STANDARD SPECIFICATIONS

FOR

ROAD AND BRIDGE CONSTRUCTION

EDITION OF 2000

Approved for January 1, 2000

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Copies of this publication may be obtained from:

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DIVISION 100

GENERAL PROVISIONS

SECTION 101 ¾ DEFINITIONS AND TERMS

101.01 GENERAL. These Standard Specifications for Road and Bridge Construction are written to the bidder, before the award of the Contract, and to the Contractor. The sentences which direct the Contractor to perform work, are written in the active voice-imperative mood. These directions to the Contractor are written as commands. For example, a requirement to provide cold weather protection would be expressed as, "Provide cold-weather protection for concrete," rather than "The Contractor shall provide cold weather protection for concrete." In the imperative mood, the subject "the bidder" or "the Contractor" is understood.

All other requirements to be performed by others have been written in the active voice. Sentences written in the active voice identify the party responsible for performing the action. For example, "The Engineer will determine the density of the compacted material." Certain requirements of the Contractor may also be written in active voice, rather than active voice-imperative mood.

Sentences that define terms, describe a product or desired result, or describe a condition that may exist are not written in either the active voice or the imperative mood. These types of sentences that describe a condition use verbs requiring no action. For example, "The characteristics of the soils actually encountered in the subgrade may affect the quality of cement and depth of treatment necessary."

101.02 ABBREVIATIONS. The following abbreviations, when used in the Contract, represent the full text shown.

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	Associated General Contractors of America
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
ASA	American Standards Association (now ANSI)
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
ATSSA	American Traffic Safety Services Association
AWPA	American Wood Preservers' Association
AWWA	American Water Works Association
AWS	American Welding Society
BMP	Best Management Practices
CRSI	Concrete Reinforcing Steel Institute
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FSS	Federal Specifications and Standards, General Services Administration
IA	Independent Assurance
KM	Kentucky Method
KRMCA	Kentucky Ready Mixed Concrete Association
KRS	Kentucky Revised Statutes
MUTCD	Manual on Uniform Traffic Control Devices for Streets and Highways
NCR	Non-Conformance Report
NEC	National Electric Code

NEMA	National Electrical Manufacturer's Association
NIST	National Institute for Standards and Technology
NTPEP	National Transportation Product Evaluation Program
OSHA	Occupational Safety and Health Administration
PCC	Portland Cement Concrete
QA	Quality Assurance
QAT	Quality Assurance Team
QC	Quality Control
QCP	Quality Control Plan
QL	Qualified Laboratories
SAE	Society of Automotive Engineers
SPIB	Southern Pine Inspection Bureau
SSPC	Steel Structures Painting Council
UL	Underwriters' Laboratory
WCLIB	West Coast Lumber Inspection Bureau

101.03 DEFINITIONS. The following terms, when used in the Contract have the meaning described.

Advertisement A public announcement, inviting Bid Proposals to perform work or furnish materials.

Authorized Adjustment An order issued by the Engineer to the Contractor detailing changes to the specified work quantities that do not increase or modify the scope of the original Contract.

As Built Plans The final Plans reflecting all changes to the original Plans.

Award The acceptance by the Department of a Bid Proposal.

Base Course See definition for Pavement Structure.

Best Management Practices The portion of the QCP detailing how the Contractor intends to conform to the requirements of Section 213 of the Standard Specifications.

Bidder An individual, partnership, firm, corporation, or any acceptable combination thereof, or joint venture, submitting a Bid Proposal.

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

Bridge A structure, including supports, erected over a depression or an obstruction, such as water, a highway, or a railway, and carrying traffic or other moving loads via a track or passageway and with 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.

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

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

Cabinet The Kentucky Transportation Cabinet.

Calendar Day	Any day shown on the calendar, beginning and ending at midnight.
Change Order	A written order issued by the Engineer to the Contractor, detailing significant changes to the specified work quantities or that increase or modify the scope of the original Contract.
Channel	A natural or artificial watercourse.
Codes	Code numbers listed with pay items are bid item code numbers used in project Bid Proposals.
Commercial Quality or Grade	Materials readily available from commercial sources. These materials require no sampling or testing.
Commissioner	Chief Executive Officer of the Department of Highways or a duly authorized representative.
Commonwealth	The Commonwealth of Kentucky.
Construction Revision	Any change in the Plans authorized by the Department.
Contract	The written agreement between the Department and the Contractor setting forth the obligations of the each party for the performance of the prescribed work. The Contract includes the Bid Proposal, Contract Form, Contract Payment Bond, Contract Performance Bond, Standard Specifications, Supplemental Specifications, Standard Drawings, Plans, Special Provisions, Special Notes, Notice of Award, Notice to Begin Work, all change orders, and all Supplemental Agreements, all of which constitute one instrument.
Contract Form	A document describing the work and the specifications to which the work shall be performed, which, when signed by an agent of both the Department and the Contractor, binds both parties to the terms described therein.
Contract Payment Bond	The form of security furnished by the Contractor and his surety and approved by the Commissioner as security for the faithful payment in full of all legal accounts for labor, materials, and supplies furnished in the Contract.
Contract Item or Pay Item	A specific unit of work that a price is provided for in the Contract.
Contract Performance Bond	The security furnished to the Department to guarantee completion of the work according to the Contract.
Contract Time	The number of working days or calendar days allowed for completion of the Contract. When a calendar date of completion is shown in the Bid Proposal instead of a number of working or calendar days, complete the Contract by that date.
Contractor	The individual, partnership, firm, corporation, or any acceptable combination thereof, or joint venture, contracting with the Department of Highways for performance of the work.

Controlling Item or Operation	An item or operation that, if delayed, will delay the completion time of the Contract. The Engineer will determine the controlling items or operations.
Cost Plus	A basis of payment for the directed performance of highway construction work with payment based on the actual cost of labor, equipment, and materials furnished and considerations for overhead and profit according to Subsection 109.04.
County	The county containing the project.
Culvert	Any structure not classified as a bridge providing an opening under the roadway.
Department	The Kentucky Department of Highways.
Design Quantity	The original Contract quantity not including contingencies.
Detour	The directing of traffic onto another roadway to bypass a temporary traffic control zone.
Diversion	The directing of traffic onto a temporary roadway or alignment placed in or next to the right-of-way.
Employee	Any person working on the project who is under the direction or control of, or receives compensation from, the Contractor or subcontractor.
Engineer	The State Highway Engineer of the Department, or a duly authorized representative responsible for engineering supervision of the Contract.
Equipment	All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of the work.
Extra Work	An item of work not provided for in the Contract as awarded but found essential by the Engineer for the satisfactory completion of the Contract.
Federal Project	Any project funded wholly or in part by the Federal Government.
Final Estimate	The final Contract payment amount for all quantities of work including all changes from the design quantity.
Formal Acceptance	Acceptance by the Department which relieves the Contractor of further obligation for the work performed.
Highway	A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
Highway Separation	Any structure carrying highway traffic over or under another highway or street.
Highway-Railway Separation	Any structure carrying highway traffic over or under the tracks of any railway.

Holidays

New Year's Day. The first day of January plus one other day determined by the Governor of Kentucky each year.
Martin Luther King Day. The third Monday in January.
Good Friday. Friday before Easter.
Memorial Day. The last Monday in May.
Independence Day. The fourth day of July.
Labor Day. The first Monday in September.
Presidential Election Day. The first Tuesday after the first Monday in November of presidential election years.
Veteran's Day. The eleventh day of November.
Thanksgiving Day. The fourth Thursday in November plus the following Friday.
Christmas Day. The twenty-fifth day of December plus one other day determined by the Governor of Kentucky each year.

These holidays are subject to subsequent changes by the General Assembly of the Commonwealth of Kentucky.

Independent Assurance

The Department's Division of Materials will conduct testing to provide an unbiased and independent evaluation of all sampling and testing procedures used in the acceptance program.

Inspector

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

Laboratory

The official testing laboratory of the Department.

Local Traffic

Traffic that has either its origin or destination at some point within the limits of the project or an adjacent project. Local traffic includes traffic on all side roads that lead into the project without another satisfactory outlet over a passable road or street and school buses and mail delivery vehicles making stops within the project.

Major and Minor Items

All original Contract items having a value of 10 percent or more of the original Contract amount, based on the original Contract price and original estimated quantity, are major items. All remaining items are minor items.

Masonry

Concrete or stone masonry.

Materials

Any substances used in connection with the construction and maintenance of any structure or the roadway and its appurtenances.

Median

The portion of a divided highway separating the traveled ways for traffic moving in opposite directions.

Minor Structures

Any structure not classified or defined as a bridge or a culvert, including catch basins, inlets, manholes, retaining walls, steps, buildings, fences, and other miscellaneous items.

Non–Conformance Report

A formal written document of notification detailing a deficiency, or non-conformance in characteristic, documentation, or procedure, which renders the quality of an item or activity unacceptable or indeterminate. Corrective action is required, including but not limited to, supportive documentation of

correction for the deficiency.

Notice of Award Written notice to the Contractor stating that their Bid Proposal has been accepted by the Cabinet.

Notice to Contractors The official notice inviting bids for the proposed highway improvements.

Notice to Begin Work Written notice to the Contractor to proceed with the Contract work. When applicable, the Engineer will begin counting Contract time (working days) starting with the Notice to Begin Work date.

Quality Assurance QA consists of all planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy specified requirements for quality. QA serves to provide confidence in the Contract requirements, which include materials handling and construction procedures, calibration and maintenance of equipment, production process control and any sampling, testing and inspection which is performed by the Department for these purposes.

Quality Assurance Team Department teams which check the validity of the QCP to ensure all work is in accordance with the Contract.

Quality Control The sum total of activities performed by the Contractor to ensure the end product meets the Contract requirements.

Quality Control Plan A detailed description in manual format of the type and frequency of inspection, staffing, materials handling and construction procedures, calibration and maintenance of equipment, production process control, sampling, and testing deemed necessary to measure and control quality as specified by the Contract documents.

Qualified Laboratories Department approved laboratories used for sampling and testing of material.

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

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

Base Course. The layer or layers of specified or selected materials of designed thickness placed on a subgrade to support a surface course.

Surface Course (Wearing Course). One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate.

Pay Item or Contract Item A specific unit of work that a price is provided for in the Contract.

Plans The approved Contract drawings including the plan, profile, and cross section sheets; general notes; the working drawings; supplemental drawings; and construction revisions showing the location, type, character, dimensions, and details of the

work required.

Professional Archaeologist An individual with a Masters degree in archaeology or anthropology, or an individual with Society of Professional Archaeologists certification, specializing in historic or prehistoric archaeology and having field experience in archaeological investigation.

Profile Grade The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either the elevation or gradient of such trace according to the context.

Project The specific section of the highway, including approaches and all appurtenances, and construction to be performed under the Contract.

Project Completion The satisfactory completion of all work relating to both Contract Bid Proposal items and items added by supplemental agreement.

Project Completion Notice The notice issued by standard form that the Project has been satisfactorily completed and is ready for final inspection.

Proper Local Authorities Officials authorized by law to act for counties and other civil subdivisions.

Proposal Guaranty The security furnished with a Bid Proposal guaranteeing that a bidder submitting an accepted Bid Proposal enters into the Contract.

Ramp An interconnecting roadway of a traffic interchange, or a connection between highways at different levels or between parallel highways on which vehicles may enter or leave a designated roadway.

Responsive Bid A Bid Proposal which conforms to all requirements of the proposal pamphlet.

Responsible Bidder A bidder that is a responsible Contractor.

Responsible Contractor A Contractor that has the requisite skill, resources, desire, and integrity to complete the work in conformance with the provisions of the Contract.

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

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

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

Roadside A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a

divided highway may also be considered roadside.

Roadside Development Those items necessary to the complete highway providing for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching, and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

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

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

Sidewalk That portion of the roadway outside normal vehicle paths constructed primarily for the use of pedestrians.

Skew or Skew Angle The acute angle formed by the intersection of a line normal to the centerline of the roadway with a line parallel to the face of the abutments, or in the case of culverts, with the centerline of the culverts.

Special Notes See definition for Specifications.

Special Provisions See definition for Specifications.

Specifications A general term applied to written directions, provisions, and requirements pertaining to performance of the work. Specifications are included in documents such as the Special Notes, Special Provisions, Standard Specifications, or Supplemental Specifications.

Special Notes. Specifications developed for a specific item of work which may be appropriate only for a particular project but may become standard if regularly used as future projects using the item develop.

Special Provisions. Specifications developed for a specific item of work which may be appropriate only for a particular project but may become standard if regularly used as future projects using the item develop.

Standard Specifications. A book of specifications approved for general application and repetitive use by the Department entitled, "Standard Specifications for Road and Bridge Construction".

Supplemental Specifications. Additions and revisions to the Standard Specifications that are made subsequently to issuance of the Standard Specifications.

Specified Completion Date The date by which the Contract work is specified to be completed.

Standard Drawings Detailed drawings approved for repetitive use.

Standard Specifications See definition for Specifications.

State Highway Engineer	The State Highway Engineer of the Department acting directly or through an authorized representative.
Street	A general term denoting a public way for purposes of vehicular travel in a city, including the entire area within the right-of-way.
Structures	Bridges, culverts, or minor structures.
Subcontractor	An individual, firm, or corporation who, with the written consent of the Department, subcontracts any part of the Contract. First tier Subcontractors are those to whom the Contractor subcontracts a portion of the work. Second tier Subcontractors are those to whom a first tier Subcontractor subcontracts a portion of the work.
Subgrade	See definition for Pavement Structure.
Substructure	All of that part of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings or rigid frames, together with the back walls, wingwalls, and wing protection railings.
Superintendent	The Contractor's authorized representative in responsible charge of the work.
Superstructure	The entire structure except the substructure.
Supplemental Agreement	A written agreement executed by the Contractor and the Commissioner, with the consent of the surety when required, covering significant changes, and revised or new unit prices and items, that supplements the original Contract.
Supplemental Drawings	Drawings included in the Plans to specify construction details.
Supplemental Specifications	See definition for Specifications.
Surety	The corporation, firm, or individual, other than the Contractor, executing a bond furnished by the Contractor.
Surface Course (Wearing Course)	See definition for Pavement Structure.
Temporary Structures	Structures required for the use of traffic during construction and not remaining a part of the permanent roadway.
Through Traffic	All traffic other than traffic defined as Local Traffic.
Titles or Headings	The titles or headings of the Sections and Subsections herein are intended for convenience of reference and shall not have any bearing on their interpretation.
Traveled Way	The portion of the roadway used for the movement of vehicles, exclusive of shoulders and auxiliary lanes.
Work	The furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project or Contract item and the performance

of all duties and obligations imposed by the Contract.

Working Day A calendar day, exclusive of Saturday, Sunday, holidays, or days when the weather, seasonal, or temperature limitations of the specifications, or other conditions beyond the control of the Contractor, prevent, as judged by the Engineer, construction operations from proceeding for at least 5 hours by the normal working force engaged in performing the controlling item or items of work.

Working Drawings Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data the Contractor is required to submit to the Engineer for review.

SECTION 102 ¾ BIDDING REQUIREMENTS AND CONDITIONS

102.01 PREQUALIFICATION OF BIDDERS. All organizations and individuals bidding on Department projects and accepting subcontracts on Department projects must apply for and receive Department prequalification and possess a Certificate of Eligibility as provided in regulations published by the Department according to KRS Section 176.140.

The Department reserves the right to waive this requirement on certain projects in connection with the letting of contracts not covered by the statutes. The Department will place a waiver of this requirement in the Notice to Contractors and the Bid Proposal for such projects.

102.02 CURRENT CAPACITY RATING. The Department will determine the current capacity rating of a bidder as the net difference between the bidder's maximum capacity rating as set forth in a Certificate of Eligibility and the total value of uncompleted prime Contract work that the bidder is performing for any owner.

