c) Reinforcement: Reinforcement shall be as shown on the plans, and shall not vary more than 1/4 inch from the positions shown, except at pipe connections. At pipe connections no variance from the positions shown is allowed. Cover on reinforcement shall not be less than that shown on the plans.

(d) Curing: Units shall be cured in accordance with Subsection 805.10 or Subsection 805.14(e).

(e) Form Removal: Forms shall remain in place for 1 curing day in accordance with Subsection 805.11, Method 2.

(f) Workmanship: Units shall be true to shape, and surfaces shall be smooth, dense and uniform in appearance. Units will be rejected for defects in workmanship in accordance with ASTM C 478. When approved, minor surface cavities or irregularities which do not impair the service value of the unit and which can be corrected without marring its appearance shall be pointed with approved patching material listed in QPL 49 as soon as forms are removed.

(g) Quality Assurance: Acceptability of units will be determined by results of compression tests on concrete cylinders and by inspection during manufacture to determine their conformance with the design and workmanship prescribed in these specifications and on the plans. Units will be rejected for defects in workmanship in accordance with ASTM C 478.

A minimum of three cylinders for acceptance shall be made and cured in accordance with DOTD TR 226 or DOTD TR 227 and tested in accordance with DOTD TR 230 for each pour. Additional cylinders shall be made in pairs and used to determine the strength for moving within the plant.

Section 1017
Epoxy Systems

1017.01 GENERAL. This Section covers the material requirements for epoxy resin systems.

1017.02 EPOXY RESIN SYSTEMS

(a) General: Epoxy resin systems for applications as specified herein, shall be approved products listed in QPL 32. Epoxy resin systems shall consist of two components which, when combined in accordance with the manufacturer's recommendations, shall conform to the requirements of this Subsection.

(b) Packaging and Marking: Both components shall be supplied in separate containers that are nonreactive with the contents. The containers shall be identified as Component A for the epoxy resin and Component B for the curing agent and shall show the product name, formulator, lot or batch number, date of packaging, shelf-life, and recommended mixing ratio either by weight or volume unless specified.

(c) Classification: Epoxy resin systems shall be classified by type and grade based on the following applications and consistencies:

(1) The types of epoxy resin systems are defined according to the following applications:

Type I - For use primarily in bonding hardened concrete and other materials to hardened concrete, setting dowels or bolts and other applications where a thin glue line is required; also as a binder for high strength epoxy mortars for structural repairs.

Type II - For use in bonding plastic concrete to hardened concrete.

Type III - For use in bonding skid-resistant materials to hardened concrete, and as a binder in epoxy mortars.

Type V - For use primarily in bonding raised pavement markers to portland cement concrete and asphaltic concrete surfaces. Equal parts, by volume, of the epoxy resin and hardener components must be mixed together to obtain the finished adhesive.

(2) The grades are defined according to consistency characteristics of the mixed components as shown in Heading (e)(1) for Types I, II and III epoxy systems.

Grade A - A low viscosity material used primarily for crack injection and horizontal surface applications.

Grade B - A medium viscosity material or thin paste primarily used for horizontal or slight incline surface applications.

Grade C - A nonsagging gel or nonsagging paste primarily used for vertical or overhead surfaces.

(d) Properties of Epoxy Resin Systems: Component A of epoxy resin systems classified as Types I, II, and III shall contain a bisphenol-A, epichlorohydrin epoxy resin with or without a reactive diluent. Component B for epoxy resin systems of all types classified above shall contain one or more curing agents, which on mixing with Component A will cause the mixture to harden.

The mixed epoxy system, along with the separate components, shall conform to the applicable physical requirements and the following general requirements:

(1) All fillers, pigments, and thixotropic agents in either component shall be of sufficiently fine particle size and dispersed so that no appreciable separation or settling will occur during storage. Any fillers present in a Type I Grade A epoxy resin system shall be of such a nature that they shall not interfere with application by injection equipment or damage such equipment.

(2) The components shall be free of lumps, skinning or foreign material.

(3) The consistency of the individual components shall not change more than ±15 percent after 14 days in closed containers at 115±3°F.

(e) Test Requirements: Epoxy resin systems submitted for approval shall be specified by the manufacturer as being one or more of the types shown in Heading (c). Test procedures and requirements for each type shall be as follows:

(1) Types I, II and III epoxy resin systems, shall conform to the following requirements.

Property	Test Method	Type I		Type II		Type III	
		Min.	Max.	Min.	Max.	Min.	Max.
Consistency:	DOTD TR 702						
Grade A, # 3 Spindle at 20 RPM, poises		---	20	---	20	---	20
Grade B, # 3 Spindle at 20 RPM, poises		20	---	20	---	20	---
Grade C, Sag, inches		---	0.25	---	0.25	---	0.25
Epoxide Equivalent of Comp. A, g/g mole	DOTD TR 518	160	275	160	275	160	275
Gel Time, minutes[1]	DOTD TR 703	20	---	20	---	20	---
Water Absorption, 24 hr. Immersion, %	DOTD TR 704	---	0.8	---	0.8	---	0.8
Compressive Strength, 24 hr., psi	DOTD TR 705	5000	---	---	---	3000	---
Tensile Bond Strength, psi	DOTD TR 706						
24 hours (dry cure)		350	---	---	---	250	---
72 hours (moist cure)		---	---	150	---	---	---
Diagonal Shear Strength, psi	DOTD TR 707						
2 days (dry cure)		4000	---	---	---	1000	---
14 days (moist cure)		---	---	3000	---	---	---
Volatile Content, Cured System, %	DOTD TR 701	---	5	---	5	---	---
Thermal Compatibility	ASTM C 884	---	---	---	---	Pass	
Property Retention After 5 Cycles from 30 to 110°F:							
Tensile Bond Strength, psi	DOTD TR 708	350	---	150	---	250	---

[1]Specification limits apply to working life of Grade C material. The minimum gel time for Type 1 Grade A material used for crack injection is 15 minutes.

PROPERTY	TEST METHOD	TYPE V (STANDARD) MIN.	TYPE V (STANDARD) MAX.	TYPE V (RAPID) MIN.	TYPE V (RAPID) MAX.
Consistency	DOTD TR 702				
Component A (Resin) TD Spindle at 5 RPM, Poises		1000	3500	1000	3500
Component B (Hardener) TD Spindle at 5 RPM, Poises		1000	3500	1000	3500
Shear Ratio (each component)		2.0	---	2.0	---
Gel Time, Minutes[1]	DOTD TR 703	6	10	6	10
Tensile Bond Strength to reach 170 PSI, Minutes	DOTD TR 706	---	210	---	40
Diagonal Shear Bond Strength	DOTD TR 707				
24 hour, PSI		2000	---	1000	---
24 hour, plus 7 day water soak, PSI		1500	---	800	---

[1]The gel time for mixtures that are mixed and dispensed by hand shall be a minimum of 7 minutes to a maximum of 13 minutes.

Section 1018
Miscellaneous Materials

1018.01 WATER FOR CEMENT. Water suitable for human consumption may be used in mixtures with portland cement without testing. Water obtained from other sources, when tested in accordance with AASHTO T 26 shall meet the following requirements.

	Percent By Weight (Max.)
Alkali	0.1
Solids (Organic)	0.1
Solids (Inorganic)	0.4
Salt (NaCl)	0.5
Sugar, Oil, or Acid	0.0

1018.02 CALCIUM CHLORIDE. Calcium chloride shall conform to AASHTO M 144.

1018.03 LIME. Lime shall be hydrated lime or quicklime from an approved source listed in QPL 34.

(a) Hydrated Lime shall conform to ASTM C 207, Type S, except that maximum free moisture shall be 1.50 percent.

(b) Quicklime shall conform to the following chemical requirements:
Minimum CaO + MgO: 90 percent by weight of total material.
Maximum MgO: 8 percent by weight of total material.