The Department will determine the value of uncompleted prime Contract work that the bidder is performing from the last approved pay estimate for each uncompleted Contract. The Department will allow the bidder credit for subcontract work listed in the Bid Proposal providing it does not exceed 50 percent of the total bid and the subcontractor or subcontractors are prequalified and approved by the Department. The Department will compare the current capacity rating of the bidder with the difference between the total amount of the Bid Proposal and the approved subcontracted items listed in the Bid Proposal.

The Department will carry forward credits allowed in an accepted Bid Proposal in determining the current capacity rating of the bidder on future bids. The Department will not give credit for any other work subcontracted.

The Department will divide the total Bid Proposal of a joint venture equally among the participants in the joint venture. The Department will divide the total value of the uncompleted work of joint ventured projects equally among the joint venturers in determining a bidder's current capacity rating.

The Department will not consider Bid Proposals exceeding the current capacity rating of a bidder.

102.03 CONTENTS OF THE BID PROPOSAL FORM. Upon request, the Department will furnish the prospective bidder with a Bid Proposal form. The form states the location and description of the contemplated construction and shows the approximate estimate of the various quantities and kinds of work to be performed or materials to be furnished, and includes a schedule of items for which unit bid prices are invited. The Bid Proposal form states the time allowed to perform the work, the amount of the Proposal Guaranty, and the date, time, and place of the opening of the Bid Proposals. The form also includes any special provisions or requirements varying from or not contained in the Standard Specifications.

The Department considers all papers bound with or attached to the Bid Proposal form a part of the Bid Proposal. Do not detach or alter any parts of the submitted Bid Proposal.

The Department considers the Plans, Specifications, and other documents designated in the Bid Proposal form a part of the Bid Proposal whether attached or not.

The prospective bidder must pay the Department the sum stated in the Notice to Contractors for each copy of the Bid Proposal form.

102.04 ISSUANCE OF BID PROPOSAL FORM. The Department reserves the right to disqualify or refuse to issue a Bid Proposal form when a bidder is in default for any of the following reasons:

1) failure to comply with any prequalification regulations of the Department;
2) default under previous contracts;

3) when a bidder's existing, uncompleted contracts and subcontracts with the Department are behind schedule to the extent that they might hinder or prevent prompt completion of any additional contracts;
4) when either the actual progress for all of a bidder's existing grade and drain; or grade, drain, and surfacing; or bridge contracts and subcontracts is 20 percent or more behind the scheduled progress for the contracts and subcontracts, or when any one of the bidder's contracts or subcontracts is 30 percent or more behind schedule;
5) when the average actual progress for all of a bidder's surfacing or resurfacing, seeding, signing, or other miscellaneous contracts and subcontracts is 50 percent or more behind the scheduled progress or when any one of these contracts or subcontracts exceeds the original Contract time or completion date without significant cause;
6) failure to reimburse the Commonwealth for monies owed on any previously awarded contracts, including those contracts where the prospective bidder is party to a joint venture and the joint venture fails to reimburse the Commonwealth for monies owed; and
7) failure to reimburse the Commonwealth for monies owed for plans and Bid Proposal forms.

The Department will resume issuing Bid Proposal forms to the bidder only after the bidder improves his operations to the satisfaction of the State Highway Engineer.

102.05 INTERPRETATIONS OF QUANTITIES IN BID SCHEDULE. The Department's estimated quantities appear in the bid schedule only for the purpose of comparing the Bid Proposals. The Department will pay the Contractor only for the actual quantities of work performed and accepted or materials furnished according to the Contract. The Department may increase, decrease, or omit the estimated quantities of work and materials furnished.

102.06 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, SPECIAL NOTES, AND SITE OF WORK. Examine the site of the proposed work, the Bid Proposal, Plans, specifications, and contract forms, before submitting the Bid Proposal. The Department considers the submission of a Bid Proposal prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the Contract.

Professing ignorance or a misunderstanding regarding requirements of the work does not in any way serve to modify the provisions of the Contract.

102.07 PREPARATION OF BID PROPOSAL.

102.07.01 General. Submit the Bid Proposal on the forms furnished by the Department. Specify a unit price in figures for each pay item for which a quantity is given and show the products of the respective unit prices and quantities written in figures in the column provided for that purpose. Round the products by dropping all digits past the cent. Indicate the total amount of the Bid Proposal, obtained by adding the rounded amounts of the items. Write in ink or type all figures.

When an item in a Bid Proposal allows a bidder to make a choice, indicate a choice according to the specifications for that particular item.

Sign Bid Proposals in ink using the individual, one or more members of the partnership, one or more members of each firm representing a joint venture, one or more officers of a corporation, or an agent of the bidder legally qualified and acceptable to the Department. When proposing as an individual, indicate the name and post office address of the individual. When proposing as a partnership, indicate the name and post office address of each partnership member. When proposing as a joint venture, indicate the name and post office address of each member or officer of the firms represented by the joint venture. When proposing as a corporation, indicate the name of the corporation and the business address of its corporate officials.

102.07.02 Computer Bidding. When ordering a Bid Proposal for a specific project, a bidder may order, at the same time, a diskette for a personal computer which contains a bid item spreadsheet program for the same project. The bid item spreadsheet program is an identical copy of the bid sheet or sheets shown in the Bid Proposal. The bidder may use this spreadsheet program to prepare a Bid Proposal for submission to the Department. If using the spreadsheet program, enter only the unit prices for each bid item of the project. The bidder may insert completed bid item sheets printed from the spreadsheet program into the bidder's Bid Proposal and submit the sheets to the Department.

In the case of a dispute, the Bid Proposal and the bid item sheets issued with the Bid Proposal take precedence over any bid item sheet printed using the spreadsheet program.

The Department will provide the diskette for the bidder's use. Do not return the diskette to the Department unless directed to do so.

The Department assumes no responsibility for the use of the diskette. The Department will not be responsible for any bid item spread sheet program on diskette which is not compatible with the bidder's computer equipment or software. The bidder shall be liable for any damage or loss, including special, incidental, or consequential damages caused by the use of this diskette. Furthermore, the Department takes no responsibility for the loss or damage of the diskette after it is mailed to the bidder. If the diskette is lost or damaged, reorder and purchase another diskette, if desired.

102.08 IRREGULAR BID PROPOSALS. The Department will consider Bid Proposals irregular and will reject them when the bidder either:

1) omits both a unit price for any pay item and an amount for the entire quantity of the same pay item, except when the Bid Proposal allows a choice of authorized pay items; or
2) submits zero as a unit price for any pay item or as an amount for the entire quantity of the same pay item except when the Bid Proposal form allows a choice of authorized pay items.
3) fails to submit the bid on the current revised pay items.

The Department will consider Bid Proposals irregular and may reject them for the following reasons:

1) when the Bid Proposal is on a form other than that furnished by the Department, or printed from other than the authorized bid item sheet diskette, or when the form is altered or any part is detached; or
2) when there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the Bid Proposal incomplete, indefinite, or ambiguous as to its meaning; or
3) when the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a Contract pursuant to an award; or
4) any failure to comply with the provisions of Subsection 102.07; or
5) Bid Proposals in which the Department determines that the prices are unbalanced; or
6) when the sum of the total amount of the Bid Proposal under consideration exceeds the bidder's Current Capacity Rating.

102.09 BID PROPOSAL GUARANTY. The Department will reject and will not read any Bid Proposal that is not accompanied by a guaranty in the form of a cashier's check, certified check, or bid bond and in an amount no less than the amount indicated on the Bid Proposal form. Make the cashier's check, certified check, or bid bond payable to the Kentucky State Treasurer.

102.10 DELIVERY OF BID PROPOSALS. Submit each Bid Proposal in a special envelope furnished by the Department. Correctly fill in the blank spaces on the

envelope to clearly indicate its contents. When using an envelope other than the envelope furnished by the Department, use an envelope of the same general size and shape similarly marked to clearly indicate its contents. When sent by mail, address the sealed Bid Proposal to the Department at the address and in care of the office and official receiving the Bid Proposals. Submit all Bid Proposals prior to the time and at the place specified in the Notice to Contractors. The Department will time-stamp and return to the bidder unopened Bid Proposals received after the time for opening of bids.

102.11 WITHDRAWAL OR REVISION OF BID PROPOSALS. A bidder may withdraw or revise a Bid Proposal after depositing the Bid Proposal with the Department, provided the Department receives the request for such withdrawal or revision in writing or by telegram before the time set for opening Bid Proposals.

102.12 COMBINATION BID PROPOSALS. The Department may issue Bid Proposals for projects in combination or separately. Submit Bid Proposals on either the combination or the separate projects of the combination. The Department reserves the right to make awards on combination bids or separate bids to the best advantage of the Department.

102.13 PUBLIC OPENING OF BID PROPOSALS. The Department will publicly open and read all Bid Proposals at the time and place indicated in the Notice to Contractors, or at any other location the Department designates.

102.14 DISQUALIFICATION OF BIDDERS. The Department may consider any of the following reasons sufficient for the disqualification of a bidder and the rejection of the bidder's Bid Proposal(s):

1) more than one Bid Proposal for the same work submitted by an individual, firm, or corporation under the same or different name;
2) evidence of collusion among bidders. The Department will not recognize participants in such collusion as bidders for any future Department work until the Department reinstates such participant as a qualified bidder.

   Collusive bidding is a violation of the law and may result in criminal prosecution, civil damage actions, and State and Federal administrative sanctions.

102.15 PROCESS AGENT. Every corporation doing business with the Department shall submit evidence of compliance with KRS Sections 271A.070, 271A.385, 271A.555, 271A.565, and 271A.615, and file with the Department the name and address of the process agent upon whom process may be served.

Every individual residing in another state, or members of a co-partnership who reside in another state, doing business with the Department shall file with the Department the names and addresses of at least 2 persons residing in Kentucky upon whom process may be served.

When any change is made in any such corporation's, individual's, or co-partnership's process agent, the corporation, individual, or co-partnership shall immediately file with the Department a statement of the change. The former agent shall remain agent for the purpose of service of process until the bidder files a statement with the Department designating the new agent.

Submit or file evidence of compliance with the KRS Sections cited above and/or designation of process agents, as required by this section, with the Department at the time of qualifying or at the time of submitting a Bid Proposal, or at any time prior to the issuance of the Contract and work order and/or purchase order.

SECTION 103 ¾ AWARD AND EXECUTION OF CONTRACT

103.01 CONSIDERATION OF BID. The Department will tabulate the bid as soon as possible after opening the Bid Proposals and will compare the bids based on a correct summation of items at the prices bid. The Department will then make the result public. In the event of a discrepancy between unit bid prices and extensions, the Department will use the unit bid price. The Commissioner reserves the right to reject any or all Bid Proposals and to waive minor technicalities if doing so is in the best interest of the Commonwealth.

103.02 AWARD OF CONTRACT. Unless rejecting all Bid Proposals, the Department will award the Contract to the lowest responsible bidder, without discrimination on the grounds of race, creed, color, sex, or national origin, whose Bid Proposal complies with the requirements of the law, the regulations, and the Contract.

The Department may reject unbalanced Bid Proposals and award the Contract to the next lowest acceptable bidder.

The Department will award the Contract within 10 calendar days after the date of receiving Bid Proposals unless the Department deems it best to hold the Bid Proposals of any or all bidders for a period not to exceed 60 calendar days for final disposition of award. The Department may hold the Bid Proposal of the lowest bidder longer than 60 days if the bidder concurs. The Department will mail the official Notice of Award to the address shown on the Contractor's Certificate of Eligibility.

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

103.04 RETURN OF PROPOSAL GUARANTIES. The Department will return the Proposal Guaranties of all except the 2 lowest bidders within 5 calendar days after checking, tabulating, and comparing the Bid Proposals. The Department will hold the Proposal Guaranty of the lowest bidder and the Proposal Guaranty of the second lowest bidder, as determined by the Commissioner, until the Department awards the Contract and executes and approves the Contract and bond of the successful bidder, or until the Department rejects all Bid Proposals. If the Department does not make an award within 60 calendar days, the Department will return all Proposal Guaranties.

The Department will not release a bidder from the obligations of the Bid Proposal because of an alleged error in the preparation of the Bid Proposal unless the Department retains the bidder's Proposal Guaranty.

103.05 REQUIREMENT OF CONTRACT BOND. Within 15 calendar days after receiving the Notice of Award and at the time of execution of the Contract, execute separate performance and payment bonds on the Department furnished forms, each in the penal sum of 100 percent of the amount of the Contract, with a surety subject to the Department's approval. Submit Contract bonds conditioned upon the faithful performance of the requirements of the Contract and any modifications in conformity with the Contract; payment of proper compensation under the required labor and wage conditions as provided in the Contract; payment of claims against the Contractor for materials, labor and supplies; and reimbursement to the Department for any overpayment made on the Contract. Maintain the Contract bond in full force for the time required by law. In the event the surety or bonding company fails or becomes financially insolvent, then, within 5 calendar days of such failure or insolvency, file a new and sufficient bond in the amount the Commissioner designates.

The surety of a Contract bond shall only sign a prescribed form through a duly appointed power of attorney with certifications acceptable to the Department. File an attested copy of all certifications of attorneys-in-fact with the Franklin County Court Clerk prior to submission to the Department and file a certified copy with the Department.

All non-resident agents of Kentucky signing the bond as representatives of a

surety company shall obtain the countersignature of a licensed Kentucky agent of the insurer as required by law. All appointments of attorneys-in-fact shall contain a provision that the appointment will not be revoked without giving the Department notice in writing at least 30 calendar days prior to the effective date of the revocation and filing same with the Franklin County Court Clerk. More than one surety may execute a bond for any one Contract, and, in such event when 2 or more sureties are provided on such bond, each surety shall be liable and obligated for the full amount required herein before.

103.06 EXECUTION OF CONTRACT. Within 15 calendar days after receiving the Contract, execute and file it with the Department along with the following items:

1) the Contract bond required in Subsection 103.05;
2) satisfactory evidence of required liability insurance;
3) satisfactory evidence of compliance with Subsection 102.15;
4) when the bidder lists proposed subcontractors in the Bid Proposal, and the amount of work proposed to be subcontracted is not to be deducted from the bidder's current capacity rating, then submit Form TC 14-9, Confirmation of Subcontract, reported in the Bid Proposal. Sign submittal and obtain signatures of each proposed subcontractor. Verify all signatures by a notary public.
5) when the Bid Proposal form designates a certain percentage of the Contract as the Disadvantaged Business Enterprise (DBE) portion, submit the necessary number of agreements with DBEs to meet or exceed these designated percentages. Execute an agreement with each DBE that includes the items of work, the unit price that the DBE will be paid for each item, and notarized signatures of both parties. Should the bidder fail to reach the designated DBE percentages, then the Department will consider whether the bidder made reasonable efforts to meet these percentages prior to issuing a work order.

Execute the Contract and bond only on the form furnished by the Department. Upon the filing with the Department by the Contractor of the executed Contract accompanied by the listed items, the Commissioner will, within the period not exceeding 30 calendar days from the date of such filing, make final disposition of the Contract and, if Contract bond is approved, will issue Notice to Begin Work. Should the Department withhold the Notice to Begin Work in excess of the 30 calendar day period, the Contractor shall have the option of accepting or rejecting the Contract without forfeiting the Proposal Guaranty.

103.07 APPROVAL OF CONTRACT. The Contract is not binding until the Commissioner executes it and certain agencies of the Commonwealth, as required by law, certify that sufficient funds are available.

103.08 FAILURE TO EXECUTE CONTRACT. The bidder's failure to execute the Contract or to comply with all requirements of Subsection 103.06 within 15 calendar days after the Contract has been received by the bidder will be just cause for the Department to nullify the award. It is understood by both the bidder and the Commissioner that, in the event of the annulment of the award, the bidder will forfeit the amount of guaranty deposited with the Bid Proposal as agreed liquidated damages to the Commonwealth; not as a penalty, but in liquidation of damages sustained. The Department can then make an award to the next lowest responsible bidder; or readvertise the work or take other action as provided by statute on this subject, as the Commissioner may elect. A bidder who forfeits a Proposal Guaranty according to this Section will not be considered in future bid proposals for the same project unless there has been a substantial change in the design of the project subsequent to the forfeiture of the Guaranty.