Quicklime shall be protected from contact with moisture prior to testing, shall be free flowing and graded so that 100 percent will pass a 3/8 inch sieve. When the quicklime is to be used in a slurry the gradation shall be a minimum of 95 percent passing the 3/4 inch sieve.

1018.04 MANHOLE FRAMES, GRATES AND COVERS. Metal units shall conform to the following requirements:

(a) Gray iron castings shall conform to Subsection 1013.06.
(b) Steel castings shall conform to Subsection 1013.05.
(c) Malleable iron castings shall conform to Subsection 1013.06.
(d) Galvanizing shall conform to ASTM A 123.

1018.05 GROUND ROD ASSEMBLIES. Ground rod assemblies suitable for grounding fences and other applicable grounding requirements shall meet the following requirements:

(a) Ground rods shall be 5/8 inch nominal diameter copper weld steel rod 8 feet long.

(b) Ground wire shall be an AWG No. 6 solid copper conductor firmly attached in such a manner that fence fabric, barbed wire, metal post and ground rod are electrically connected.

(c) Mechanical connectors for attaching ground wire to fence fabric, barbed wire and metal posts shall be solid copper alloy UL approved. Coated steel hardware will not be permitted.

(d) Mechanical connectors for attaching ground wire to ground rods shall be solid copper alloy UL approved.

1018.06 PREFABRICATED MASONRY PADS.

(a) Type A Pads: These pads shall be composed of multiple layers of 8-ounce cotton duck impregnated and bound with high quality rubber compound, or of equally suitable materials compressed into resilient pads of uniform thickness after compressing and vulcanizing.

Pads shall withstand 10,000 psi compressive loads perpendicular to the plane of laminations. Load deflection properties in accordance with MIL-C-882C shall be the following maximum percentages of total pad thickness: 10 percent at 1,000 psi; 15 percent at 2,000 psi. When loaded to 1,500 psi, permanent set as load is removed, in accordance with MIL-C-882C, shall be a maximum of 2.5 percent of the original "zero point" thickness. Shore "A" Durometer hardness shall be 90±5. The material shall not lose effectiveness throughout a temperature range of -65 to +150°F. There shall be no visual evidence of damage or deterioration by effects of sunshine, humidity, salt spray, fungus and dust in accordance with MIL-E-5272C. Thickness shall not vary from that specified by more than 5 percent.

(b) Type B Pads: These pads shall consist of fabric and rubber body made from new unvulcanized rubber and new fabric fibers in proper proportion to maintain strength and stability.

The vulcanized and cured pad shall have a Shore "A" Durometer hardness of 80±10 and shall withstand a 10,000 psi compressive load without excessive extrusion or detrimental reduction in thickness. Thickness shall not vary from that specified by more than 1/32 inch.

1018.07 TIMBER CONNECTORS. Connectors for treated timber structures, except those of malleable iron, shall be galvanized in accordance with ASTM A 123.

(a) Split Ring Connectors: Split rings of 2 1/2 inches, 4 inches and 6 inches inside diameter shall be manufactured from hot-rolled, low-carbon steel conforming to ASTM A 711, Grade 1015. Each ring shall form a closed true circle with an outside cylindrical surface parallel to the axis of the ring. The inside surface, except for the 6-inch ring, shall be beveled from the median line toward the edges. It shall be cut through in one place in its circumference to form a tongue and slot.

Connector grooves in timber shall be cut concentric with the bolt hole and shall be of the following dimensions, in inches:

Ring Size	Inside Diameter	Groove Width	Groove Depth
2 1/2	2.56	0.18	0.37
4	4.08	0.21	0.50
6	6.12	0.27	0.62

(b) Toothed-Ring Connectors: Toothed-ring connectors shall be stamped cold from 0.060 inch thick rolled sheet steel conforming to ASTM A 711, Grade 1015, and shall be bent cold to form a circular, corrugated, sharp-toothed band and circle and shall be parallel to the axis of the ring. The central band shall be welded to fully develop the strength of the band. All sizes shall have an overall depth of 0.94 inch and depth of fillet of 0.25 inch.

(c) Shear Plate Connectors: Shear plate connectors shall be of the following types:

(1) Pressed Steel Type: Pressed steel shear plates of 2 5/8 inches in diameter shall be manufactured from steel conforming to ASTM A 711, Grade 1015. Each plate shall be a true circle with a flange around the edge, extending at right angles to the face of the plate and extending from one face only. The plate portion shall have a central bolt hole and two small perforations on opposite sides of the hole and midway from the center and circumference.

(2) Malleable Iron Type: Malleable iron shear plates of 4-inch diameter shall be manufactured according to ASTM A 47, Grade 35018. Each casting shall consist of a perforated round plate with a flange around the edge extending at right angles to the face of the plate and projecting from one face only. The plate portion shall have a central bolt hole reamed to size with an integral hub concentric to the bolt hole and extending from the same face as the flange.

(d) Claw-Plate Connectors: Claw-plate connectors of 2 5/8 inches, 3 1/8 inches and 4 inches in diameter shall be of malleable iron, manufactured according to ASTM A 47, Grade 35018. Each claw-plate shall consist of a perforated circular flanged plate with three-sided teeth arranged about the perimeter of one face. The male plate shall have integral cylindrical hubs on both faces concentric to a bolt hole through the center of the plate. The female plate shall be flat on the side opposite the teeth, but shall have an integral cylindrical hub concentric to the central bolt hole and on the face with the teeth.

(e) Spike-Grid Connectors: Spike-grid connectors shall be manufactured according to ASTM A 47, Grade 35018. They shall consist of four rows of opposing spikes forming a 4 1/8 inch square grid with 16 teeth which are held in place by fillets. Fillets for the flat grid in cross section shall be diamond shaped. Fillets for single and double curve grids shall be increased in depth to allow for curvature and shall maintain a thickness between sloping faces on fillets equal to the width of the fillet.

1018.08 HARDWARE AND STRUCTURAL SHAPES.

(a) Hardware: Bolts shall conform to ASTM A 307. Dowels shall conform to ASTM A 709, Grade 36 except the maximum tensile strength shall be 88,000 psi. Washers shall be cast ogee gray iron or malleable castings. A Standard washer shall be used under heads of lag screws.

Machine bolts may have either square or hex heads and nuts. Nails shall be cut or round wire of standard form. Spikes shall be cut wire or boat spikes. Bridge hardware shall be galvanized in accordance with ASTM A 153 or ASTM A 123 or by an approved mechanical galvanizing process conforming to ASTM B 695 that provides the same coating thickness.

(b) Structural Shapes: Structural shapes, rods and plates shall be of structural steel conforming to Section 1013.

(c) Electrical Hardware: Hardware for electrical apparatus shall conform to ASTM A 193, Grade B8 (bolts and studs) and ASTM A 194, Grade 8 or 8A (nuts).

(d) Eyebolts: Eyebolts shall conform to ASTM A 489.

1018.09 RIGID METAL ELECTRICAL CONDUIT. Rigid metal electrical conduit shall conform to ANSI C 80.1 or ANSI C 80.5.

1018.10 ELECTRICAL CONDUCTORS. Electrical conduction shall conform to IPCEA Publication No. S-19-81, IPCEA Publication S-66-524, and IPCEA Publication S-61-402.

1018.11 ALUMINUM PLATE FOR ELECTRICAL BOXES. Aluminum plate shall conform to ASTM B 209, Alloy 6061-T6.

1018.12 BARRICADE WARNING LIGHTS.

(a) General: Types A, B and C barricade warning lights shall be in accordance with the MUTCD and shall be an approved product listed in QPL 16.

(b) Markings: Each light submitted for approval and each light placed on a project shall have a permanently attached identification plate or other permanent markings with the following information:

(1) Manufacturer's name
(2) Model number
(3) Type
(4) Lens manufacturer and identification number
(5) Circuit manufacturer and identification number
(6) Bulb number
(7) Minimum operating voltage required to conform to minimum intensity requirements
(8) Year of manufacture

(c) Certification: Prior to installation, the contractor shall furnish the engineer with the following information:

(1) Notarized material certification (Certificate of Compliance)
(2) Proposed number of warning lights to be used,
(3) Type
(4) Trade name
(5) Manufacturer's name and model number as contained in QPL-16

The certification shall also state that each light assembly has been tested, is functioning properly and will be maintained in satisfactory working order.

1018.13 ROOFING PITCH. Roofing pitch shall conform to AASHTO M 118.

1018.14 ELASTOMERIC BRIDGE BEARING PADS.

(a) General: Elastomeric bridge bearing pads shall be either plain (consisting of elastomer only) or laminated (consisting of layers of elastomer separated by nonelastic laminates. The elastomer portion of the compound used for bearings shall be 100 percent virgin chloroprene stock. Natural rubber, vulcanized rubber (natural or synthetic) or other synthetic rubber-like materials will not be acceptable.

Nonelastic laminates shall be a nominal 1/16 inch thickness rolled steel sheets with a minimum yield strength of 33,000 psi.

Elastomeric bridge bearing pads shall be an approved product listed in QPL 3.

(b) Physical Properties of Elastomer: The elastomer compound for plain and laminated bearings shall meet the requirements in Table 24. Tests shall be made on the finished product. Special molded or prepared specimens, where required, shall conform to the specimen preparation requirements of the test involved.

(c) Manufacturing Requirements: Components of laminated bearing pads shall be molded into an integral unit. Edges of the nonelastic laminations shall be covered by a minimum of 1/8 inch of elastomer. Laminates shall be parallel with the bottom surface of the bearing, subject to the tolerances that follow.

The preparation of elastomer compound prior to placement in the mold shall be such as to result in a homogeneous, finished bearing pad free of voids, blisters, cracks, folds, cuts, nonfills and any appearance of layers or ply separation on the surface or within the pad. Plain bearing pads may be molded individually or cut to length from previously molded strips or slabs. No pads shall be formed from the lamination of previously cured sheets or slabs. Finish of cut surfaces shall be at least as smooth as ANSI No. 250 finish.

Each bearing pad shall be marked with the manufacturer's identification number in such manner as to remain legible until the bearing pad is placed in the structure. This number shall identify the batch from which it was produced. A batch is defined as the quantity of compound produced from each separate mixture of ingredients.

(d) Appearance and Dimensions: Flash tolerance and appearance shall conform to Drawing RMA F3-T.063 of the RMA Rubber Products Handbook as published by the Rubber Manufacturers Association, Inc.

For both plain and laminated bearings, permissible variation from specified dimensions and configuration shall be as follows:

	Tolerance Inches
Overall Vertical Dimensions	
Average Total Thickness 1 1/4 in. or less	-0, +1/8
Average Total Thickness over 1 1/4 in.	-0, +1/4
Overall Horizontal Dimensions	-0, +1/4
Thickness of Individual Layers of Elastomer (Laminated Bearings Only)	±1/8
Variation from Plane Parallel to Theoretical Surface	
Top	±1/8
Sides	±1/4
Individual Nonelastic Laminates (determined by measurements at edges of bearing)	±1/8
Position of Exposed Connection Members	±1/8
Edge Cover of Embedded Laminates or Connection Members	-0, +1/8
Size of Holes, Slots or Inserts	-0, +1/8
Position of Holes, Slots or Inserts	±1/8
Thickness of Nonelastic Laminates	-0, +1/16

(e) Load Testing: For laminated bearings, each bearing shall be subjected to an average compression of 1,500 psi by the manufacturer. The performance of each bearing will be considered satisfactory if there is no visible evidence of bond failure or other damage to the bearing because of this loading. The Department will verify that pads meet this requirement by means of random testing.

(f) Certification: Prior to installation, the contractor shall furnish the Materials Engineer Administrator with a notarized material Certificate of Analysis and a list of:

(1) the proposed number of laminated bearing pads to be used itemized by type and size.
(2) manufacturer's name and identification number
(3) the state project number

The certification shall also state that each laminated bearing pad shipped has been load tested and found to conform to specifications as described in Subsection 1018.14(e). It shall also state that the steel laminates in each pad are aligned as required in Subsection 1018.14(d).

1018.15 FLY ASH. Fly ash shall be from an approved source listed in QPL 50 and shall conform to the following requirements when tested in accordance with ASTM C 311.

PROPERTY	PORTLAND CEMENT REPLACEMENT	GENERAL USE
$Si_2+Al_2O_3+Fe_2O_3$, percent, Min.	50.0	50.0
SO_3, %, Max.	5.0	5.0
MgO, %, Max.	---	6.0
CaO, %, Max.	---	18.0
Loss on Ignition, %, Max.	4.0	4.0
Available Alkali Content, Na_2O equivalent, %, Max.	1.5	---
Moisture Content, %, Max.	3.0	3.0
Fineness, % retained when wet-sieved on a No. 325 sieve, Max.	25.0	25.0
Strength Activity Index, with portland cement		
at 7 days, percent of control	75	---
at 28 days, percent of control, Min.	75	---
Water Requirement, percent of control, Max.	105	---
Autoclave Expansion or Contraction, %, Max.	0.8	---

1018.16 FERTILIZER. Fertilizer shall be a commercial type conforming to the commercial fertilizer laws in effect as regulated by the Louisiana Department of Agriculture and Forestry. The chemical composition shall be as specified and shall be designated by a 3-number sequence representing minimum percentages by weight, respectively, of nitrogen (N), available phosphoric acid (P_2O_5) and soluble potash (K_2O). Fertilizer supplied in granulated or pelletized form shall be packaged in moisture proof containers.

1018.17 AGRICULTURAL LIME. Agricultural lime shall consist of ground limestone or seashells containing at least 90 percent calcium carbonate equivalent ($CaCO_3$). The material shall be ground so that a minimum of 90 percent passes a No. 10 sieve and 25 percent passes a No. 100 sieve.

1018.18 SEED. Seed shall conform to requirements of Louisiana Law. The minimum percentage of pure live seed and the maximum percentage of weed seed permitted shall be in accordance with Table 24.

Each variety of seed shall be furnished and delivered in separate bags or other containers. Each bag or container shall bear an analysis tag which is a minimum No. 6 standard shipping tag having all information required by the Louisiana Seed Law, arranged as shown in Illustration No. 1.

Seed furnished shall be the previous season's crop (the last crop year for the crop kind in question) and the date of analysis shown on each tag shall be within 5 months (excluding the month in which the test is completed) of the time of delivery to the project.

TABLE 24
SEED REQUIREMENTS

Variety	Min. % of Pure Live Seed (Purity Times Germination Including Hard Seed by Count)	Max. % of Weed Seed, by Count
Hulled Bermuda	83	1
Pensacola Bahia	81	2
Crimson Clover	78	1
Kentucky 31 Fescue	80	1
Unhulled Bermuda	80	1
Balled Clover	80	1
Vetch (Common)	80	1
Lespedeza	80	1

(a) Noxious Weeds: Noxious weeds shall be interpreted to mean that list of weeds, except Bermuda, which has been adopted by the Louisiana Seed Commission as being noxious in Louisiana. Noxious weed seeds shall not exceed the limitations prescribed in the regulations and in no case shall they exceed 500 per pound.

Analysis tags shall be removed from each bag or container only by the engineer or an authorized representative.

(b) Test Report: A copy of the laboratory test report of an "official" sample taken and tested for each lot of seed furnished as prepared by the State Seed Analyst of the Louisiana Department of Agriculture and Forestry shall be submitted to the engineer by the contractor. The Department will accept test reports from the Agricultural Departments of other states provided the requirements of these specifications are met. The lot number on the analysis tag shall match the laboratory test report lot number.