SECTION 104 ¾ SCOPE OF WORK

104.01 INTENT OF CONTRACT. The intent of the Contract is to provide for the construction and completion in every detail of the work described. Furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work according to the Contract.

104.02 ALTERATIONS OF PLANS OR CHARACTER OF WORK.

104.02.01 General. At any time, and without invalidating the Contract or releasing the surety, the Engineer reserves the right to make, in writing, changes in quantities and alterations in the work when necessary to complete the project satisfactorily. Perform the work as altered.

When alterations or changes in quantities significantly change the character of the work under the Contract, the Department will adjust the Contract. The Department will not consider loss of anticipated profits. Before performing the significantly changed work, reach agreement with the Department concerning the basis for the adjustment. Absent an agreement, the Engineer will determine a fair and equitable adjustment.

If the alterations or changes in quantities do not significantly change the character of the work, the Department will make payment as provided elsewhere in the Contract. A significant change occurs when:

1) the character of the work is altered materially in kind or nature from that involved or included in the original proposed construction or,
2) the quantity of a major item of work, as defined in Subsection 101.03, increases above 125 percent or decreases below 75 percent of the original Contract quantity. The Department will allow an adjustment in cost only for the quantity in excess of 125 percent of the original Contract quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

104.02.02 Overrun and Underrun Formulas. The Department will use the following supplemental formulas to determine the adjusted unit prices for the items listed herein when a listed item is a major item, and when either an underrun or overrun of more than 25 percent occurs in the quantity of that major item constructed.

The excessive underrun of an item is defined as 75 percent of the original Contract quantity of the item minus the final quantity of the item. The excessive overrun of an item is defined as the final quantity of the item minus 125 percent of the original Contract quantity of the item.

The Department will apply this subsection when all the following conditions are met:

1) an excessive underrun or overrun occurs for one or more of the bid items listed below;
2) the affected item is a major item, as defined in Subsection 101.03; and
3) the final quantity of the affected item is at least 20 percent of the original Contract quantity. When the final quantity of the affected item is less than 20 percent of the original Contract quantity, the Department will not apply the formula but will prepare a supplemental agreement according to Subsections 109.03 and 109.04.

   The specified bid items which are covered by this subsection are:

   - Pavement Markers
   - Pavement Striping (temporary and permanent)
   - Temporary Marking Tape
   - Delineators
   - Asphalt Pavement Milling and Texturing

- Concrete Overlay Latex
- Concrete Overlay Low Slump
- Concrete Class M for Full Depth Patching

The Department will apply this subsection to other bid items when specified in the Contract.

For excessive underruns and overruns, the Department will adjust the payment for the final quantity in all subsequent pay estimates according to the appropriate following formula:

Excessive Underrun Formula

$$NP = OP + \frac{(EU \times 0.25 \times OP)}{FQCI}$$

Excessive Overrun Formula

$$NP = OP - \frac{(EO \times 0.25 \times OP)}{FQCI}$$

Where:

NP = New Unit Price
OP = Original Unit Price Bid by Contractor
EU = Excessive Underrun
EO = Excessive Overrun
FQCI = Final Quantity Contract Item

When the Contractor submits a completed Bid Proposal for a project containing one or more of the listed items, the Contractor agrees to accept payment for excessive underruns or excessive overruns in the quantities of these items according to the appropriate formula. The Contractor further agrees that the formulas provide full and complete compensation for the excessive underrun or excessive overrun quantities, including any and all unreimbursed expenses, loss of expected reimbursement, loss of anticipated profits, delay, inefficiency, and all other costs.

104.02.03 Differing Site Conditions. Differing site conditions exist when one party discovers that:

1) subsurface or latent physical conditions differ materially from those shown in the Contract, or
2) unknown subsurface or latent physical conditions differ materially from conditions normally encountered or from those generally recognized as inherent in the work provided for in the Contract.

Promptly notify the Engineer in writing of the specific differing conditions before disturbing the conditions and before performing the affected work.

Upon written notification, the Engineer will investigate the conditions and determine if the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of work under the Contract. When justified, the Engineer will make an adjustment, in time, or cost, or both, excluding anticipated profits, and modify the Contract in writing accordingly. The Engineer will notify the Contractor whether or not the conditions warrant an adjustment.

The Department will allow no Contract adjustment unless the Contractor provides the required written notice.

104.03 EXTRA WORK. Perform Extra Work for which there is no quantity or price in the Contract only by supplemental agreement. The Department will pay for this Extra Work at a unit price or lump sum price agreed upon and included in a written supplemental agreement executed by all parties to the Contract as specified in

Subsection 109.04. The Department will consider an extension of Contract time for Extra Work according to Subsection 108.07.

104.04 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK. The Contractor, with the Engineer's approval, may use on the project stone, gravel, sand, or other material found in the excavation that the Engineer determines is suitable. The Department will pay 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. Replace all excavated material so removed and used with other acceptable material at no additional expense to the Department. The Department will not charge the Contractor for the materials found in the excavation and used in the work. Do not excavate or remove any material from outside the grading limits, as indicated by the slope and grade lines, without the Engineer's written authorization.

Take ownership of and dispose of any materials of value, such as merchantable timber or coal, that may be encountered during construction of the project and that are not necessary to perform or complete the work. Leave a sufficient amount of material on the site to complete the project according to the Contract.

104.05 FINAL CLEANING UP. The Department will not consider the work complete and will not make final payment until the Contractor clears the right-of-way, borrow pits, and all ground the Contractor occupies in connection with the work of all rubbish, equipment, excess materials, temporary structures, and weeds. Place rubbish and all waste materials of whatever nature, other than hazardous materials, on either public or private property in a location out of view from the roadway and in a manner to the Department that does not present an unsightly appearance. Restore in an acceptable manner all property, both public and private, that was damaged in the prosecution of the work. Drain all ditches and all borrow pits where practical, and leave all space under structures unobstructed and in such condition that drift will not collect and induce scouring.

104.06 METRIC CONFLICTS. The Department's Standard Drawings and Standard Specifications are in Metric or English units. Conflicts may occur when using plans designed in Metric Units. Additionally, metric materials may not be readily available. When conflicts occur or when materials are unavailable, submit to the Engineer a proposed solution or substitution for approval. The Department will make no separate measurement or payment for this work.

SECTION 105 ¾ CONTROL OF WORK

105.01 AUTHORITY OF DEPARTMENT PERSONNEL.

105.01.01 Authority of the Engineer. The Engineer will decide all questions regarding the quality and acceptability of materials furnished, work performed, and the rate of progress of the work; all interpretation of the Plans and Specifications; and the acceptable fulfillment of the Contract. The Engineer will, in writing, suspend the work, wholly or in part when the Contractor fails to correct conditions unsafe for the workmen or the general public; for failure to carry out Contract provisions; for failure to carry out orders; for periods of unsuitable weather; for conditions unsuitable for the prosecution of the work; or for any other condition or reason determined to be in the public interest.

To prevent misunderstanding, the Engineer, within a reasonable time, will decide any and all questions concerning the quality and acceptability of materials furnished, work performed, and as to the manner of performance and rate of progress of the work. The Engineer will decide all questions concerning the interpretation of the Contract relating to the work, and all questions concerning the acceptable fulfillment of the work performed by the Contractor. The Engineer will determine the quantity and quality of the several kinds of work performed and materials furnished that the Department will pay for under the Contract, and such decision and estimate will be final and conclusive. In case any question arises, the Engineer's estimate will be a condition precedent to the right of the Contractor to receive any money due under the Contract. The Contractor may appeal to the Commissioner any decision of the Engineer by procedures outlined in Subsection 105.13. The Engineer will answer any questions as to the meaning of the Contract, or any obscurity as to the wording of the Contract and give all directions and explanations necessary to make definite any of the provisions of the Contract, or necessary to complete or give them due effect.

The Contractor may request and the Engineer will provide written instructions concerning any significant item.

105.01.02 Authority of Inspectors. Inspectors employed by the Department are authorized to inspect all work performed and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials furnished. The inspector is not authorized to alter or waive provisions of the Contract. The inspector is not authorized to issue instructions contrary to the Contract, or to act as foreman for the Contractor. However, the inspector has the authority to reject work or materials until any questions at issue are referred to and as the Engineer decides.

105.01.03 Inspection of Work. Provide the Engineer access to all materials and each part or detail of the work, and furnish the Engineer with such information and assistance as required to make a complete and detailed inspection.

At the Engineer's request, at any time before acceptance of the work, remove or uncover such portions of the finished work as directed. After examination, restore said portions of the work to the standard required by these Specifications. Should the work thus exposed or examined prove acceptable, the Department will pay for the uncovering, or removing, and the replacing of the covering or making good of the parts removed as Extra Work. Should the work so exposed or examined prove unacceptable, perform the uncovering, or removing, and the replacing of the covering or making good of the parts removed at no expense to the Department.

As the Engineer directs, remove and replace, at no expense to the Department, all work performed or materials used without the Engineer's supervision or inspection, unless the Engineer failed to inspect after having been given 3 working days notice in writing that the work was to be performed.

When any unit of government or political subdivision or any railroad corporation pays a portion of the cost of the work covered by the Contract, provide access to its respective representatives to inspect the work. Such inspection in no way makes any

unit of government or political subdivision or any railroad corporation a party to this Contract, and in no way interferes with the rights of either party hereunder.

105.01.04 Removal of Defective and Unauthorized Work. Remedy, or remove and replace in an acceptable manner, at no expense to the Department, all work which has been rejected. The Department will consider any work performed beyond the lines and grades specified in the Plans or as given, except as herein provided, or any Extra Work performed without a supplemental agreement, as unauthorized and at no expense to the Department. The Department will not measure such work for payment.

Should the Contractor decline or neglect to begin the removal and the replacement of any defective work or remove any unauthorized work within the amount of time stated in a written notice to do so has been given him, the Department may retain all monies due or which may become due the Contractor until the requirements of these Specifications have been met. When deemed best by the Commissioner, the Commissioner will employ the necessary labor to make good or remove such defective or unauthorized work and deduct the cost from any monies due or to become due the Contractor.

105.02 PLANS AND WORKING DRAWINGS. Roadway plans will, in general, show alignment, profile, typical section of improvement, and general cross sections.

Structure plans will, in general, show in detail all dimensions of the work contemplated. When the structure plans do not show all dimensions in detail, they will show general features and such details as are necessary to give a comprehensive idea of the structure. When such drawings are necessary to give comprehensive idea of the structure, submit detailed shop or working drawings to the Department for review. The Contractor shall bear all risk for work done or material ordered prior to the Department's review of these drawings for the structures involved.

Submit working drawings for steel structures consisting of shop detail, erection, and other working plans, showing details, dimensions, size of materials, and other information necessary to completely fabricate and erect the work.

Submit working drawings for concrete structures consisting of such detailed plans as required to successfully prosecute the work and which are not specified in the Plans. These may include plans for falsework, bracing, centering and form work, cofferdams, caissons, layout diagrams, and diagrams for bent reinforcement.

The Department will review the Contractor's working drawings in general only. The Department's review does not relieve the Contractor from any responsibility whatsoever.

Upon final review of all working drawings, submit to the Department copies of the final detailed drawings and upon completion of the work, surrender to the Department the original tracings.

Include in the Contract price the cost of furnishing all working drawings.

105.03 RECORD PLANS. Record Plans are those reproductions of the original Plans on which the accepted Bid Proposal was based and stamped "RECORD PLANS", and signed by a duly authorized representative of the Department. The Department will make these plans available for inspection in the Central Office at least 24 hours prior to the time of opening bids and up to the time of letting of a project or projects. The quantities appearing on the Record Plans are the same as those on which Bid Proposals are received. The Department will use these Record Plans as the controlling plans in the prosecution of the Contract. The Department will make 2 sets of Record Plans for each project, and will maintain one on file in the Central Office and one on file in the District Office. The Department will not make any changes on Record Plans subsequent to their issue.

105.04 CONFORMITY WITH PLANS AND SPECIFICATIONS. Perform all work and furnish all materials in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements specified in the Contract. Where definite tolerances are specified in the Contract, the Department will use such tolerances to establish the limits of reasonably close conformity. Where tolerances are

not specified in the Contract, the Engineer will determine the limits of reasonably close conformity in each individual case.

When the Engineer finds the materials, or the finished product in which the materials are used, not within reasonably close conformity with the Contract but that reasonably acceptable work has been produced, he will then make a determination to accept the work in place. In this event, the Engineer will document the basis of acceptance by Contract modification providing for an appropriate adjustment in the Contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

When the Engineer finds that either the materials, the finished product in which the materials are used, or the work performed are not in reasonably close conformity with the Contract and have resulted in an inferior or unsatisfactory product, remove, replace, or correct the work and materials at no additional expense to the Department.

When referenced standards, such as those promulgated by AASHTO, ASTM, or other recognized organizations, or the Department's own specifications, standard drawings, or similar documents are revised subsequent to the letting date, the Contractor may propose to furnish materials or perform work conforming to the latest edition at the time the work is done. The Engineer may approve such a request if the material or work is deemed to be equal to or better than originally required; however, the Engineer may require a reduction in bid prices before granting approval when the revision significantly reduces the cost of furnishing material or performing the work. In the event of any dispute, the Department will select the referenced standard current at the date of advertisement for Bid Proposals or the standard specifically referenced in the Contract to determine the cost.

105.05 COORDINATION OF CONTRACT DOCUMENTS. All documents defined under Contract in Subsection 101.03 are essential parts of the Contract. A requirement occurring in one is as binding as though occurring in all. They are complementary and describe and provide for a complete contract. In the case of a discrepancy, the governing ranking will be:

Dimensions	Documents
1. Plan	1. Special Notes
2. Calculated	2. Special Provisions
3. Scaled	3. Plans
	4. Standard Drawings
	5. Supplemental Specifications
	6. Standard Specifications

Do not take advantage of any apparent error or omission in the Contract. Immediately notify the Engineer upon discovering such an error or omission. The Engineer will then make any necessary corrections and interpretations deemed necessary for fulfilling the intent of the Contract.

105.06 COOPERATION BY CONTRACTOR. Maintain copies of the Plans and Specifications at the site of the work at all times and furnish copies to each foreman. Require each foreman to have with him on the site, at all times, a copy of that part of the Plans and Specifications applying to the work he is directing. Be present or have a representative present on the project at all times, when construction is in progress, to receive and carry out such instructions as the Engineer may give. Provide reasonable facilities to enable the Engineer to inspect the workmanship and materials entering into the work, and cooperate in setting and preserving survey stakes, bench marks, etc., and in all other things necessary to satisfactorily complete the work as contemplated.

When the Department lets separate contracts within the limits of any one project or for adjacent projects, conduct the work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors. Cooperate with contractors working on the same project or adjacent projects. In case of a dispute with other contractors, the Engineer will referee and make a final and binding decision.

The Contractor shall assume all liability, financial or otherwise, in connection with

the Contract and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and the operations of other contractors working within the limits of the same project. The Contractor shall assume all responsibility for all work not completed or accepted on the Contract because of the presence and operations of the other contractors.

As far as possible, arrange the work and place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same project or on adjacent projects. Join the work with that of the other contractors in an acceptable manner, and perform it in proper sequence with the work of the other contractors.

105.07 COOPERATION WITH UTILITIES. The Department will notify all utility facility owners or other parties affected and endeavor to have all necessary adjustments of utility fixtures, pipelines, and other appurtenances in conflict with construction made as soon as practical.

The Department will arrange to have the owners of all water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cables, signals, sewers, and all other utility appurtenances in conflict with the limits of the proposed construction relocate or adjust those facilities in conflict except as otherwise provided for in the Contract.

Consider all of the permanent and temporary utility facilities in their present or relocated positions, as specified in the Special Note for Utilities/Impact on Construction included in the Bid Proposal form, when preparing a Bid Proposal. The Department will not allow any additional compensation for delays, inconvenience, or damage sustained by the Contractor due to any interference from the said utility appurtenances or due to the operation of moving them. The Department will review requests for an extension of Contract time for such delays according to Subsection 108.07.

Prior to any excavation activities, comply with the requirements for Excavators in the Underground Facility Damage Prevention Act of 1994 which is contained in KRS 367 Sections 1 through 10.

105.08 PROTECTION AND RESTORATION OF EXISTING ROADWAY FACILITIES. Protect and preserve all existing roadway facilities including:

1) those which are to remain in place and remain in service as a part of the improved roadway;
2) those which are to be removed and reused as a part of the improved roadway; and
3) those which are to be removed and neatly stacked along the right-of-way for future Department use.

Restore and replace in kind any such existing facilities damaged or destroyed by the Contractor through faulty handling as the Engineer directs, at no expense to the Department.

105.09 CONSTRUCTION STAKES, LINES, AND GRADES. Unless the Contract specifies otherwise, the Engineer will establish lines, slopes, and grades, and will furnish the Contractor with all necessary information relating to lines, slopes, and grades.

Furnish, set, and preserve the stakes and marks necessary to construct the project according to the established lines, slopes, and grades as provided in Section 201.

105.10 HAULING.

105.10.01 Hauling to Projects. According to Subsections 107.01 and 109.01.05, perform the hauling of materials and all other hauling in conjunction with the construction of a project so as not to violate any of the truck size, gross weight, axle weight, or tire width limitations provided by law or regulation.

105.10.02 Hauling Within Project Limits.

A) Grade and Drain Projects. The Department will not restrict vehicles operating at any phase of grade and drain construction as to any type of equipment or loading except as provided under Subsection 207.03.03 and as specified hereinafter for Hauling Over Structures.

B) Hauling Over Structures. Inspect and examine all structures to determine whether or not any structure has been damaged before beginning hauling. For damaged structures, request the Department to appraise the existing damage and grant a release, in writing, from liability for the damage disclosed, or otherwise stand liable. Repair all damage to the structure, including joints, that may be incurred as a result of the hauling operations, at no expense to the Department. Submit for the Engineer's review and approval all proposed methods to protect structures prior to the start of hauling.

The Department will list construction vehicles allowed on bridges in the Table of Empty Construction Vehicles Permissible on Bridges, provided that the vehicles are equipped with tires no smaller than the listed tire sizes, that the axle loads are not in excess of those listed, and that the vehicles do not operate on structures of lesser design loads than indicated.

The Department additionally limits the operation of construction vehicles over structures as follows:

1) obtain written approval from the Engineer before any off-highway vehicle is operated over a structure;
2) limit the movement of off-highway construction vehicles across bridges to one-lane operation centrally aligned with the bridge and at intervals between vehicles no less than 100 feet;
3) maintain bridge floors free from spilled materials, lumber, or any other impact producing obstruction;
4) do not use an earth cushion on bridge;
5) prior to hauling construction loads over a bridge, construct temporary approaches 100 feet in length with the 50 feet adjacent to each end of the bridge constructed to the finished grade elevation of the bridge. Maintain temporary ramps and approaches, at the direction of the Engineer, to minimize the impact of moving construction loads onto the highway structure;
6) for off-highway construction vehicles on the approaches and bridges, do not exceed a speed of 10 mph; and
7) protect from overloads, by temporary fill or by other means, culverts, regardless of span, pipe culverts, and other items which are covered or which are to be covered by fill or backfill.

TABLE OF EMPTY[1] CONSTRUCTION VEHICLES PERMISSIBLE ON BRIDGES								
Make & Model	Manufacturers Rated Capacity	Wheelbase	Listed Tire Size	Axle Weight - lbs (Empty)[1]				Min. Bridge Design Load
				Front	Middle	Rear	Total	
Off Highway Trucks - Rear Dump								
Euclid R-12	12 tons	12′-4″	12.00 x 25	10.450	----	12.350	22.800	H 15
Dart D2210	18 tons	11′-0″	F-13.00 x 25, R-16.00 x 25	14,500	----	15,500	30,000	H 15
Euclid R-20	20 tons	12′-11″	16.00 x 25	14,550	----	19,750	34,300	H 15
I-H 65 (B)	20 tons	12′-4″	16.00 x 25	14,300	----	22,100	36,400	H 15
WABCO Haulpak 25	25 tons	10′-10″	18.00 x 25	20,575	----	21,675	42,250	H 15
Dart D2320	27 tons	12′-0″	F-16.00 x 25, R-18.00 x 25	20,000	----	24,000	44,000	H 15
WABCO Haulpak 30	30 tons	10′-10″	18.00 x 25	22,150	----	24,200	46,350	H 15
Dart D2330	32 tons	12′-0″	18.00 x 25	23,000	----	24,000	47,000	H 15
I-H 100	30 tons	13′-1″	18.00 x 25	21,500	----	26,000	47,500	H 15
WABCO Haulpak 35	35 tons	10′-10″	18.00 x 25	23,100	----	25,000	48,100	H 15
Euclid R45 (14FFD)	45 tons	15′-0″	10 - 18.00 x 35	25,400	----	48,600	74,000	HS 15
Two Wheel Tractor - Four Wheel Tractor - Scraper								
WABCO D-Pull	7 yd^3	16′-1″	18.00 x 25	15.918	----	7.152	23.070	H 15
Euclid S-7	7 yd^3	17′-10″	18.00 x 25	18,300	----	8,200	26,200	H 15
WABCO 111-A	11 yd^3	18′-10 1/2″	18.00 x 25	19,998	----	10,320	30,300	H 15
Michigan 110	8 yd^3	19′-5″	23.50 x 25	21,080	----	9,920	31,000	H 15
Euclid S-7 Hancock	12 yd^3	20′-0″	18.00 x 25	19,530	----	13,840	33,370	H 15
Michigan 110-H	12 yd^3	20′-9″	23.50 x 25	26,116	----	11,734	37,850	H 15
I-H 270	14 yd^3	22′-0″	26.50 x 25	28,000	----	14,200	42,200	H 15
WABCO "C"	14 yd^3	22′-4″	24.00 x 25	27,720	----	18,480	46,200	H 15
A-C 260	15 yd^3	21′-0″	26.50 x 25	29,800	----	16,600	46,400	H 15
I-H E-270	21 yd^3	25′-5″	26.50 x 25	31,450	----	17,550	49,000	H 15

[1] *The two construction vehicles so referenced are permissible on bridges when loaded and the respective axle weights indicated are the loaded weights.*

TABLE OF EMPTY[1] CONSTRUCTION VEHICLES PERMISSIBLE ON BRIDGES								
Make & Model	Manufacturers Rated Capacity	Wheelbase	Listed Tire Size	Axle Weight - lbs (Empty)[1]				Min. Bridge Design Load
				Front	Middle	Rear	Total	
Two Wheel Tractor – Four Wheel Tractor - Scraper								
Michigan 210	15 yd³	23′-6″	26.50 x 29	33,728	----	15,872	49,600	H 15
Cat 621	14 yd³	23′-5″	26.50 x 29	35,900	----	15,500	51,400	H 15
Euclid TS-14	14 yd³	23′-4″	29.50 x 25	29,300	----	24,000	53,300	H 15
A-C 260	23 yd³	23′-5″	26.50 x 25	36,700	----	21,300	58,000	H 15
[1]WABCO D-Pull	7 yd³	16′-1″	18.00 x 25	24,980	----	18,080	43,070	H 15
[1]Michigan 110	8 yd³	19′-5″	23.50 x 25	30,210	----	26,790	57,000	H 15
Four Wheel Tractor – Six Wheel Tractor – Scraper								
John Deere SD 760	9 yd³	8′-0″, 19′-4 3/4″	11.00 x 16, 18.00 x 25 (2)	6,420	14,080	10,600	31,100	H 15
Euclid SS-24	24 yd³	11′-8″, 25′-6 1/4″	14.00 x 25, 27.00 x 33 (2)	16,900	31,850	29,550	78,300	H 15
Cat 632	28 yd³	10′-11″, 27′-11″	16.00 x 25, 29.5 x 35, 33.50 x 39	17,200	32,800	33,000	83,000	H 15
Cat 630	21 yd³	10′-11″, 25′-8″	16.00 x 25, 29.50 x 35 (2)	17,785	34,020	25,520	77,325	H 20
Euclid SS-28	28 yd³	11′-8″, 28′-9 1/2″	14.00 x 25, 33.50 x 30, 37.50 x 33	15,740	38,500	36,520	90,760	H 20
Euclid SS-40	40 yd³	11′-4″, 28′-9″	14.00 x 25, 33.50 x 33, 37.50 x 33	16,250	40,500	37,250	94,000	H 20
Cat 650	32 yd³	12′-4″, 30′-1″	18.00 x 25, 33.50 x 39, 37.50 x 39	24,200	44,100	39,700	108,000	H 20

[1] *The two construction vehicles so referenced are permissable on bridges when loaded and the respective axel weights indicated are the loaded weights.*

C) **Hauling Over Pavements Within Project Limits.** During the construction of surfaces or pavements, equip all hauling vehicles operating over the subgrade and base, intermediate, and surface courses with rubber tires. Ensure that all hauling vehicles operating over the base, intermediate, and surface courses conform to the axle weight and tire width limitations provided by law or regulation.

Limit hauling over pavements as follows:

1) do not allow the gross weight to exceed the posted load limit of a bridge in any instance; and
2) comply with any decreased gross weight limits when, in the Engineer's judgment, the roadway or structures would be damaged by allowing the posted load limit.

105.11 MAINTENANCE DURING CONSTRUCTION. Maintain the work during construction and until the Department accepts the project. Provide maintenance through continuous and effective work prosecuted day by day, with adequate equipment and forces keeping the roadway or structures in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, maintain the previous course or subgrade until completing the succeeding course.

Include the cost of all maintenance work in the unit prices bid on the appropriate pay items.

The Department will be responsible for routine roadway maintenance operations such as mowing, ditching, snow removal, signing, and pothole patching for portions of the roadway that remain open to traffic and unaffected by Contractor operations. The Department will conduct these operations in a manner not to disturb the construction operations.

105.12 FINAL INSPECTION AND ACCEPTANCE OF WORK. Notify the Engineer when the project is near completion. The Engineer will then advise in writing all work items that are unsatisfactory. When these work items are complete to the Engineer's satisfaction, the Engineer will call the project complete and issue a Project Completion Notice. When there are seasonal limitations or other compelling situations, the Engineer may call the project complete without requiring correction of the unsatisfactory work items until weather permits or the situation is remedied. When the project is called complete, it is ready for the Department's final inspection.

The Department and other appropriate agencies, such as FHWA, will complete final inspections on all items of work for Formal Acceptance within 90 calendar days of the date of issuance of the Project Completion Notice with the exception of seeding, other erosion control items, tree planting, and landscaping. The Department will make final inspections on seeding and other erosion control items according to Section 213. The Department will make final inspections on tree planting and landscaping as the Contract specifies. The Department will make individual final inspections on particular groups of work items such as structures, grade and drain, and surface. The Department may make final inspections before the project is called complete on items of work that have been completed. The Engineer will issue written final inspection reports for items of work upon completion of each final inspection. The reports will include a list of all uncompleted work and required corrective work. When all final inspections are complete, the Engineer will issue a comprehensive final inspection report including a list of all Formal Acceptance requirements. Complete all items of uncompleted work and all required corrective work listed in the final inspection reports within the following time limits:

1) Within 90 calendar days of the date of the Engineer's comprehensive final inspection report when the Engineer issues the report on or between March 1 and September 30 of the current year, or

2) By June 1 of the later year when the Engineer issues the comprehensive final inspection report on or between October 1 of one year and February 28 of the next year.

When the following occur, substitute the deferral date for the date of the Engineer's comprehensive final inspection report when determining the above time limits for completion of uncompleted work and corrective work:

1) the Contract specifies deferral of payment,
2) the project is complete before the date the Department can make payment (deferral date), and
3) the deferral date is later than the date of the Engineer's comprehensive final inspection report.

When applicable, submit required as-built drawings, project documentation (such as Federal Form PR-47), and required information on materials incorporated into the project. Consider them as uncompleted work or required corrective work.

If there is a dispute regarding any of the items listed as uncompleted work or required corrective work on any of the final inspection reports, submit in writing a letter of dispute to the Engineer within 30 days of receipt of the report. The Department will respond back in writing to the letter of dispute within 21 days. If there is still a dispute, proceed according to Subsection 105.13. When the dispute does not apply to all items of work in the report, complete the items not in dispute as specified herein.

The Department will assess liquidated damages according to Subsection 108.09 for failure to complete the required work items within the specified time period. After 30 days of liquidated damages, the Department will proceed according to Subsections 102.03 and 108.10.

When all uncompleted work and required corrective work is finished, the Department will make Formal Acceptance of the project and take responsibility for the project, subject to Section 107.17. Formal Acceptance is effective as of the date all corrective work was completed. If there are no uncompleted work items or required corrective work listed on any of the final inspection reports, the Department will make Formal Acceptance as of the project completion date.

105.13 CLAIMS FOR ADJUSTMENTS AND DISPUTES. The Contractor shall notify the Engineer in writing when the Contractor believes that additional compensation is due for work or materials not clearly covered in the Contract nor Engineer ordered as Extra Work. Provide this request for additional compensation before beginning the disputed work. The Contractor waives all rights to a claim when the Contractor fails to provide such notice or does not provide the Engineer with the proper access and records to account for the actual cost of the work. Document these costs according to the procedures outlined in Subsection 109.04.

The Contractor's compliance with this provision and the Engineer's accounting of the costs does not validate the claim. If the Engineer determines that the claim is justified, the Department will pay for it as Extra Work as provided in Subsection 104.03. This provision does not establish a claim contrary to the terms of Subsection 104.02.

SECTION 106 ¾ CONTROL OF MATERIALS

106.01 SOURCE OF SUPPLY AND MATERIALS REQUIREMENTS. Provide materials that conform to all requirements of the Contract. At the Department's option, the Engineer may approve the materials at the source of supply before delivery is started. When requested by the Engineer, submit representative samples of the materials intended for use in the work for the Engineer to examine and test according to Subsection 106.02. The Department may inspect or test all materials at any time during their preparation, storage, and use. If the Department determines that previously approved materials from any source are not uniform and satisfactory or that the product from any source proves unacceptable, cease operations. Provide acceptable material and resume operations. Do not use material which, after approval, has in any way become unfit for use. Use only new materials.

106.02 SAMPLES, TESTS, AND CITED SPECIFICATIONS. The Department will bear the cost of conducting tests except as otherwise provided. The Engineer will collect samples at the site of work and will retain custody of the samples until delivered to the laboratory, to a common carrier, or to the US Postal Service. The Contractor may deliver to the laboratory samples that a Department employee placed in containers and sealed with a Department seal. The Department will not accept for testing any samples submitted in any other manner. When requested, give the Engineer assistance in obtaining samples.

Perform, or ensure that the material producer performs, all testing necessary for quality control and process control. The Department will sample and test to ensure the acceptability of the materials incorporated into the work.

The Department will sample, test, and approve all materials in conformance with the Department's Kentucky Methods and the Manual of Field Sampling and Testing Practices; but the Department reserves the right to sample at any point and to perform any additional or special tests necessary to ensure the suitability of the material for its intended use. The Department may charge the supplier or Contractor for the cost of any additional test or inspection of unacceptable material.

The Department will bear only the costs of normal acceptance testing of materials actually used in the work. Show good faith and request sampling of only those sources from which material will be furnished for the project. Do not use Department sampling and testing to investigate various potential materials sources for informational purposes. When the Contractor submits samples from or requests sampling of materials sources that are not used, the Department may charge the Contractor for the cost of sampling and testing the source.

Bear the cost of special investigations or tests beyond the normal acceptance testing, which are required to determine the degree of acceptability of finished work that incorporates materials not conforming to the Contract. This provision applies to materials on which testing is not normally completed until after their incorporation into the work. This provision is not a means to use materials that are previously tested and rejected prior to use. The Department or a Department approved commercial testing laboratory will perform these tests and investigations.

Whenever reference is made to the standards of AASHTO, ASTM, Federal Specifications, or standards promulgated by other recognized societies or organizations, the current specification at the date of the bid letting is applicable.