Illustration No. 1
(Analysis Tag)

Kind & Variety _____
Where Grown _____ Net Wt. _____ Lot No. _____
Pure Seed _____% Germination _____%
Inert Matter _____% Hard Seed _____%
Crop Seed _____% Total Germ. & Hard Seed _____%
Weed Seed _____% Date of Test _____
Name & No. of Noxious Weed Seed per lb. _____
_____
Name _____
Address _____

1018.19 VEGETATIVE MULCH. Mulch shall consist of pine straw, stems or stalks of oats, rye, rice, or other approved straws. The contractor may also use hay obtained from various legumes and grasses such as lespedezas, clover, vetches, soybeans, Bermuda, Dallis, carpet sedge, fescue or other approved legumes or grasses of any combination thereof. Straw or hay shall be reasonably dry and free from mold, Johnson grass or other noxious weeds.

1018.20 FIBER GLASS ROVING.

(a) Description: This specification covers a continuous fiber glass roving used with asphalt to control erosion on newly seeded slopes and drainage channels.

(b) General Requirements: The material shall be formed from continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound, collected into strands and lightly bound together into roving without the use of clay, starch or like deleterious substances. The roving shall be wound into a cylindrical package approximately 1 foot high in such manner that the roving can be continuously fed from the center of the package through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

(c) Detailed Requirements: Fiber glass roving shall conform to the following requirements:

Property	Test Method	Requirements
Strands/Rove, Min.	DOTD TR 509	20 minimum
Yards/lb of Rove	DOTD TR 509	175-250
Fiber Diameter, in., nominal (Trade Designation)		
G	DOTD TR 509	0.00038
K	DOTD TR 509	0.00053
Organic Content, %, Max.	DOTD TR 509	2.0
Package Wt, lb	ASTM D 578	25-40

1018.21 SACKS FOR SACKED CONCRETE. Sacks for sacked concrete revetment shall be suitable new burlap bags. Burlap shall conform to AASHTO M 182.

1018.22 HARDWARE CLOTH: Hardware cloth shall be a minimum of 19 gage, 2 x 2 mesh galvanized in accordance with ASTM A 153.

1018.23 CONCRETE ANCHOR SYSTEMS. Concrete anchor systems shall consist of mechanical anchor devices, epoxy systems or other approved methods for anchoring fasteners to hardened concrete. These systems shall be approved products listed in QPL 40.

1018.24 EROSION CONTROL MATTING AND HARDWARE:

(a) Straw Matting: Straw matting shall consist of a machine produced mat of straw covered with a biodegradeable extruded plastic mesh, or other approved biodegradable material. The straw shall be stitched to the plastic mesh with biodegradable yarn on a maximum of 3-inch centers with a maximum stitch length of 3 inches. The straw shall consist of stems or stalks of oats, rye, rice, wheat, or other approved straws. The matting shall have a minimum weight of 0.5 pounds per square yard. Matting shall be furnished with suitable protection for outdoor storage.

(b) Curled Wood Matting: Curled wood matting shall consist of a machine produced mat of curled wood excelsior covered with a biodegradeable extruded plastic mesh, or other approved biodegradable material. The matting shall be made smolder-resistant without the use of chemical additives. The wood fibers shall be of a consistent thickness, with 80 percent of the fibers being at least 6 inches long, and shall be evenly distributed in the matting. The matting shall have a minimum weight of 0.88 pounds per square yard. The matting shall be furnished with suitable protection for outdoor storage.

(c) Steel Staples: Staples shall be 8 gage (0.162 inch diameter) wire. Staples shall be U shaped with a 1-inch crown or T shaped with the bar of the T at least 4 inches long with the single wire end bent downward approximately 3/4-inch. The legs of the staples shall be 8 or 12 inches as required.

(d) Wood Stakes: Stakes shall be 1 inch x 2 inch x 12 inch wedge-shaped wood stakes.

1018.25 FORM RELEASE AGENT: Form release agent for concrete shall be an approved product listed in QPL 29.

1018.26 MIX RELEASE AGENT FOR ASPHALTIC CONCRETE: Mix release agent for asphaltic concrete shall be an approved product listed in QPL 25. Diesel is not allowed as a mix release agent.

1018.27 NON-SHRINK GROUT: Non-shrink grout shall conform to U. S. Army Corps of Engineers Specification CRD-C 621 and shall be an approved product listed in QPL 47.

Section 1019
Geotextile Fabric and Geocomposite Systems

1019.01 GEOTEXTILE FABRIC.

(a) General Requirements: The geotextile fabric shall be composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which adversely alter its physical properties. When required, the geotextile fabric shall contain stabilizers and/or inhibitors added to the base material to make filaments resistant to deterioration due to ultraviolet and heat exposure. Edges of geotextile fabric shall be finished to prevent the outer yarn from pulling away from the fabric. Fibers of other composition may be woven into the geotextile fabric for reinforcing purposes. Durability of these fibers shall be equivalent to that of the geotextile fabric.

Geotextile fabric rolls shall be furnished with an opaque, waterproof wrapping for protection against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged with the manufacturer's name, date of manufacture, batch number, name of product.

Unless otherwise specified on the plans or in the project specifications, the geotextile fabric shall be an approved product in QPL 61.

(b) Detailed Requirements: The geotextile fabric shall conform to the requirements in Table 25 and shall be utilized as follows unless otherwise specified:

Use		Classes
(1)	Drainage:	
	Underdrains	A, B, C or D
	Pipe and Precast Manhole Joints	A, B, C or D
	Weep Holes	A, B, C or D
	Bedding Fabric	B, C, or D
	Approach Slabs	D
	Fabric for Geocomposite Drainage Systems[1]	B, C, or D
(2)	Stabilization:	
	Bulkheads	C or D
	Flexible Revetments	C or D
	Rip Rap	D
	Railroad Crossings	D
	Soil Stabilization	C, D, or S
(3)	Paving Fabric:[2]	B or C (modified)
(4)	Silt Fencing	
	Wire Supported	F
	Self Supported	G

[1]Refer to Section 1019.02 for additional requirements.
[2]Refer to Section 1019.03 for additional requirements.

1019.02 GEOCOMPOSITE DRAINAGE SYSTEMS. The geocomposite fabric drain shall consist of a nonwoven geotextile fabric and a core as specified below with the geotextile completely enveloping the core. Fittings shall be as recommended by the manufacturer. The geotextile fabric shall be sufficiently secured to the core to prevent separation of the geotextile fabric and intrusion of the backfill material during installation. The geocomposite drainage system shall be an approved product listed in QPL 62.

(a) Geotextile Fabric: The fabric shall meet the requirements for Class B, C or D geotextile fabric of Subsection 1019.01 with the following modifications:

Property	Test Method	Requirements
Elongation, %, Min.	ASTM D 4632	20
Shear Seam Strength (Fabric to Fabric), lb/in. width, Min.	ASTM D 4437	15

(b) Cores:

(1) Edgedrain (Shoulder Drain): The core shall be a flexible, rectangular design made of a polyolefin material not sensitive to moisture. The geocomposite design shall allow drainage of water from both the pavement and shoulder. The thickness of the core shall be as specified in the plans and shall meet the following requirements.

Property	Test Method	Requirements
Compressive Strength, psf @ 20% Max. deflection, Min.	ASTM D 1621[1]	4000
Constant Head Hydraulic Transmissivity GPM/ft. width at 10 psi load after 100 hours at a hydraulic gradient of 0.1, Min.	ASTM D 4716	15

[1]Test specimen shall be approximately 12-by-12 inches.

(2) Wall Drains (Single Sided): The core shall be a flexible, solid-backed, rectangular design made of a polyolefin material not sensitive to moisture. The geocomposite design shall allow drainage of water from one side only. The core shall consist of supports having a minimum height of 5/16 inch upon which the fabric shall be securely fastened. The cross section open area of the core which will allow the passage of water shall be a minimum of 40 percent.