When a sieve number is designated in these Specifications, use sieves that conform to AASHTO M 92.

Fabricate, purchase, or otherwise furnish any special equipment necessary to obtain samples when the Contract requires.

106.03 PLANT INSPECTION.

106.03.01 General. The Engineer may undertake the inspection of materials at the source. For plant inspections, conform to the following conditions:

1) Cooperate with and assist the Engineer, and ensure that the producer cooperates with and assists the Engineer.
2) Provide the Engineer full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.
3) For tests performed at the source of supply or other locations for the convenience of the Contractor, the Engineer may require the Contractor to furnish a suitable laboratory and the necessary testing equipment.
4) Provide and maintain adequate safety measures, according to Subsection 107.01.01.

The Department reserves the right to retest all materials that are tested at the source of supply, after delivery and prior to their incorporation into the work. The Department reserves the right to reject all retested materials that fail to conform to the requirements of the Contract.

106.03.02 Field Laboratory. Provide a field laboratory at the site of asphalt plants, and the site of mixing or batching concrete. Locate the field laboratory conveniently near the plant and conform to the applicable requirements of Subsection 401.02.01 A). Include a supply of water when it is required to perform the necessary testing. Provide this field laboratory for the exclusive use of the Engineer, the technicians employed by the Contractor, or the material producer, to perform testing for quality control and process control.

At material or product sources other than those listed above, the Engineer will determine if the field laboratory will be required for proper testing and inspection of the material or product.

106.04 BUY AMERICAN REQUIREMENT. Produce, mill, fabricate, and manufacture in the United States of America all iron and steel materials, including but not limited to structural steel, guardrail materials, corrugated steel culvert pipe, structural plate, prestressing strands, and steel reinforcing bars. Produce, mill, fabricate, and manufacture in the United States of America all aluminum components of bridges, tunnels, and large sign support systems, for which either shop fabrication, shop inspection, or certified mill test reports are required as the basis of acceptance by the Department.

Use foreign materials only under the following conditions:

1) When the materials are not permanently incorporated into the project; or
2) When the delivered cost of such materials used does not exceed 0.1 percent of the total Contract amount or $2,500.00, whichever is greater

106.05 CERTIFICATION OF COMPLIANCE. The Engineer may allow use prior to sampling and testing of certain materials accompanied by Certificates of Compliance stating that such materials fully comply with the requirements of the Contract. Deliver each lot of such materials to the work site with a Certificate of Compliance that is signed by an authorized agent of the testing agency and that clearly identifies the lot. The Engineer may sample and test materials used on the basis of Certificates of Compliance at any time, and when such materials fail to conform to the Contract, the Engineer will reject them, whether in place or not.

The Engineer will determine the form and distribution of Certificates of Compliance.

The Engineer reserves the right to refuse permission to use materials on the basis of Certificates of Compliance.

106.06 DEFECTIVE MATERIAL. Remove materials delivered to the work site that fail to conform to the requirements of the Contract and dispose of them so as to prohibit their return to the site or incorporation into the work. If the Contractor declines or neglects to remove unsatisfactory material from the work site within the time that the Engineer directs such removal, the Department may retain all monies due or which may become due the Contractor on pay estimates until the Contractor

removes the unsatisfactory material. As an alternative, the Commissioner may elect to employ the necessary labor to remove and dispose of the unsatisfactory materials and deduct the cost of same from any money due or that may become due the Contractor.

106.07 DEPARTMENT–FURNISHED MATERIAL. Furnish all materials required to complete the work, except those specified as Department-furnished. The Department will deliver or make available Department-furnished materials at locations specified in the Contract. Include the cost of handling and placing all Department-furnished materials after they are turned over to the Contractor in the Contract price for the item incorporating the Department-furnished materials.

The Department will hold the Contractor responsible for all Department-furnished material that is turned over to the Contractor. The Department will deduct from any monies due the Contractor to make good on any material shortages and deficiencies, from any cause whatsoever, and for any damage that may occur after such turnover, and for any demurrage charges.

The Department will apply the requirements of this section to Department-furnished items that the Contractor is required to return to the Department, such as, but not limited to, traffic signals and structural steel members.

106.08 STORAGE OF MATERIALS. Store materials to ensure preservation of their quality and fitness for the work. Locate stored materials to facilitate prompt inspection. The Contractor may use that portion of the right-of-way not required for construction of the roadway for storing materials, plant, and equipment. Provide any additional space required at no expense to the Department.

If the Department provides partial payment for material prior to the Contractor incorporating them into the work, store these materials according to Subsection 109.05.01.

106.09 LIST OF APPROVED MATERIALS. Due to the special or lengthy tests required for approval of certain materials, the Department maintains a List of Approved Materials. Use only materials included on the List of Approved Materials at the time of use on the project. The Department will sample and test materials on the list after delivery to the project as specified or when deemed necessary, and will reject any material found not to conform to the Contract regardless of any prior approval.

106.10 FIELD WELDER CERTIFICATION REQUIREMENTS. Welder's or welding operator's qualifications to perform field welding shall remain effective for 2 years from the date of test unless:

1) the welder or welding operator is not engaged in the welding process for which the welder or welding operator is qualified for a period exceeding 6 months; or
2) in the judgment of the Engineer, there is reason to question the welder's or welding operator's ability.

Keep records of the types of welds and dates engaged in welding within the 2-year period to maintain the welder's or welding operator's qualification. If the Contractor fails to maintain such records for review and use in each project's records, the Department will require the welder or welding operator to be retested at any time.

SECTION 107 ¾ LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.01 LAWS TO BE OBSERVED. In all operations connected with the work, the Department will require strict compliance with all state, federal, and local ordinances, regulations, laws, and bylaws controlling or limiting in any way the actions of those engaged on the work, in such manner to save the Commonwealth, its agents, and employees harmless.

107.01.01 Safety, Health, and Sanitation. Comply with all applicable state, federal, and local laws governing safety, health, and sanitation. Provide all safeguards, safety devices, and protective equipment and take all other actions that are reasonably necessary to protect the life and health of all employees and personnel on the project, provide for the safety of the public, and protect all property affected by the performance of the work covered by the Contract, and as the Engineer directs.

As provided in KRS Chapter 338 in the Kentucky Occupational Safety and Health Act and in subsequent regulations and standards promulgated by the Kentucky Occupational Safety and Health Standards Board, do not require any personnel employed in performance of the Contract, including employees of subcontractors, to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to the employee's health and safety.

Provide fall protection according to 29 CFR Part 1926 as adopted by Kentucky Administrative Regulations. Include but do not limit to the following protection: safety nets, safety belts, lifelines, lanyards, life vests, hand rails, temporary bridge flooring, or equivalent protection.

For work over a navigable stream, unless working exclusively on a bridge deck, provide a manned power boat. Position the boat under personnel for rescue whenever work is in progress.

107.01.02 Motor Vehicle Laws. Obey all Motor Vehicle Laws on all state, federal, and county roads and city streets, including roads and streets used as detours and roads and streets under construction beyond the limits of the proposed improvement specified in the Contract. Obey the specific provisions of such laws within the limits of construction when stated in the Contract for that particular type of construction.

107.01.03 Water Pollution. Conform to the Department's requirements for abating and minimizing water pollution as specified in Section 213.

107.01.04 Air Pollution. Perform construction activities in a manner that prevents air pollution from occurring as the result of burning (where allowed), drilling, blasting, production of materials, hauling, or any other necessary construction operations of any kind. Conform to the applicable provisions of KRS Chapter 224 and regulations issued by the responsible state and federal agencies, and conform to regulations established by local governmental agencies pursuant to KRS Chapter 77.

Apply water or other approved materials when, where, and as directed or approved by the Engineer in order to effectively prevent and control dust from becoming an air pollutant, safety hazard, or other type nuisance during the construction of a project. For failure to perform this item of work satisfactorily, the Department will defer the processing of any pay estimates due the Contractor for the project, until the work is in compliance.

When dust results entirely from the performance of the work, include all costs for providing dust control in the pay items for the work being performed.

When dust is caused either partially or entirely by the traveling public, the Department will pay for the water at the Contract unit price per 1,000 gallons. The Contractor may use materials other than water to prevent and control dust caused partially or entirely by the traveling public, provided the Engineer approves the use of such materials and the Contractor furnishes and applies the materials at no expense to

the Department.

When the Contract designates blast cleaning concrete and steel surfaces, perform the blast cleaning as specified in the Contract. Choose a method allowed by the Contract that conforms to the air and water pollution regulations applicable to the county or city where the site of work is located and to the applicable safety and health regulations. Discontinue any method that does not consistently provide satisfactory work and conform to the above requirements, and replace it with an acceptable method. While blast cleaning, confine all debris of every type, including dirty water, resulting from the blast cleaning operation. Immediately and thoroughly clean debris from the blast–cleaned surfaces and all other areas where any escaped debris may have accumulated.

Perform all drilling, grinding, and sawing of rock, shale, concrete, and other similar dust-producing materials with equipment provided with water sprays, fabric-filtered collection systems, or other suitable devices to prevent excessive dust from becoming airborne.

Perform all burning according to Regulation 401 KAR 63:005.

107.01.05 Highways Through National Forests and National Parks. When the construction of all or a portion of a project is through a National Forest, National Park, or other type of governmentally controlled property, perform the work according to the Clearing and Fire Plans stated herein, as applicable.

The Contract will indicate the portion of a project that is within a National Forest, National Park, or other governmentally controlled property. The Contractor is responsible for determining the extent to which this subsection is applicable to a specific project.

A) Clearing Plans. Perform the clearing operation according to the following:

1) Plainly mark the boundaries of the clearing limits specified in the Plans or established by the Engineer prior to clearing.
2) Do not cut or damage any residual stand of trees, shrubs, or ground cover outside the boundaries of the clearing limits.
3) Contrary to Subsection 104.05, yard or stockpile merchantable timber within the clearing limits for disposition by the governmental agency in charge of the forest or other type property.
4) Dispose of logs, brush, limbs, stumps, and all other undesirable materials by burning, chipping, or hauling to approved dumps or waste areas. Perform burning as prescribed in the Fire Plan.

B) Fire Plan. The term Forest Officer-in-Charge means the officer or employee of the U.S. Forest Service designated by the Forest Supervisor to supervise burning and fire precautions on the project. The Forest Officer-in-Charge will be the District Ranger, or his designated representative.

Comply with all Kentucky State Fire Laws and the following:

1) Do not perform burning without written permission from the Forest Officer-in-Charge. The Forest Officer-in-Charge will stipulate the hours for burning and the time to extinguish all fires.
2) Prior to beginning any burning, submit to the Forest Officer-in-Charge a burning plan stating the intended burning times and dates. Prior to beginning any burning, notify the Forest Officer-in-Charge.
3) Maintain an on-site representative authorized to receive and carry out all instructions issued by the Forest Officer-in-Charge with regard to the burning and fire precautions.
4) At all times when burning is in progress, maintain a sufficient number of personnel to control the fires. Attend to all fires at all times.
5) Maintain adequate fire tools on the project at all times when burning is in progress, and store the tools in sealed tool boxes clearly marked "FOR FIRE ONLY". The US Forest Service will provide these boxes, and the

Forest Officer-in-Charge will specify the location to place each box. Keep each box as near the burning as practical, and never more than 1/8 mile from the burning. Move the fire tools along the job as the burning operation progresses. Maintain the fire tools ready for fire-fighting at all times, and return the tools to the U.S. Forest Service in serviceable condition after completing the burning operations.

6) Provide a satisfactory water pump with 500 feet of one-inch or 1 1/2-inch hose and a minimum of 300 gallons of available water.
7) Provide adequate spark arresters acceptable to the Forest Officer-in-Charge for all steam and internal combustion engines, including tractors, trucks, power rollers, power shovels, and chain saws. Confine the use of welding equipment, cutting torches, and similar equipment to an area cleared of all vegetation, leaves, and debris. Do not refuel power saws while hot. Refuel power saws only on a roadway or other cleared area.
8) Remove all flammable material for a distance of no less than 500 feet from brush or debris to be burned.
9) Prohibit smoking at such times as the Forest Officer-in-Charge deems necessary as a precautionary measure. At such times, allow smoking only in designated places cleared of debris, leaves, or other flammable material and approved by the Forest Officer-in-Charge.
10) The Contractor shall bear full responsibility (monetary or otherwise) for all fires resulting from his operations.
11) Notify the Forest Officer-in-Charge immediately in the event of escape of any fire, and act immediately to control the fire. The Forest Officer-in-Charge may, at his discretion, take charge of the fire control operations. Provide the Forest Officer-in-Charge with sufficient personnel, tools, and equipment as the Forest Officer-in-Charge deems necessary to control any fire caused by the project activities. The Contractor's actions in this regard shall not minimize the liability of the Contractor for damages and for the cost of controlling the fire.

C) Measurement and Payment. The Department will not measure or pay for any work required by this Subsection. The Department considers this work as incidental to other items in the Contract.

107.02 RIGHT-OF-WAY. The Department will make every effort to provide all necessary right-of-way and to clear all utility facilities on each project, but when the right of entry is lawfully withdrawn or invalidated, or when because of some other unforeseen reason either the right-of-way or the right of entry is obstructed, make no monetary claim for any damages, nor hold the Department liable for any delays resulting from such unforeseen conditions or occurrences. The Engineer may extend the Contract because of these delays, according to Subsection 108.07.

107.03 LABOR REQUIREMENTS. Comply with all state and federal labor laws and with the wage requirements specified in the Contract. The Department will set forth these requirements in the Contract. Do not discriminate against any worker because of race, creed, color, sex, national origin, age, or handicap.

107.04 PERMITS, LICENSES, TAXES. Procure all permits, licenses, inspections, and memberships, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work. When any portion of the project is located in an Enterprise Zone as defined in KRS 154, Subchapter 45, the Department will not seek an exemption from sales and use tax provided for in KRS Chapter 139. Accordingly, the Department will not execute any certificates of exemption for the purchase of building materials or any other tangible personal property to be incorporated into the project.

107.05 PATENTED DEVICES, MATERIALS, AND PROCESSES. When using any

design, device, material, or process covered by letters of patent or copyright, provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the Surety shall indemnify and save harmless the Commonwealth, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright, and shall indemnify the Commonwealth for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the prosecution or after the completion of the work.

107.06 RESTORATION OF SURFACES OPENED BY PERMIT. Do not allow any openings to be made in any surface or pavement except with the written permission of the Department. If the Department grants an encroachment permit to any person or corporation resulting in the need for an opening in the surface or pavement, perform necessary repair work at the opening as the Engineer directs and at the expense of the party to whom the permit was granted.

107.07 FEDERAL AID PARTICIPATION. When the Federal Government participates in the cost of the work covered by the Contract, proceed with the work under the supervision of the Commonwealth, but subject to the inspection and approval of the proper officials of the Federal Government and according to the applicable federal statutes, rules and regulations.

The Federal Government's inspection will not make the Federal Government a party to this Contract and will not interfere with the rights of either party under this Contract.

107.08 PUBLIC CONVENIENCE AND SAFETY. Store materials and conduct work to cause the minimum necessary obstruction to the traveling public.

For roads under construction that are used by the traveling public, maintain the roadbed, subgrade, or newly laid surface in a condition that the public can travel over in comfort and safety. Whenever the alignment of the new roadway and the grade line specified in the Plans or as established by the Engineer require any excavation or the construction of an embankment on any part of the existing traveled road, perform the work through completion with continuous, successive operations as quickly as practical, and maintain the completed work in a smooth and acceptable condition. Maintain open, passable sections where the old road and the new road coincide with as little inconvenience to the traveling public as possible. Do not close any sections of the road without first obtaining the Engineer's written permission.

When constructing temporary crossings for crossovers, bridges, or culvert openings, the Contractor is responsible for accidents that occur on the roadway approaches as well as the structures of such crossings.

107.09 RAILWAY-HIGHWAY PROVISIONS. When the Plans require hauling materials across the tracks of any railway, the Department will arrange with the railway company for permission for the Contractor to cross the railway right-of-way and tracks, provided that the Contractor executes a license agreement satisfactory to the railway company and agrees to reimburse the railway company for all costs associated with providing and removing temporary grade crossings, and for all costs of other work or items the railway company deems necessary for protection of its property and operations. When the Contractor desires railway crossings for his convenience, the Contractor shall make his own arrangements for the use of such crossings.

Perform all work on the railway right-of-way at times and in a manner to not unnecessarily interfere with the movement of trains or traffic upon the track of the railway company, and according to all other requirements of the Contract. Take all precautions to avoid accidents, damage, delays or interference with the railway company's trains or other property.

When work includes construction, maintenance, or demolition of a railroad bridge, conform to the personnel safety rules for bridge workers. These rules are consistent with existing OSHA regulations, but the FRA will be the enforcement agency. The rules are published in the June 24, 1992 Federal Register.

107.10 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS. Conduct all work over, on, or adjacent to navigable waters in a manner that does not interfere with the free navigation of the waterway and does not impair the existing navigable depths except as allowed by permit issued by either the US Coast Guard or the US Army Corps of Engineers.

107.11 USE OF EXPLOSIVES. Conduct blasting operations according to KRS Sections 351.310 - 351.340 and applicable rules and regulations issued by the Department of Mines and Minerals.

Notify each property owner and public utility company having structures or facilities in proximity to the site of the work of the intent to use explosives. Give such notice sufficiently in advance to enable those being notified to take the necessary steps to protect their property from injury.

Preserve the original bearing value of rock located under proposed structure foundations from damage by blasting, by concussion from blasting, or by excessive breakage. The Contractor shall bear any increases in structure costs caused by blasting damage to rock under proposed foundations.

107.12 PROTECTION AND RESTORATION OF PROPERTY.

107.12.01 General. Do not enter upon private property for any purpose without obtaining permission from the property owner.

The Contractor is responsible for preserving all public and private property and shall use every precaution necessary to prevent such damage or injury. Exercise the necessary precautions to prevent damage to pipes, conduits, and other underground structures. Carefully protect from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location, and do not remove them until directed.

The Contractor is responsible for all damage or injury to property resulting from any act, omission, neglect, or misconduct in the Contractor's manner or method of executing the work, or due to the Contractor's non-execution of the work, or due to defective work or materials.

When or where any direct or indirect damage or injury occurs to public or private property by or on account of any act, omission, neglect, or misconduct in the Contractor's execution, or lack of execution of the work, the Contractor shall restore, at no expense to the Department, such property to a condition similar or equal to that existing before such damage or injury was done.

If the Contractor fails to restore such property or repair such damage or injury within a reasonable time, then the Department may, upon 48 hours notice, proceed to repair, rebuild, or otherwise restore such property, and the Department will deduct the cost thereof from any monies due or that may become due to the Contractor under the Contract.

107.12.02 Preservation of Mailboxes. The Contractor is responsible for preserving mailboxes within the right-of-way and easements for the project. Remove and relocate mailboxes as necessary during construction of the project, and reinstall at their permanent location as soon as is practical. During construction of the project, provide access to mailboxes for US Postal Service vehicles at all times. Install mailboxes at both their temporary and final locations according to the requirements of the Department and the US Postal Service. When a new post is necessary for the final installation, furnish a 4-inch by 4-inch by 7-foot treated wood post, conforming to Section 820. Install other types of posts conforming to the requirements of the Department and the US Postal Service when the post is furnished by the owner of the mailbox.

Except for surfacing materials, perform all work necessary to preserve, remove, relocate, and reinstall mailboxes, and maintain access for US Postal Service vehicles, at no expense to the Department.

107.13 RESPONSIBILITY FOR DAMAGE CLAIMS. The Contractor shall indemnify and save harmless the Commonwealth, the Department, and all its officers, agents, and employees from all suits, actions, or claims of any character brought on account of any of the following:

1) injuries or damages sustained by any person or property resulting from the Contractor's acts;
2) neglecting safeguarding the work;
3) acts, omissions, neglect, or misconduct;
4) claims or amounts recovered from any infringement of patent, trademark, or copyright; and
5) claims or amounts arising or recovered under the Workers Compensation Act, or any other law, ordinance, order, or decree.

The Department will retain money due the Contractor in amounts sufficient to cover the cost of such suits, actions, or claims for the use of the Commonwealth.

By executing this Contract, the parties do not intend to create for the public or any of its members a third party beneficiary, or to authorize anyone not a party to the Contract, a suit for personal injuries or property damage.

107.14 CONTRACTOR'S RESPONSIBILITY FOR WORK. Until the Department makes final written acceptance of the work, protect against injury or damage to any part of the work by the action of the elements, or from any other cause, whether arising from the execution, or from the non-execution, of the work. Rebuild, repair, and restore any portion of the work damaged by any of the above causes. The Contractor shall bear the expense of such repairs except for damages to the work due to unforeseeable causes beyond the control of and without fault or negligence of the Contractor, including but not restricted to acts of God or of the public enemy, acts of the Government, slides that the Engineer finds to have been unavoidable, and ordinary wear and tear on any section of the road that the Engineer orders opened to traffic.

The Department may issue written encroachment permits to make openings in, along, or across the road, but in such cases the individuals or organizations obtaining the permit shall perform the work.

107.15 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES. At points where the work is adjacent to the properties of utility companies or others to which damage from performing the work might result in considerable expense, loss, or inconvenience, do not start the work without first making all arrangements necessary to protect the adjacent property. Cooperate with the owners of any underground or overhead utility lines while they remove or relocate such utilities so that their operations progress in a reasonable manner with minimal duplication, and so that the services rendered by those parties is not unnecessarily interrupted.

Use all possible care in excavating on the project to avoid damaging existing utilities, whether the utilities are or are not specified in the Plans. Elevations and locations of existing utilities specified in the Plans are approximate only. As specified in Subsection 107.12, the Contractor is responsible for protecting and restoring existing utility property specified in the Plans.

In the event that water and utility services are interrupted as a result of accidental breakage, or as a result of being exposed or unsupported, promptly notify the proper authority and cooperate with that authority to restore services. When water service is interrupted, perform the repair work continuously until the service is restored. Do not perform work around fire hydrants until the local fire authority approves the plan for restoring service.

Prior to any excavation activities, comply with the requirements for Excavators in the Underground Facility Damage Prevention Act of 1994 which is contained in KRS 367 Sections 1 through 10.

107.16 PERSONAL LIABILITY OF PUBLIC OFFICIALS. In carrying out any of

the provisions of the Contract, or in exercising any power or authority granted to them by or within the scope of the Contract, the Commissioner, Engineer, or their authorized representatives have no liability, either personally or as officials of the Commonwealth; in all such matters they act solely as agents and representatives of the Commonwealth.

107.17 NO WAIVER OF LEGAL RIGHTS. The Department is not precluded or estopped, by any measurement, estimate, or certificate made either before or after the completion and acceptance of the work and payment for the work, from showing the true quantity and character of the Contractor's work and materials furnished by the Contractor, or from showing that any such measurement, estimate, or certificate is untrue or incorrectly made, or that the Contractor's work or materials that the Contractor furnishes do not conform to the Contract.

The Department is not precluded or estopped, notwithstanding any such measurement, estimate, or certificate and payment according thereto, from recovering from the Contractor and his surety such damages as it may sustain by reason of the Contractor's failure to comply with the terms of the Contract. Neither the Department's acceptance, or the acceptance of any representatives of the Department, nor any payment for or acceptance of the whole or any part of the work, nor any extension of time, nor any Department possession of the work operate as a waiver of any portion of the Contract or of any power herein reserved, or any right to damages herein provided. A waiver of any breach of the Contract does not operate as a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, is liable to the Department for latent defects, fraud or such gross mistakes as may amount to fraud, and the Department's rights under any warranty or guaranty.

107.18 REQUIRED LIABILITY INSURANCE. In addition to any other forms of insurance or bonds required under the terms of the Contract, carry insurance of the following kinds and amounts:

A) Public Liability Insurance. Furnish proof of insurance to the Department, with respect to all construction operations, for regular Contractors' Public Liability Insurance providing for a limit of no less than (amount shown in the Bid Proposal) dollars for all damages arising out of bodily injuries to or death of one person, and subject to that limit for each person, a total limit of (amount shown in the Bid Proposal) dollars for all damages arising out of bodily injuries to or death of 2 or more persons in any one accident.

B) Property Damage Liability Insurance. Furnish proof of insurance to the Department, with respect to all construction operations, for regular Contractors' Property Damage Liability Insurance providing for a limit of no less than (amount shown in the Bid Proposal) dollars for all damages arising out of injury to or destruction of property in any one accident, and subject to that limit per accident, a total (or aggregate) limit of (amount shown in the Bid Proposal) dollars for all damages arising out of injury to or destruction of property during the policy period.

C) Protective Public Liability Insurance. Furnish proof of insurance (carried in the Contractor's own behalf) to the Department, with respect to all subcontractor construction operations, for regular Contractors' Protective Public Liability Insurance providing for a limit of no less than (amount shown in the Bid Proposal) dollars for all damages arising out of bodily injuries to or death of one person, and subject to that limit for each person, a total limit of (amount shown in the Bid Proposal) dollars for all damages arising out of bodily injuries to or death of 2 or more persons in any one accident.

D) Protective Property Damage Liability. Furnish proof of insurance (carried in the Contractor's own behalf) to the Department, with respect to subcontractor construction operations, for regular Contractors' Protective Property Damage Liability Insurance providing for a limit of no less than (amount shown in the Bid Proposal) dollars for all damages arising out of injury to or destruction of property

in any one accident and, subject to that limit per accident, a total (or aggregate) limit of (amount shown in the Bid Proposal) dollars for all damages arising out of injury to or destruction of property during the policy period.

E) Liability Insurance for Highway and Railroad Separation. Furnish proof of insurance (carried in the behalf of the Railroad Company shown in the Bid Proposal) to the Department, with respect to all construction operations and subcontractor construction operations, for Railroad Company regular Protective Public Liability Insurance providing for a limit of no less than (amount shown in the Bid Proposal) dollars for all damages arising out of bodily injuries to or death of one person, and, subject to that limit for each person, a total limit of (amount shown in the Bid Proposal) dollars for all damages arising out of bodily injuries to or death of 2 or more persons in any one accident, and regular Protective Property Damage Liability Insurance providing for a limit of no less than (amount shown in the Bid Proposal) dollars for all damages arising out of injury to or destruction of property in any accident and, subject to that limit per accident, a total (or aggregate) limit of (amount shown in the Bid Proposal) dollars for all damages arising out of injury to or destruction of property during the policy period.

F) General. Carry the insurance herein before specified until all work required to be performed under the terms of the Contract is satisfactorily completed as evidenced by the Formal Acceptance by the Commonwealth. When the Contract is a joint venture, each party to such undertaking shall furnish proof of endorsement on any insurance required indicating the extension of coverage to that contract undertaking, or the joint venture shall provide the coverage required for the undertaking by a contract of insurance for that purpose. Provide insurance at no expense to the Department.

When subletting any part of the work, provide on behalf of the subcontractors or ensure that when subletting the subcontractors provide similar insurance to cover their operations.

SECTION 108 ¾ PROSECUTION AND PROGRESS

108.01 SUBCONTRACTING OF CONTRACT. Do not subcontract, sell, transfer, assign, or otherwise dispose of the Contract or Contracts or any portion of the Contract or Contracts, or of the right, title, or interest therein, without the Engineer's written consent. When the Engineer gives such consent, the Engineer will allow the Contractor to subcontract a portion, but the Contractor must perform with his own organization work amounting to no less than 50 percent of the total Contract cost. However, the Contractor may subcontract any items designated in the Contract as specialty items, and the Department will deduct the cost of any such specialty items performed by subcontract from the total cost before computing the amount of work the Contractor must perform with his own organization. Do not allow any subcontractor to further subcontract any portion of the work without obtaining written consent from the Engineer. When the Engineer gives such consent, the first tier subcontractor may further subcontract a portion of his work not to exceed 50 percent of the work originally subcontracted to him by the Contractor. Do not allow any second tier subcontractor to subcontract any portion of the work.

The Engineer's written consent to subcontract, assign, or otherwise dispose of any portion of the Contract does not, under any circumstances, relieve the Contractor of his liabilities and obligations under the Contract. The Engineer will make transactions only with the Contractor. The Engineer will recognize subcontractors only in the similar capacity of employees or workers of the Contractor who are subject to the same requirements as to character and competence as specified in Subsection 108.06.

The Contractor shall not use equipment in the performance of the Contract to which title is not held by the Contractor or an approved subcontractor, except licensed trucks or miscellaneous special equipment of minor importance to the work without an approved lease or rental agreement. Equipment that is leased or rented from an established, Department approved rental company is released from this requirement.

The Engineer will approve equipment lease or rental agreements only when a true copy of the agreement is submitted to the Department. Submit the agreement signed by both the lessor and lessee, with signatures that are verified by a notary public. In unexpected or emergency situations, the Engineer may give oral approval to use leased or rented equipment only for the duration of the unexpected or emergency situation. After the unexpected or emergency situation ends, immediately remove the equipment from the project or submit an acceptable copy of the lease or rental agreement prior to that time.

Submit lease or rental agreements that provide for reimbursement based on the time the equipment is used on the project. Employ, or ensure that an approved subcontractor employs, all operators of leased equipment while working on the project.

108.02 PRECONSTRUCTION CONFERENCE. After Contract award, the Engineer may schedule a preconstruction conference. At this conference, submit a progress schedule showing the order in which the work will be carried out. Ensure that the schedule identifies start and anticipated completion dates of activities and all features of the work, including submittals as specified in Subsection 105.02. The Contractor may submit the schedule in a bar chart format or a critical path method format. Ensure that no schedule activity is shorter than one day. When the Engineer deems that the duration of an activity is too long, subdivide the activity into activities of shorter durations. Ensure that the schedule shows interrelationships among the activities and identifies the controlling items of work throughout the project. If requested by the Engineer, furnish information needed to justify activity time duration, including estimated manpower, equipment, unit quantities and production rates. Ensure that the schedule completion date is not later than the Contract completion date.

When applicable, also provide the following at the conference:

1) the names of the project superintendent, the safety officer, and the project and company EEO officers;
2) the names and telephone numbers of persons responsible for traffic control 24 hours per day, 7 days a week;
3) the name of the Professional Engineer in charge of staking;
4) a letter from each DBE/WBE subcontractor stating the name of the superintendent and stating that this individual is not affiliated with the prime contractor;
5) the erosion control and water pollution prevention plan; and
6) a proposed traffic signing diagram.

If the Contractor does not provide the required submissions, the Engineer may order the preconstruction conference suspended until such time as the Contractor furnishes them. Do not begin work until the preconstruction conference has been concluded. The Engineer will not allow additional compensation or an extension of Contract time as a result from any delays due to such as suspension.

108.03 ORDERING DRAINAGE MATERIALS. Do not order materials for any drainage structures until the Engineer checks the quantities of such materials.

108.04 PROSECUTION OF THE WORK. Do not begin the work until receiving the Commissioner's official Notice to Begin Work. After receiving notice, begin work within the following schedule:

1) when the Contract stipulates Contract time in working days or calendar days, begin work within 30 calendar days of the date specified in the Notice to Begin Work, and prosecute the work efficiently and continuously with adequate force and equipment to completion within the number of days allowed; and
2) when the Contract specifies a fixed completion date, begin work after receipt of the Notice to Begin Work at such time as will enable completion of the work by the specified completion date.

108.05 LIMITATIONS OF OPERATIONS. Limit operations so that there is not an unnecessarily large section of the roadway under construction at any time causing undue inconvenience to the traveling public. In the prosecution of the work, start operations at such points as the Engineer may direct. When ordered by the Commissioner, open any or all sections to travel, whether the whole length of road is completed or not.

108.06 CHARACTER OF WORKERS, METHODS, AND EQUIPMENT.

A) General. Employ, at all times, sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the Contract.