The core shall meet the following requirements:

Property	Test Method	Requirement
Compressive Strength, psf @ 20% max. deflection, Min.	ASTM D 1621	8000

1019.03 PAVING FABRIC: In addition to the specifications for Class B or C geotextile fabric of Subsection 1019.01, the material shall also conform to the following requirements:

Property	Test Method	Requirements
Asphalt Retention, gal/sq yd	AASHTO M 288	0.2
Change in Area at 275°F, %, Max.	AASHTO M 288	5.0

TABLE 25
GEOTEXTILE FABRICS

PROPERTY	TEST METHOD	REQUIREMENTS CLASSES A	B	C	D	S	F	G
AOS, U. S. Sieve, Min.	ASTM D 4751	50	50	50	70	30	20	20
Grab Tensile, lb, Min.	ASTM D 4632	75	90	130	180	180	90	90
% Elongation @ Failure, Min.	ASTM D 4632	---	---	50	50	---	---	50
Burst Strength psi, Min.	ASTM D 3787	100	140	210	290	290	---	---
Puncture, lb, Min.	ASTM D 4833	25	30	40	75	75	---	---
Trapezoid Tear Strength, lb, Min.	ASTM D 4533	25	30	40	50	50	---	---
Permittivity, Sec.$^{-1}$, Min.	ASTM D 4491	1.0	1.0	1.0	1.0	0.2	0.01	0.01
Strength Retained at 150 h Weatherometer, %, Min.	ASTM D 4632 DOTD TR 611	70	70	70	70	70	---	---
Strength at 500h Weatherometer, %, Min.	ASTM D 4632 DOTD TR 611	---	---	---	---	---	70	70

Section 1020
Traffic Signals

1020.01 TRAFFIC SIGNAL HEADS.

(a) General Requirements: Traffic signal sections, beacon sections and pedestrian signal sections shall be of the adjustable type. Materials and construction of each section shall be the same.

Signals shall be constructed for either 8- or 12-inch lens in accordance with the plans. Signal sections shall have three to five sections per face and beacon sections have only one section per face. Signal sections and associated brackets shall be finished inside and out with two coats of high grade green enamel (Outdoor Advertising Association No. 144) with each coat independently baked. Visors shall be coated green on the outside and black on the inside.

Edges shall be deburred and smooth with no sharp edges.

(b) Housing, Housing Doors, and Visors: Housing and doors shall be constructed of cast aluminum conforming to ASTM B 85 or B 108 with a minimum tensile strength of 17,000 psi. Hardware for the signals, such as hinges, locking devices, screws, bolts, etc., shall be stainless steel.

(1) Housing: Housing shall be sectional and each face shall consist of as many sections as there are optical units, with a suitable top and bottom. Sections shall be rigidly and securely fastened together in a manner that provides mechanical integrity and a weatherproof optical unit.

Each face shall be provided with round openings (slip-fit for 2-inch opening) in the top and bottom so that it may be rotated 360° about its axis as a complete unit between waterproof supporting brackets or trunnions and be capable of being directed and locked at 5° intervals. Serrations, detents, bolts, or similar locking devices are required. Friction will not be an acceptable lock. These locks shall be such that any face will resist a torque of 20 ft-lb when assembled in accordance with the manufacturer's recommendations.

The portion of the housing adjacent to the bracket shall be reinforced to have sufficient strength against breakage from shock. Seals, gaskets, labyrinths, or a suitable combination shall be provided at bracket attachment points and at section joints to ensure water shedding. Supporting brackets or trunnions shall be used at the top and bottom of section assemblies to rigidly support all faces.

The bracket at the supported end of the signal section shall be 1-1/2 inch conduit or a conduit with an equivalent inside clearance for wiring. The bracket at the opposite end of the section may be either the same as the top or solid. A set screw engaging a drilled hole shall be provided at each joint on the bracket where conduit type joints are used or an equivalent locking device shall be provided.

A 6-position terminal block for connection of wires from the socket and incoming wires from signal circuits shall be provided in the center section of the signal housing and shall include provisions for grounding.

(2) Housing Doors: Housing doors shall contain locking devices which can be operated without tools. Door hinge pins shall be designed so that the door will not become disconnected from housing when open, regardless of signal position. Doors shall be field removable.

Weather resisting, mildew-proof neoprene or silicone rubber sponge gasketing between the body of the housing and the doors shall be provided that will exclude dust and moisture.

(3) Visors: Each signal section shall have a visor in accordance with the plans which tilts downward approximately 8° from the horizontal. Visors shall be constructed of aluminum alloy sheet not less than 0.05 inch (No. 18 Gage) thick, or plastic (when specified).

Visors shall be the standard Type A as shown on the plans. Type B tunnel visors shall be used where louvers are shown on the plans. Louvers shall be five vane and painted flat black. Visors shall be designed to fit tightly to the door and shall not permit any filtration of light between door and visor.

Visors for pedestrian signals shall be Type A and shall encompass the tops and sides of the signal face and be a shape and size to adequately shield the face from external light sources.

(c) Optical Unit: The optical unit shall consist of lens, reflector, lamp socket and lamp. The optical unit and visor shall be designed as a unit to eliminate the return of outside sunlight from entering the unit from above the horizontal (known as sun phantom). The optical unit shall be designed and assembled so that no light can escape from one indication to another.

(1) Lens: The minimum values of luminous transmission and limits of chromaticity for traffic signal lenses shall be as defined in ANSI D 10.1. Each lens shall consist of a round 1-piece convex glass which, when mounted, shall have a visible diameter of at least 11-3/4 inches (for standard 12-inch signal section or a visible diameter of at least 7-3/4 inches for standard 8-inch signal section). The glass shall be free from bubbles, 3/16 inch to 5/16 inch thick, and smooth on the outside surface. The lens shall be marked to indicate the top or bottom. No lettering shall be visible on the lens from normal viewing position. The performance of solid color lenses shall be such that when installed in standard traffic signals (equipped with an approved lamp and reflector properly operated and focused), the appearance, candlepower distribution and intensity, when compensated for absorption due to the color, will at least equal the light distribution specified in ANSI D 10.1.

Arrow lenses shall be 12 inches in diameter and shall conform to the above lens specification. Arrow lenses shall be given one coat of black opaque enamel on the inside of lens of a thickness sufficient to hide the light of a 200 watt lamp placed behind it. Enamel shall be free from pin holes and applied so that when the lens is in use an arrow will be illuminated. Enamel shall be baked or fired into the glass and shall not peel or flake during service or when washed. The arrow shall not be visible except when lamp is illuminated.

An alternate method to produce an arrow indication is by use of a noncorrosive metal template affixed in the door housing in the same manner as the lens. The template shall conform and be retained next to the concave surface of the lens (inside face) to create clear outline of the arrow.

(2) Reflectors: Reflectors shall be rigidly mounted in the housing to assume proper alignment and arranged to be easily swung out of the housing and away from the door to provide access to the interior of the housing. An approved neoprene or rubber gasket shall be placed between the reflector and lens to ensure a dust tight seal. The gasket shall not be detrimental to the optical performance of the signal.

Reflectors shall be made of specular Alzak Aluminum spun or punched from metal not less than 0.025-inch thick, equipped with a bead or flange on the outer edge to stiffen the reflector and ensure trueness of shape. The thickness of the anodic coating shall be a minimum of 0.0003 inch. The reflecting surface shall be free of flaws, scratches, defacements or mechanical distortion.

(3) Lamps: Lamps shall conform to the following physical dimensions and design.

Type	Wattage	Rated Voltage	Lumen Output	Rated Life,h	Light Center, in.	Bulb Envelope	Operating Position
A	60	125	610	8,000	2 7/16	Clear A-19	Horizontal
B	135	125	1750	6,000	3	Clear A-21	Horizontal

The lamp base shall be brass with a built-in fuse to protect against filament arcing. The lamp filament shall be Type C11V or Type C9. The lamp shall have a minimum of 80 percent kryton gas concentration (volume per volume) for increased lumen output at stated wattage. Each lamp shall have the following information etched into the glass bulb the manufacturer's name, wattage, voltage rating, and average user operating hours. The lamp shall be permanently marked with the date of manufacturer. The lamp output shall meet or exceed the candlepower requirement when used in a traffic signal head at the rated initial lumens as specified by ITE standards for "Traffic Signal Lamps", 1980, and "Vehicle Traffic Control Signal Heads", 1984. The lamp shall not consume more than 3 percent above the stated wattage when operated at the rated voltage and producing the above referenced light output.