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

If the Engineer judges that any person employed by the Contractor does not perform the work in a proper and skillful manner or is intemperate or disorderly, at the written request of the Engineer, the Contractor shall remove such person from the project and shall not employ such person again in any portion of the work without the approval of the Engineer. Should the Contractor fail to remove such person or persons as directed, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until the Contractor complies with such orders.

Use only equipment of sufficient size and in such mechanical condition as to conform to the requirements of the work and to produce a satisfactory quality of work. Use equipment that does not harm the roadway, adjacent property, or other highways.

When a weight or weight range is specified for compaction equipment, use equipment that has a plate or sign attached showing its weight, or minimum and maximum weights when applicable. In lieu of the plate or signs, the Contractor may weigh the equipment on scales certified by the Division of Weights and Measures before using the equipment on each project.

When the methods and equipment that are used to accomplish the construction are not prescribed in the Contract, use any methods or equipment that will, to the satisfaction of the Engineer, accomplish the Contract work in a manner conforming to the Contract.

B) Alternate Methods and Equipment. When the Contract specifies certain methods and equipment, use such methods and equipment unless the Engineer authorizes others. Request approval from the Engineer to use a method or type of equipment other than those specified in the Contract. Make the request in writing and include a full description of the methods and equipment proposed and an explanation of the reasons for desiring to make the change. If the Engineer's approval is granted, the Contractor is fully responsible for producing construction work according to the Contract. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not conform to the Contract, discontinue the use of the substitute method or equipment and complete the remaining construction with the specified methods and equipment. Remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct, at no expense to the Department. The Engineer will not change the basis of payment or the Contract time for the construction items involved as a result of authorizing a change in methods or equipment.

108.07 DETERMINATION AND EXTENSION OF CONTRACT TIME.

108.07.01 General. When the Engineer suspends or delays the performance of work, in writing, for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation or Contract time is due because of the suspension or delay, the Contractor shall submit to the Engineer, in writing, a request for an adjustment within 7 calendar days of receipt of the notice to resume work. Include the reasons and support for the adjustment in the request.

If the Engineer agrees that the cost or time required for the performance of the Contract has increased because of the suspension and the cause of the suspension was beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the Contract in writing, accordingly. The Engineer will notify the Contractor whether or not conditions warrant an adjustment. The Department will not allow any Contract adjustment if:

1) the Contractor does not provide the required written notice, or
2) the performance would have been suspended or delayed by any other cause, or
3) an adjustment is provided for or excluded under any other term or condition of the Contract.

108.07.02 Working Days. When the Contract time is specified in working days the Engineer will charge all working days that occur, beginning with the 31st calendar day following the date of the Notice to Begin Work, to the Contract even when the Contractor is not performing work, except that during December, January, February, and March, the Engineer will not charge working days to the Contract regardless of whether or not the Contractor is performing work. During the months when the Engineer is charging working days, the Engineer will furnish the Contractor biweekly statements showing the number of days charged for the period, the total number of days charged to the Contract through that date, and the number of days remaining for completion of the Contract. The Contractor acknowledges acceptance of, and agreement with, all bi-weekly statements unless the Contractor submits a written

protest containing supporting evidence for a change within 14 calendar days of receiving the bi-weekly statement.

The Department bases the specified Contract time on the original quantities of work as defined in Subsection 102.05. The Engineer will not shorten the Contract time when the final Contract cost is less than the original Contract cost because of net decreases in the quantities or the elimination of items. When the final Contract cost is greater than the original Contract cost because of net increases in the original quantities or the addition of items, the Engineer will grant an extension of the Contract time. The Engineer will determine the number of additional working days due for the additional work by dividing the value of the additional work by the value of the original Contract work and multiplying this ratio by the number of original Contract working days. When, however, the Engineer determines that the additional work is of such character, or occurs so near the time of completion of the project, that the Contractor requires more time to complete the additional work than is indicated by the working day/Contract amount ratio, the Engineer may extend the Contract time by as much as the anticipated number of working days necessary to complete the additional work. In these instances, the Engineer will establish the number of allowable working days at the time the Contractor agrees to perform the additional work.

The Contract may require that, before the Contractor orders or uses specific materials or products, the Contractor submit to the Department shop drawings, manufacturer's brochures or specifications, material certifications or mill test reports, and other similar requirements describing each of the specific materials or products identified. When any such requirements are applicable, the Department considers obtaining, preparing, or producing that which is required, gaining the necessary review or approval by the Department, and obtaining delivery to the project of these materials or products as an essential part of the Contract. When the Engineer deems that the Contract item or job-site operation associated with these requirements is the controlling item or operation, the Engineer will charge working days without regard to conditions on the project site, until the Contractor delivers sufficient materials or products, or other conditions arise, which causes a job-site operation to become the controlling operation.

When the Contract specifies that the Contractor wait for a period of time after embankment construction to achieve anticipated settlement, the Engineer will not consider the embankment where settlement is anticipated as the controlling item during the waiting period. If the Engineer determines that the controlling item or operation is delayed by the settlement period, the Engineer will not charge working days until the specified waiting period and settlement is complete. The Engineer will charge working days when work can begin or resume on the controlling item or operation.

108.07.03 Calendar Days. When the Contract time is specified in calendar days, the Engineer will charge every calendar day, beginning with the 31st calendar day following the date of the Notice to Begin Work, including all Saturdays, Sundays, holidays, and non-working days, to the Contract. The Engineer bases the Contract time on the original quantities of work as defined in Subsection 102.05. The Engineer will not shorten the Contract time when the final Contract cost is less than the original Contract cost because of net decreases in the quantities or the elimination of items. When the final Contract cost is greater than the original Contract cost because of net increases in the original quantities or the addition of items, the Engineer will grant an extension of the Contract time. The Engineer will determine the number of additional calendar days due for the additional work by dividing the value of the additional work by the value of the original Contract work and multiply this ratio by the number of original Contract calendar days. When, however, the Engineer determines that the additional work is of such character, or occurs so near the time of completion of the project, that the Contractor requires more time to complete the additional work than is indicated by the calendar day/Contract amount ratio, the Engineer may extend the Contract time by as much as the anticipated number of calendar days necessary to complete the additional work. In these instances, the Engineer will establish the

number of allowable calendar days at the time the Contractor agrees to perform the additional work.

The Engineer will not allow any extension of time for weather or resulting conditions, except for delays caused by earthquakes, tornadoes, or other similar catastrophic forces.

108.07.04 Specified Completion Date. When the Contract time is specified as a specific completion date, complete all work on the project by that date regardless of the length of time between the Notice to Begin Work and the specified completion date.

The Engineer bases the Contract time on the original quantities of work as defined in Subsection 102.05. The Engineer will not shorten the Contract time when the final Contract cost is less than the original Contract cost because of net decreases in the quantities or the elimination of items. When the final Contract cost is greater than the original Contract cost because of net increases in the original quantities or the addition of items, the Engineer will grant an extension of the Contract time. The Engineer will determine the length of the extension of time, in calendar days, due for the additional work by dividing the value of this additional work by the value of the original Contract work and multiply this ratio by the number of calendar days from Notice to Begin work to the original specified completion date. When the Engineer determines that the additional work is of such character, or occurs so near the time of completion of the project, that the Contractor requires more time to complete the additional work than is indicated by the Contract time/Contract amount ratio, the Engineer may extend the Contract time by as much as the anticipated number of calendar days necessary to complete the additional work. In these instances, the Engineer will establish the number of allowable calendar days at the time the Contractor agrees to perform the additional work.

When the period between the execution of the Contract and the issuance of the Notice to Begin Work exceeds 30 calendar days, as provided in Subsection 103.06, the Department will extend the specified completion date by the number of calendar days the Notice to Begin Work was withheld in excess of the 30 calendar days.

The Engineer will not allow any extension of time for weather or resulting conditions, except for delays caused by earthquakes, tornadoes, or other similar catastrophic forces.

108.08 SUSPENSION OF WORK. The Engineer may order the Contractor in writing to suspend, delay or interrupt all or part of the work for such period of time as the Engineer may determine to be appropriate for the convenience of the Commonwealth.

If the Engineer suspends or delays the performance of all or any portion of the work for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation or Contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer, in writing, a request for adjustment within seven calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

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

The Engineer will not allow any Contract adjustment unless the Contractor has submitted the request for adjustment within the prescribed time.

The Engineer will not allow a Contract adjustment under this clause to the extent that the performance would have been suspended or delayed by any other cause, or for which an adjustment is provided or excluded under any other term or condition of this Contract.

108.09 FAILURE TO COMPLETE ON TIME. For each calendar day that the Contractor fails to complete the work after the final Contract time allowed according to Subsection 108.07 for the completion of the Contract, the Department will deduct the applicable daily charge specified in this subsection from any money due the Contractor; not as a penalty, but as agreed liquidated damages. The Department will deduct daily charges as agreed liquidated damages for each calendar day without regard to inclement weather or the temperature limitations in the Contract, except that the Department will not deduct liquidated damages on any project during the months of December through March. When seasonal limitations of the Contract prohibit work during other periods of the year, the Department will not deduct liquidated damages during those periods when the specified seasonal limitations prohibit the Contractor from performing work on the controlling item or operation. The Department will charge the agreed liquidated damages on a calendar day basis regardless of whether the Contract time is measured in calendar days, working days, or is established as a specified completion date contract.

Because the prosecution of work in connection with the construction of road and bridge projects will inconvenience the public, obstruct traffic, and interfere with business, complete the work as quickly as practical. Also, the Department's costs for the administration of the Contract, including inspection, engineering, supervision, and maintaining detours, increases with the time that the Contractor takes to execute the work.

When the Department allows the Contractor to continue and to finish the project beyond the Contract time, such permission does not operate as a waiver by the Department of any of its rights under the Contract.

The Department will reduce the agreed liquidated damages by 50 percent after the date that the Contractor opens the project to traffic when:

1) the Contractor has substantially completed surfacing, shoulders, and devices on a project;
2) the Engineer directs that the Contractor open the project to traffic according to Subsection 112.03.14; or
3) the Contractor has constructed a new bridge project to such a stage that the Contractor can safely open the entire project to traffic.

The Department will not apply this reduction to grade and drain projects that do not include surfacing of the mainline as a part of the Contract, to projects constructed under traffic on existing highways, or when the Contractor opens frontage roads or cross roads to traffic.

The Engineer may require the Contractor to perform work to fulfill the requirements of Subsections 212.03.03 D) and 212.03.03 F) after the Contract time has elapsed and after the Engineer has declared the project otherwise complete. The Department will not assess liquidated damages for this work provided that the Contractor completes the work within the following periods:

1) complete topdressing work specified in Subsection 212.03.03 D) within 60 calendar days after the Engineer's direction to begin this work; and
2) complete corrective work to fulfill the seeding acceptance requirements of Subsection 212.03.03 G) within 30 days after the Engineer's direction to correct the seeding, or at a later date that the Engineer directs at the time of inspection.

When the Contractor has not completed this work within the time period allowed above as applicable, the Department will assess liquidated damages at 25 percent of the original Contract daily charge from the expiration of the time allowed above until the Contractor completes the specified work, except that the Department will not assess liquidated damages during the months of December through March.

The Department will apply the following schedule of agreed liquidated damages:

Original Contract Amount		Daily Charge
(From)	(To and including)	

0.00	100,000.00	150.00
100,000.01	500,000.00	200.00
500,000.01	1,000,000.00	300.00
1,000,000.01	2,000,000.00	400.00
2,000,000.01	5,000,000.00	600.00
5,000,000.01	10,000,000.00	800.00
10,000,000.01	20,000,000.00	1,600.00
20,000,000.01	or more	3,000.00

108.10 DEFAULT AND TERMINATION OF CONTRACT. The Commissioner, after giving due notice to the Contractor and his Surety, has the authority to take the prosecution of the work out of the hands of the Contractor or Surety, or both, for any breach of the Contract that the Contractor commits, as follows:

1) failure to begin the work under the Contract within the time specified
2) failure to prosecute the work with sufficient forces, equipment, or materials to complete the work within the time specified
3) failure to perform the work satisfactorily
4) discontinuing the work before completion without the Engineer's permission
5) neglecting or refusing to remove such materials or to perform anew such work that the Engineer rejects as defective or unsuitable
6) bankruptcy or insolvency, or committing any acts of bankruptcy or insolvency
7) allowing any final judgment against him to remain unsatisfied for a period of 10 calendar days
8) making an assignment for the benefit of his creditors
9) for any other reason, failing to carry on the work according to the Contract

The Commissioner will give the Contractor and his Surety written notice specifying the delay, neglect, or default and the action required. When the Contractor or his Surety, within a period of 10 calendar days after such notice, fails to proceed satisfactorily in compliance therewith, the Commissioner then has full power and authority to take the work out of the hands of the Contractor or Surety, or both; to use any or all suitable materials and equipment on the project; or to enter into Contract, or use such other methods as required to complete the work.

Any contractor employed by the Surety to perform work on the project shall comply with the prequalification requirements of Subsection 102.01.

When the Commissioner takes over the incomplete work under any of the provisions of this section, the Department will deduct all additional costs and damages, and the costs and charges of completing the same from monies due or to become due the Contractor; and when the total of such damages, costs, and charges exceeds the balance of the Contract price that would be payable to the Contractor had he completed the work, then the Contractor and Surety shall, on demand, pay to the Department the amount of such excess.

108.11 EMERGENCY DEFERMENT OR TERMINATION OF CONTRACT. When a national emergency exists, by reason of war conditions involving the US; by reason of orders of the US Government or its duly authorized agencies; or by Executive Order with respect to the prosecution of war or to national defense; and such emergency, upon a finding by the Department, creates a shortage of materials, labor, or equipment that prevents the Contractor from proceeding with his contract, the Department and the Contractor may defer such construction in whole or in part, or the Department may terminate such contract, or any part thereof.

108.11.01 Deferment. In all cases where the Department defers construction, the Department and the Contractor will execute a written agreement stating the terms and conditions of such deferment.

108.11.02 Termination. When the Department terminates the Contract or any portion of the Contract, and the Contractor is released before completing all items of

work included in the Contract, the Department will pay for the actual items of work completed. The Department will pay on the basis of agreed prices for the following:

1) Items that have no unit prices included in the Contract.
2) Contacts that the Department has decreased in excess of 25 percent and the Contract unit prices are not sufficient to equitably reimburse the Contractor for overhead.
3) Major items where the Department has decreased the total cost of the major item in excess of 25 percent. A major item is defined in Subsection 101.03.

The Department will not pay for any claim for anticipated profits.

The Department may, at the Engineer's option, purchase unused materials that the Contractor has obtained and that the Department has inspected, tested, and accepted, at such points of delivery as the Department designates and at a cost shown by receipted bills or other proper evidence.

108.12 TERMINATION OF CONTRACT IN THE PUBLIC INTEREST. When unexpected state, federal , or local conditions of extraordinary significance occur which are beyond the control of both the Contractor and the Department, causing the Department to determine that termination of a contract will be in the public interest, the Department will terminate all or selected portions of the work in the Contract that remain incomplete. The Engineer will then determine equitable payment procedures to adequately compensate the Contractor for this unusual and unexpected termination of the Contract. The Department will compensate the Contractor for a terminated contract in an amount not exceeding the original total Contract amount, unless the Engineer approved change orders for increases prior to the occurrence of the unexpected conditions or the Engineer makes subsequent field measurements of authorized excavation and other such variable items that verify that the Contractor completed quantities in excess of the Contract quantities.

108.13 TERMINATION OF CONTRACTOR'S RESPONSIBILITY. The Department will consider the Contract complete when the Contractor has completed all work, the Commissioner has accepted the project, and the Contractor has complied with all obligations relative to the Contract and the bond, except as provided in Subsection 107.17.

SECTION 109 ¾ MEASUREMENT AND PAYMENT

109.01 MEASUREMENT OF QUANTITIES.

109.01.01 General. The Engineer will measure all work completed under the Contract according to the English system.

A station, when used as a definition or term of measurement, will be 100 linear feet measured horizontally.