The lamp characteristics shall be tested by and recorded in a report from an approved independent testing laboratory.

(4) Lamp Receptacle: Lamp receptacles shall be made of heat resisting materials designed to properly position a traffic signal lamp with means for correct filament positioning. Lamp receptacles shall be designed to properly position a Type A lamp in the 8-inch lens section and Type B lamp in the 12-inch lens section. The receptacle shall be provided with a lamp grip to prevent the lamp from working loose due to vibration. Provisions shall be made to permit rotation of the lamp so that the lead wires are up and securely fastened, but shall not permit any change of position of the socket with respect to the optical center of the reflector. The metal portion of the lamp receptacle shall be brass or copper. A suitable dust-tight gasket (not cork) shall be placed between reflector and lamp socket.

Each lamp receptacle shall be provided with two color coded No. 18 or larger lead wires, Type TEW, 600-volt, AWM fixture wire with 3/64 inch, 105°C rated thermoplastic insulation, securely fastened to the socket with sufficient length to reach the terminal block with the reflector fully open. The thermoplastic insulation shall, at 34°F, be

capable of being wrapped 6 times around a 1-inch mandrel without damage to its insulating properties at rated voltage. Each lead shall have a terminal attached to its end, for connection to the terminal block in the signal housing with a screw driver.

(5) Pedestrian Signals: Pedestrian indications shall attract the attention of and be readable to the pedestrian both day and night and at all distances from 10 feet to the full width of the area to be crossed.

The indicators shall be rectangular and shall consist of the lettered messages "WALK" and "DON'T WALK."

When illuminated, the "WALK" indication shall be lunar white and the "DON'T WALK" indication shall be portland orange meeting ITE standards. All except the letters shall be obscured by an opaque material.

When not illuminated, the "WALK" and "DON'T WALK" messages shall not be distinguishable by pedestrians at the far end of the crosswalk they control. Letters shall be at least 3 inches high where the distance from the near curb to the pedestrian signal indication is 60 feet or less and shall be 4 1/2 inches high for distances over 60 feet.

The light source shall be designed and constructed so that in case of electrical or mechanical failure of the word "DON'T", the word "WALK" of the "DON'T WALK" message will also remain dark.

(d) Brackets: Brackets for the assembly of 2-way, 3-way and 4-way signal sections shall be constructed to have the center of the attachment points arranged on a 7 1/2-inch radius. Attachment to signal head shall be made with 1 1/2-inch conduit or 3-bolt type fittings with a bolt length 1 1/2 inches. Fittings at the center of the bracket shall have a removable lower plate for access to the wireway.

The bracket at the supported end of the signal section shall be 1 1/2-inch conduit or a conduit with an equivalent inside clearance for wiring and a fitting with cover for access to the wire-way. The bracket at the opposite end of the section may be either the same as the top or solid. A set screw engaging a drilled hole shall be provided at each joint on the bracket where conduit type joints are used or an equivalent locking device shall be provided.

The attachment point for mounting on the bracket shall be a 2-inch opening. When slip-fit is used, the section shall come complete with the necessary nuts and washers for 1 1/2-inch conduit. Provisions shall be made for a positive lock to prevent accidental bracket rotation. Locking may be accomplished by means of serrations, detents, set screws, or similar devices. Friction locking will not be acceptable. An acceptable alternative to the 1 1/2-inch conduit will be a tri-stud type fitting with appropriate washer. Tri-stud length shall be 1 1/2 inches.

Unused openings of signal sections shall be closed with a standard waterproof plug for a 1 1/2-inch opening. The minimum length of the plug shall be 1 1/2-inches. Steel plugs shall be galvanized in accordance with ASTM A 153. The exposed portions of plugs shall be painted to match the color of the signal heads.

Carbon steel components shall be galvanized in accordance with ASTM A 153.

(e) Signal Mounts: Signal sections and beacon sections shall be as shown on the plans and shall be suitable for one of the following standard mounts, the type mount for each shall be specified in the plans.

(1) Support Cable Mount: Support cable mounted signals shall come with a disconnect hanger and clamp described in Subsection 1020.01(g).

(2) Pedestal Mount: Pedestal mounts shall be furnished with a slip fitting for placement on a 4-inch inside diameter pipe pedestal having set screws for correct alignment of the signal. Provisions for the entrance of signal cables shall be incorporated into the design of the bracket assembly.

The bracket assembly shall incorporate a weatherproof terminal compartment or box with a removable cover allowing complete access. The box shall be a suitable size to accommodate, and shall come equipped with, a terminal strip with terminals equal to the number of signal indications in the signal heads plus one or more for common and for equipment ground. The terminal compartment shall be neat in appearance and shall be adjacent to or near the pedestal mount. In no case shall feed wires be required to pass through a signal section or face to reach the terminml compartment. A terminal compartment integral with the bracket will be permitted.

(3) Mast Arm Mount: This mount shall be furnished and installed with an adjustable stainless steel strap or cable clamp, malleable clamp casting, tightening mechanism, vertical support tube, top and bottom signal head support with set screws, and bolts. The vertical support tube shall be a minimum of 5 feet long.

Supporting brackets, trunnions, and fittings shall be made of cast aluminum, steel, or cast iron.

(4) Side Mount: This mount shall be furnished for attaching brackets to vertical supports as shown on the plans. The bracket mounting hub shall accept 1 1/2-inch conduit and provide for a wire opening equivalent to a 1 1/2-inch condulet. For timber pole installation, the side mounts shall have a vertical entrance for 1-inch conduit.

(5) Flashing Beacon Signal Mount: The flashing beacon signal shall attach to the support cable by a bracket as shown on the plans. The bracket shall be provided with a cable entrance adapter with provisions for balancing and securing the signal.

(f) Backplates: Backplates shall be designed to fit the combination of sections of each signal face. Backplates shall be flat aluminum alloy at least 0.05 inch (No. 18 gage) thick and shall withstand distortion in 70 mph winds and shall be firmly attached to each signal face to withstand the above wind load and to permit the opening of any signal door independent from the other doors in the signal face. Width of backplates shall extend a minimum of 5 1/2 inches from the signal head in all directions or as specified on the plans. Backplates shall be furnished with an oven baked black enamel.

(g) Disconnect Hanger for Traffic Signal Head: The hanger shall provide a means for connecting and disconnecting the signal head electrically and mechanically from signal support cable and span wire without use of tools.

The hanger, with top and bottom attachments and clamps, shall not increase signal height from the span wire to the bottom of the signal by more than 6 inches.

The hanger shall be as shown on the plans and shall conform to the requirements of the clamp, housing and terminal block, plug, and adapter.

(1) Clamp: The clamp shall be capable of attaching to a 1/4 inch to 7/16 inch support cable and shall attach to or be integral with a balance adjusting device and a suitable weatherproof entrance for signal cable. The support cable clamp shall utilize a minimum of two "J" or "U" type bolts 3/8 inch or larger. A 5/8 inch clevis type suspension clamp shall be provided with a 5/8-inch diameter. The balance adjustor shall be suitable for mating with a clevis-type clamp having a horizontal clearance of 5/8 inch and pin of 5/8 inch. All steel shall be galvanized in accordance with ASTM A 153.

(2) Housing: The housing and accessories shall be high-strength aluminum alloy and shall be equipped with a door of similar material. The door shall be held shut by a device operable with one hand without use of tools and shall not be easily removable. The door, when open, shall provide complete access to the interior of the housing and a device shall be included to hold the door open while working inside the hanger if it will not remain open.

The housing shall be equipped with two or more weatherproofed openings for signal cable entrance. The openings shall be equipped with suitable bushings for cable protection. Cable entrances shall be capable of accommodating three signal cables 11/16 inch in diameter. No cable opening shall be less than 1 inch in diameter.

The housing shall be provided with a permanently mounted clamping device to prevent the cable from twisting. The clamping device shall not damage the cable jacket, insulation, or break wires.

The housing shall be provided with a 3 1/2-inch-by-3 1/2-inch cast aluminum flange adaptor as shown on the plans for connecting to the signal head or bracket.

(3) Terminal Block and Plug: An easily accessible pressure type terminal block shall be located in the housing and shall accommodate from twelve or eighteen separate lines, as specified. Each terminal shall be permanently numbered for identification, shall accommodate a minimum of two AWG No. 12 conductors, and shall be sufficiently rugged to permit tightening for proper electrical connection without damaging the wire.

The terminal block shall be wired to a multi-circuit female jack connector mounted in the housing and aligned in accordance with the plans.

A minimum size No. 18 AWG wire, with 600-volt polyethylene or polyvinylchloride insulation, shall be used between the terminal strip and the jack connector. The numbered terminals on the terminal strip shall be wired to the corresponding numbered pin in the jack connector.

A suitable male plug with clamp for the corresponding female jack connector shall be furnished and shall be equipped with 4 feet of cabled leads for connection to the signal heads. Wire shall be No. 18 AWG, 600-volt polyethylene or polyvinylchloride insulated and neatly cabled.

1020.02 TRAFFIC DETECTORS AND ASSOCIATED EQUIPMENT. Loop detection shall be used for vehicle detection on actuated phases of signal operation. Pedestrian push-buttons shall be used as pedestrian detectors.

(a) Loop Detectors: Detector units shall conform to NEMA TS1, Section 15, with or without delay and extension timing as specified.

Two types of inductive detector units are specified, those with and without the ability to delay and extend a call, NEMA Type 1 and Type 1 T.

Detector units shall be suitable for accurate detection of vehicles from motorcycles to tractor-trailer combinations which ordinarily travel public streets and highways with sufficient conductive material, suitably located to permit recognition and response by the detector system.

Detector units shall also comply with NEMA TS1, Section 15.2.6.

(1) Size and Case: The amplifier case shall be constructed of rugged metallic material with a protective coating. A removable cover shall be provided to allow access to internal circuitry. The cover shall be removable with hand tools.

(2) Connectors, Switches, and Fuses: Switches, connectors, and fuses shall be located on the front of the unit.

a. Each switch shall be permanently labeled to identify its function. Each position shall be permanently labeled to identify its mode of operation. Each mode of operation shall be simple to program with one switch position assigned to one function.

b. A single connector shall be required on the front of the unit to conform to NEMA TS1, Section 15.2.28.1. This connector shall mate with cable connections MS 3106A-18-1S.

c. Plug wiring shall be as follows.

PIN[1]	FUNCTION
Pin A	AC(-)
Pin B	Relay Common
Pin C	AC(+)
Pins D & E	Loop Leads
Pin F	Relay (N.O.)
Pin G	Relay (N.C.)
Pin H	Chassis Ground
Pin I	Spare
Pin J	Delay Override

[1]No pins shall be used for any other purpose than those listed above.

d. Fuseholders shall be permanently labeled identifying the size of the fuse.

(3) Electrical Characteristics:

a. Detector unit outputs shall be a relay type as referenced in NEMA TS1, Section 15.2.29.1. The output operation shall be indicated by a high intensity light emitting diode.

b. Color coding for the wire shall be as follows:

FUNCTION	COLOR CODE
Detector Wiring	Not Specified
AC(+)	Black
AC(-)	White
Relay Common	White/Black Stripe
Ground	Green

c. The operation of the detector unit shall conform to NEMA TS1, Section 15.2.1. In addition, the detector unit shall retune to a new inductance value following an excessively large inductance change.

d. When sensor loop and loop lead-in network falls outside the specifications in NEMA TS1, Section 15.2.13, the detector shall generate a fail safe continuous output in both presence and pulse

modes. The continuous output shall remain until the memory is cleared by removing power or resetting.

e. When specified, the detector unit shall have the ability to delay and extend a call to the controller. The Delay/Extension operations shall conform to NEMA TS1, Section 15.2.24.

1. The delay time shall begin when a vehicle enters the detection area until the call relay is closed representing an activation and shall be selectable in the range between 0 and 30 seconds.

2. The extension time shall begin timing when the vehicle leaves the detection area, continuing the activation for the selected time. The time shall be selectable in the range of 0 to 7 1/2 seconds.

(4) The detector unit shall have at least three selectable frequencies which shall be visible at all times on the front of the detector unit.

(5) The Sensitivity Control shall conform to NEMA TS1, Section 15.2.14 and Section 15.2.15. There shall be at least three selectable sensitivity ranges located on the front of the detector unit. The sensitivities shall be nominally 0.02 percent, 0.08 percent, and 0.32 percent change in total loop inductance.

(6) The modes of operation shall conform to NEMA TS1, Section 15.2.17. There shall be two presence modes and one pulse mode. The selected mode shall be indicated at all times on the front of the detector unit.

a. Long presence mode shall continue to detect the same vehicle within the detection area for at least 3 1/2 minutes for a Class 1 type test vehicle.

b. Medium presence mode shall continue to detect the same vehicle within the detection area for at least 20 seconds for a Class 1 type test vehicle.

(7) Fail Safe: The detector shall operate with the sensor loop shorted to ground or of poor quality. The unit shall generate a continuous call when returning failed sensor loop, failed detector unit, or power failure.

(b) Pedestrian Pushbuttons: Pedestrian pushbuttons shall consist of a direct push type button and single momentary contact switch in a cast metal housing on which shall be attached the pushbutton sign shown in the plans. The cast metal housing shall include conduit fittings for 1/2-inch conduit on the back and bottom. Operating voltage for pedestrian pushbuttons shall not exceed 24 volts DC.

The assembly shall be weatherproof and constructed so that it will be impossible to receive an electrical shock under any weather condition.

When a pedestrian pushbutton is attached to a pole, the housing shall be shaped to fit the curvature of the standard or post to which it is attached to provide a rigid installation.

When a pushbutton is to be mounted on top of a 2 1/2-inch post, the housing shall be provided with a slip-fitter fitting and screws for securing rigidly to the post.

1020.03 TRAFFIC SIGNAL HARDWARE AND EQUIPMENT:

(a) General: This Subsection defines the general requirements that shall apply to all hardware and equipment not specifically listed. When design tests are specified, documentation may be provided indicating that such tests have previously been satisfactorily completed.

(b) Miscellaneous Hardware: Screws, nuts, and lock washers shall be stainless steel or galvanized in accordance with ASTM A 153. No self tapping screws shall be used unless approved.

(c) Pedestal Anchor Bolts: Steel anchor bolts shall be as shown on the plans and shall be fitted with one hex nut and one washer. Nuts, washers, and anchor bolts shall be galvanized in accordance with ASTM A 153.

(d) Support Cable: Support cable for interconnect and detector support cable shall be 1/4-inch outside diameter and signal support cable and guy wire shall be 3/8-inch outside diameter and shall conform to ASTM A 475, 7-strand Siemens-Martin grade with Class A coating.

(e) Guy Components: Guying components and hardware shall be galvanized in accordance with ASTM A 123 and ASTM A 153.

Guy clamps shall be steel, 3-bolt type, 6 inches in length, and of proper strand size to fit both sizes of cable. Clamp bolts shall have an upset shoulder fitting into the clamp plate.

(f) Traffic Signal Cable: The cable shall be 600 volt insulated cable. Filler material, when used, shall be non-metallic, moisture resistant, non-hydroscopic, non-wicking, and non-absorbent. The conductors that are to be marked with tracer in addition to the solid color shall have the tracer as part of the insulation, ink marking is not acceptable. The outside jacket shall be smooth and shall not display patterns of the conductor lay on the outside of the jacket.

The traffic signal cable shall be No. 14 AWG solid conductor. Interconnect cable shall be No. 16 AWG in the 24 conductor and 12 AWG in the 7 conductor. All material, color code, and testing shall conform to IMSA 20-1. The interconnecting cable between intersections for closed loop and telemetry operation shall be 6 pair IMSA 20-2.

Loop lead-in cable shall be tinned No. 14 AWG stranded conductor, twisted pair with an overall shield. The cable shall conform to IMSA 50-2. Loop detector wire shall conform to IMSA 51-3 and shall be No. 16 AWG-19 strands/No. 29 AWG copper. Insulation shall be 0.080-inch XLPE.

(g) Electrical Junction Box: Junction boxes shall be constructed of Class M concrete, cast iron or epoxy/sand composite, as shown on the plans.

Class M concrete shall conform to Section 901. Reinforcement shall consist of welded wire fabric, 4-inch-by-4-inch No. 4/4 conforming to Section 1009. Pull boxes may be cast-in-place or precast.

Epoxy/sand composite boxes shall be manufactured in accordance with the plans. The composite material shall have a minimum compressive strength of 11,000 psi. The manufactured box shall have a minimum compressive strength of 5,000 pounds over any 100 square inch area on the cover when installed on the box.

1020.04 POLES FOR TRAFFIC SIGNAL SYSTEMS:

(a) Pedestal Support Signal Poles: The pole shall be in accordance with the plans. The base of the pedestal shall be cast iron or aluminum and shall be at least 16 inches wide at the bottom, at least 16 inches high and shall be octagonal.

The upper end of the base shall be threaded to receive a 4-inch diameter pipe shaft.

The base shall be designed so that it may be fastened to the foundation using 5/8-inch-by-16-inch anchor bolts located 90° apart on the circumference of a circle 12 3/4 inches in diameter.

The base shall contain a removable door to allow access to anchor bolts and to permit cable splicing. This door shall be fastened to the base using a hex head stainless steel screw into a threaded hole in the base.

The shaft shall be 4 1/4 inches in inside diameter welded steel tubing with a minimum 1/8-inch wall thickness. The lower end of the shaft shall be welded to a 6-inch nipple to screw into the base. This shaft shall be a single piece of tubing.

Pedestals shall be finished with at least one coat of rustproofing primer, applied to a clean surface and one coat of green enamel.

The length of pedestal, shaft plus base, shall be a minimum of 8 feet.

(b) Steel Signal Support Pole:

(1) General: Poles and fittings shall be in accordance with the plans and shall be galvanized in accordance with ASTM A 123 and A 153. Poles shall be suitable for a minimum horizontal load of 4,000 pounds applied 1 foot below top of pole.

(2) Pole Shaft: The pole shaft shall have a minimum base diameter of 11 inches and a maximum base diameter of 11.75 inches. The pole shaft shall be tapered to approximately 7-inch diameter at the top. The pole shaft may have a round or octagonal cross section. A cap shall be used to cover the pole shaft top.

The pole shall be designed so that its maximum deflection is as follows:

Deflection Table

Pole Length, ft	Maximum Deflection, in./100 lb
26	0.25
28	0.30
30	0.38

(3) Handholes and Bosses: A hand hole shall be provided approximately 18 inches above the base with approximate dimensions of 4 inches by 6 1/2 inches and cover shall be provided. The cover shall be restrained to the pole with a 15 inch No. 35 stainless steel chain fastened to the cover and to the inside of the hand hole so that the chain will be inside the pole after the cover is installed on the pole. There shall be no sharp edges on the cover, in the hand hole, or in the pole. The cover shall have the manufacturer's name and the pole height stenciled on it, readable from the outside of the pole. The stencil shall be legible after galvanizing. The hand hole strain bar shall be formed to provide a mechanical lock against the hand hole to prevent turning. No obstructions shall be in the hand hole with the cover removed. A grounding nut (1/2 inch-13NC) shall be welded to the inside of the shaft 90° left and horizontal from the hand hole. A grounding lug shall be provided with each pole.

All poles shall have a 1 inch and 3 inch boss centered on a horizontal line 24 inches from the base. When facing the bosses, the 1-inch boss shall be a maximum of 35° to the right of the 3-inch boss. The 3-inch boss shall be located 180° from the hand hole. The bosses at the top of the pole shall be in line with the bosses at the bottom. The poles shall be shipped with all bosses plugged using galvanized steel

conduit plugs installed to full thread depth. On octagonal poles the 3-inch boss shall be centered on one face that is parallel to one edge of the base plate.

(c) Steel Standards and Mast Arms:

(1) General: Standards, mast arms and fittings shall be galvanized in accordance with ASTM A 123 and A 153. The height of poles, shaft dimensions, and wall thickness shall meet the design requirements and mounting height of traffic signals set forth in the project specifications and in the plans. The length of arms shall be as shown on the plans.

Standards shall consist of straight or uniformly tapered shafts, cylindrical or octagonal in cross section, having a base welded to the lower end with anchor bolts. Castings shall be clean and smooth with details well defined and true to pattern. Mechanical control shall prevent the arm from twisting on the shaft, friction is not acceptable.

Mast arms shall be compatible with poles in materials, strength, shape, and size. Mast arms shall slip fit on the shaft.

(2) Hand Holes and Bosses: A hand hole shall be provided for access to the wireway at the union of the arm and the pole shaft. Bosses shall be 1 1/2 FPT in the mast arm and set at 45° from horizontal (downward rotation at the center of the boss, 0° toward the arm top). Bosses shall be located a horizontal distance of 10 feet apart, the first located 16 inches from the top of the arm. The number of bosses required is listed in the following table.

Arm Length, ft	Number of Bosses	Shaft Diameter, Inches, Max.	Shaft Base Plate Bolt Circle, Inches, Max.
10-20	2	10	14 1/2
25-30	3	12	15
35-50	4	13	16

(3) Hanger Plate: A hanger plate and horizontal boss shall be at the tip of the arm. The arm shall have an up-sweep design. Design load on the arm shall be sufficient to place a signal head at each boss.

(4) Design Requirements: For establishing the loads, applied to each structure, the following weights and projected areas shall be used for traffic signal heads:

Type[1]	Design Weight Per Signal, lb[1]	Projected Area Per Signal	
		Less Backplates, sq ft	Backplates, sq ft
1-Way, 3 Section	62	4.8	8.9
1-Way, 4 Section	76	6.6	11.2
2-Way, 3 + 3 Sections	126	8.7	12.2
3-Way, 3+3+3 Sections	179	13.35	15.6
4-Way, 3+3+3+3 Sections	235	13.2	15.6

[1]When signal heads of a type different from that shown above are used, the weights and projected area shown above shall be increased for the equipment proposed for use. Adjusted values shall be based on the use of 12-inch diameter lenses and backplates (when used) extending 5 inches beyond signal enclosure.

(5) Standard Shaft: The standard shaft base shall have a minimum diameter of 11 inches. Mast arm standards shall be provided with a transformer type base.

Each pole shall be bolted to transformer base with four hex head bolts with two washers and one nut for each bolt.

(6) Transformer Base: The transformer base shall be approximately 20 inches high. The top of the transformer base shall have four 1 1/2-inch-by-2 1/2-inch slots for bolting the pole to the transformer base. The 2 1/2-inch dimension of the slot shall be centered on and perpendicular to a 13 1/2-inch bolt circle.

A removal panel on the side of the transformer base shall be provided for access to the base. A 1/2-inch-13NC grounding nut shall be provided 90° left of this panel. A grounding lug shall be provided with each pole. The bottom of the transformer base shall fit a 16-inch bolt circle using four 1-3/4-inch bolts supplied with each pole. These bolts shall conform to these specifications and plan details with exception that the cap nuts shall be replaced with the regular hex nuts. The transformer base shall be capable of being rotated 360°.

(7) Wireways: The pole shaft and mast arm shall be suitable for wireways throughout their length.

(8) Identification: The pole shaft, mast arm and arms, and transformer base shall have a matching serial number. Serial numbers shall be assigned by the Traffic Services and Operations Engineer or shown on the plans.

(d) Timber Wood Poles: Poles shall conform to Section 1014.

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