The Engineer will determine quantities of material the Contractor furnishes and work the Contractor performs under the Contract using measurement methods and computations generally recognized as conforming to good engineering practice.

The Engineer will take longitudinal measurements for area computations of pavement surfaces horizontally, and make no deductions for individual fixtures having an area of one square meter or less. The Engineer will determine transverse measurements for area computations of pavement surfaces using the neat dimensions specified in the Plans or ordered in writing except the Department will measure PCC Pavement according to Subsection 501.04.

The Engineer will measure structures according to neat lines specified in the Plans or as altered by the Engineer to fit field conditions.

For all items measured by the linear foot, such as pipe culverts, guardrail, underdrains, etc., the Engineer will measure parallel to the base or foundation of the structures unless otherwise specified in the Plans.

In computing volumes of excavation and embankments, the Engineer will use the average end area method or other acceptable methods. For the purpose of ascertaining the quantities, the Engineer will use the planimeter.

The Engineer will specify and measure the thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing.

When the Contract uses the term "ton", it means the short ton consisting of 2,000 pounds. A metric ton consists of 1 000 kilograms.

The Engineer will measure asphalt materials by the gallon or ton. The Engineer will measure volumes at 60 °F or will make corrections to determine the volume at 60 °F, using ASTM D 1250 for asphalts or ASTM D 633 for tars. When the Contractor ships bituminous materials by truck or transport, the Engineer may use net certified weights, subject to correction for loss, for computing quantities. Certify weights according to the Department's current procedures.

The Engineer will measure cement by the ton.

When the Contract uses the term "lump sum" as an item of payment it means the complete payment amount for the work described.

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

When the Contract specifies standard manufactured items such as fence, wire, plates, rolled shapes, pipe, or conduit, and these items are identified by thickness or diameter, unit weight, section dimensions or other dimensions, such identification refers to nominal weights or dimensions. Unless the Department specifies more stringent tolerances, the Engineer will accept manufacturing tolerances established by the industries involved.

When the Contract designates design quantities for a specific portion of the work as the pay quantities, the Engineer will use these as the final pay quantities for that specific portion of the work, unless the Engineer revises the dimensions of said portions of the work from those specified in the Plans. When the Engineer's revised dimensions result in an increase or decrease in the quantities of such work, the Engineer will revise the final pay quantities accordingly.

The Engineer will perform final measurement of only those quantities that are delivered, in-place, and accepted. When weights include rejected material, the Engineer will deduct the quantity of such rejected material from the final measurement.

For the measurement of concrete or stone masonry, the Engineer will include only

that volume within the neat lines as specified in the Plans or as the Engineer has staked. The Engineer will use the prismoidal formula in computing the volumes of structures, or portions of structures, having end sections of unequal areas.

The Engineer will measure quantities of work or materials not included herein according to the applicable Sections in these Standard Specifications. When not so specified, the Engineer will measure other quantities according to well recognized practices and will not consider local rules or customs.

109.01.02 Weighing - General. Except as otherwise provided, furnish all scales. Provide scales that are suitable for the purposes intended and conform to the tolerances and specifications of the Division of Weights and Measures. Have all scales inspected to ascertain their accuracy whether operating at a commercial plant or operating on the project. Ensure that all scales are inspected, by a representative of a commercial scale company registered with the Division of Weights and Measures, within 3 months before the beginning of production, every 3 months during production, and any other time the Engineer deems necessary. The Engineer will accept inspection by the Division of Weights and Measures as a substitute for a commercial scale company inspection.

Keep a copy or ensure that the material supplier keeps a copy of the latest report of inspection by the Division of Weights and Measures or commercial scale company on file at the scale location.

Furnish or ensure that the material supplier furnishes all personnel necessary to perform weighing, including tare weighing, and to prepare all required records.

Use properly housed truck pit-scales of an approved type that are tested, or automatic printing scales as specified in Subsection 109.01.03. Use scales that are accurate to within 0.2 percent throughout their entire weighing range.

Certify or ensure that the material supplier certifies the quantities furnished each day for all materials which the Department will pay for in tons.

Complete or ensure that the material supplier completes a weight ticket for each load of material delivered to the project and that the weigher or plant manager signs each weight ticket, unless otherwise approved by the Engineer.

A) Weight Tickets. Ensure that the weigher or plant manager prepares or signs each weight ticket, unless otherwise approved by the Engineer.

B) Daily Summary. Prepare or ensure that the material supplier prepares the daily summary, and ensure that the plant manager signs the summary certifying that the day's total net weight is correct.

C) Tare Sheet. Prepare or ensure that the material supplier prepares the daily tare sheet, when used, and ensure that the plant manager signs the tare sheet certifying that the tare data is correct.

Provide the completed and signed daily summary and daily tare sheet to the Engineer on the project within 3 working days.

When hauling material over a route passing a permanent scale installation operated by the Department of Vehicle Regulation (DVR), the DVR will weigh each load. Ensure that the driver advises the state weigher that his load is going to a Transportation Cabinet project, and that the driver requests a ticket. Provide this to the Department representative receiving the material along with the supplier's ticket.

At temporary locations utilizing portable scales, ensure that the trucks stop for check weighing when the DVR officer or the Engineer directs.

The Engineer will select trucks on a random basis for check weighing on other approved scales. The Engineer may have these check weights performed on loaded trucks to check gross weight, or empty trucks to check tare weight, or both.

Each time the Engineer directs a truck away from the project haul route to another scale, and when the check weighing indicates the accuracy of the Contractor's or material supplier's scales is acceptable, the Department will pay the agreed unit price of $2.50 per mile or $25.00 or each truck checked, whichever is larger, for Scale Check Reimbursement.

The Engineer will measure the distance for Scale Check Reimbursement as the

total additional distance haul vehicles travel for acceptable scale checks based on the vehicle odometer to the nearest 0.1 mile. The Department will pay the agreed unit price per mile or per truck checked as full compensation for all costs and delays associated with the check weighing.

If the check weighing or any additional checks performed by or at the Engineer's direction show, that the accuracy of the Contractor's or material supplier's scales is not acceptable, the Department will not pay for any Scale Check Reimbursement, and the Engineer will adjust pay weights as specified below.

The Contractor's or material supplier's scales are not acceptable if tare check weights are more than 0.4 percent plus 120 pounds greater than the initial weight, and gross check weights are more than 0.4 percent plus 120 pounds less than the initial weight, when checked at a permanent scale location. If the Engineer deems it appropriate, the Engineer will modify initial tare weights by the estimated fuel consumption between the initial weight and check weight. If the Engineer determines that the check weights are outside these tolerances, the Engineer will direct the Contractor to perform additional checks to determine if net pay weights are within specified tolerances. If the Engineer determines that pay weights are outside these tolerances, the Engineer will reduce, by the difference greater than the specified tolerance for check weighing, the net weights of all loads previously weighed that day and all previous days back to the latest acceptable check weight or the latest scale certification, or for the previous 10 working days, whichever is least.

For check weights that are determined on scales with short platforms requiring split weights, the Department will accept check weights that are within 1.0 percent of the initial weight; if not, the Department will require check weights determined on a larger scale and apply the tolerance for check weights and adjustments specified for permanent scales.

For check weights that are determined by DVR portable scales, the Department will accept check weights that are within 2.0 percent of the initial weight; if not, the Department will require check weights determined on a permanent scale and apply the tolerance for check weights and adjustments specified for permanent scales.

When check weights that are determined on permanent scales are outside the specified 0.4 percent tolerance, the Department will require that the certifying firm immediately order the Contractor to have an approved scale company check the Contractor's or material supplier's scales. The Engineer may either suspend weighing operations or may allow weighing to continue with the Engineer making appropriate adjustments until an approved scale company has checked the scales.

The Department will not make separate measurement or payment for work required by this section other than Scale Check Reimbursement. The Department considers all work necessary to determine the weight of materials as incidental to the Contract unit prices for the various items that include such materials.

Obtain actual truck weights for all deliveries except as otherwise provided; the Department will accept railroad weights on aggregate deliveries of less than 10,000 tons.

Include in the Contract unit prices for the various pay items of the project, all other costs in connection with furnishing, installing, certifying or testing, and maintaining scales; for furnishing check weights and scale house; and all other items specified in this Section for weighing highway and bridge construction materials for proportioning or payment.

On a daily basis, weigh empty trucks used to haul material that the Department pays for by weight when the Engineer directs, and identify each truck with a plainly legible mark.

When the Department measures a material in units of weight and the Contractor delivers the material in standard containers of uniform size, the Engineer may measure the material by counting the containers and converting the count to weights provided that the material supplier prints the net weight of the materials on the container and the Contractor provides certification to the Engineer that the net weights are accurate within the tolerances allowed. Dispose of, or remove from the work, all empty containers when and as the Engineer directs.

As an alternative to the specified units of measure, the Contractor may request

the following:

1) For material specified to be measured by volume, the Contractor may request that the Engineer measure the material by weight and convert the weight to volume for payment.
2) For material specified to be measured by weight, the Contractor may request that the Engineer measure the material by volume and convert the volume to weight for payment.

Obtain the Engineer's approval, in writing, prior to implementing either of these alternatives. If approved, the Engineer will determine the conversion factors between the volume and weight measurements.

109.01.03 Automatic Printing Scales. Use the following types of scales:

1) Truck scales with an automatic printer
2) Scales used for automatic batching and recording in batch plants producing asphalt mixtures (when surge or storage bins are not used)
3) A weigh box or hopper located under a surge or storage bin

Do not use belt scales for determining pay weights.

Use only automatic printers that are an integral part of the scale equipment or the scale, and directly connected so that gross weights cannot be manually entered. The Department will allow the manual entry of truck tare weights, truck numbers, or other data.

Equip all aggregate sources and hot-mix asphalt plants furnishing materials that the Department pays for directly by weight with automatic printing scales for determining pay weights. The Engineer may grant exceptions to this requirement for installations that normally supply a total of less than 10,000 tons of material per year to Department projects.

A) Truck Tare Weights. Determine truck tare weights by weighing each truck once daily at random times on an approved scale. Submit a tare sheet showing all tare weights at the end of each working day.

The only exceptions to this requirement are:

1) When using truck scales and the capability exists, determine each truck tare just prior to loading each load and print it on the weight ticket. In this case, the Department will not require the daily tare sheet.
2) When the automatic printing scales are so designed and operated that tare weight is not used to calculate net weight, determine the tare weight of each truck before that truck begins hauling. In this case, the Department will not require further tare weighing or the daily tare sheet.
3) When all hauling is within the project limits or on the Contractor's haul roads, and the automatic printing scales are designed and operated so that tare weight is not used to calculate net weight, determine tare weights only as the Engineer deems necessary to conform to Subsection 105.10.02.

B) Printing. Use an automatic printer that produces a weight ticket for each load, in the required number of copies, and that contains all information that is shown on the Department's conventional weight ticket in digital form. Ensure that the weight tickets for each project indicate a sequential load number for each load. When using the weights that are printed in conjunction with automatic batching at asphalt batch plants, use a system that prints the weight of each individual batch component, the total weight of each batch, and the total weight of all batches in each truck load.

Submit weight tickets that show truck tare and gross weight on each ticket.

The Contractor may show weights in tons in lieu of pounds, provided that the Contractor shows the weight to at least 0.01 ton.

Provide a ticket that includes the certification stating the material is to be used on a Department project only and space for the signature of the Department representative receiving the material on the project.

C) Certification of Quantities. Certify or ensure that the material supplier certifies the daily quantities, and conform with the following requirements:

1) Use automatic printing scales, and perform accuracy checks of both the scales and the printing system, that conform to the Contract.
2) Ensure that the weigher or plant manager signs each ticket, unless otherwise approved by the Engineer.
3) Determine the pay quantity for each day as the certified quantity, less any material not actually delivered to the project, and less any deductions.
4) Prepare or ensure that the material supplier prepares the daily tare sheet (when used) and ensure that the plant manager signs the document, certifying that the tare data is correct.
5) Submit the completed and signed daily summary and daily tare sheet to the Engineer within 3 working days.
6) The Department reserves the right to inspect the Contractor's (or material supplier's) weighing equipment and procedures at any time, and to occasionally check-weigh a truck on other approved scales.

D) Scale and Printer Accuracy. Use scales with a degree of accuracy that conforms to the Contract. Use an automatic printing system with a degree of accuracy that conforms to the requirements of the Division of Weights and Measures. Note that the requirements listed in Subsection 401.02.03 are related to the accuracy of the batching process in automatic batch plants, and are not related to weighing for determining pay quantities.

When observed during production, ensure that the printed weight is within 60 pounds of the weight shown on the scale display.

E) Printer or Scale Malfunction. If the automatic printer becomes inoperative or is recording weights that are outside the specified accuracy tolerance, continue production only if weights can be read directly and produce weight tickets manually. However, continue manual weighing and preparing tickets manually only until the end of the workday in which the printer malfunction occurs.

If the scales malfunction or are operating outside the specified accuracy tolerance, continue production by weighing the material on other scales that conform to the Contract.

Notify the Engineer immediately of any scale or printer malfunction.

When manually weighing or preparing tickets due to equipment malfunction, proceed as follows:

1) Truck Tare Weights. Determine truck tare weights by weighing each truck once daily at random times on an approved scale. Submit a tare sheet showing all tare weights at the end of each working day. Prepare or ensure that the material supplier prepares the daily tare sheet and ensure that the plant manager signs the document, certifying that the tare data is correct.
2) Weight Tickets. Manually weigh each load of material and issue a hand written ticket for each load and certify by signing each ticket.
3) Daily Summary Sheet. Prepare or ensure that a summary sheet is prepared as follows:

    a) list all loads shipped that day
    b) truck number and load number for each load
    c) net weight of each load

d) total net weight shipped that day, supported by an adding machine tape

The Department will accept a computer printout in lieu of the standard form, provided it includes a certification similar to the standard form, space for the signature of the plant manager, space for the checkers signature, and space for the Engineers signature of approval.

If the Contractor uses equipment that is capable of calculating a cumulative total of net weights for each material and printing the cumulative total for the project on each ticket as the day progresses, with the final ticket showing the daily total for the project, then the Department will accept a daily summary without the listing of individual loads.

4) Certification of Quantities. Certify the quantity according to Subsection 109.01.02.

109.01.04 Weighing Small Quantities. After obtaining the Engineer's approval, the Contractor may certify the quantities of certain materials, in lieu of the Engineer weighing them. The materials, maximum daily quantities, and maximum quantities per project covered by this subsection are as follows.

Item	Maximum Daily Quantity	Maximum Quantity Per Product
Aggregates	100 tons	200 tons
Plant-mixed aggregate bases	100 tons	200 tons
Cement-treated bases	50 tons	100 tons
Asphalt Prime or Tack	5 tons	20 tons
Asphalt Mixtures	50 tons	100 tons

109.01.05 Overloads. The Department will not pay for that portion of any load that exceeds the legal or authorized load limit.

Weigh all material on approved scales. Accompany each shipment with a certified weight ticket.

The Engineer may direct the Contractor to reweigh any shipment if the Engineer determines that the stated weight appears to be incorrect. The Engineer may direct the Contractor to discontinue weighing by any method and require weighing by other approved means at any time the Engineer discovers unsatisfactory results.

109.02 SCOPE OF PAYMENT. Receive and accept the compensation provided for in the Contract as full payment for furnishing all materials and for performing all work under the Contract, including changes in work, materials, or Plans as provided herein, in a complete and acceptable manner; for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof; and for all expenses incurred in consequence of the suspension or discontinuance of the work as specified under the Contract. The Department's payment of any estimate does not relieve the Contractor of any obligation to make good any defective work or material.

Accept the Department's payment of the Contract unit prices for the various bid items of the Contract as full compensation for all labor, materials, supplies, equipment, tools, and all things of whatever nature required for the complete incorporation of the item into the work the same as though the items were to be read "In Place".

109.03 COMPENSATION FOR ALTERED QUANTITIES. Should the Engineer require any alterations in the Plans, as described in Subsections 102.05 and 104.02, that result in an increase or decrease in the quantities of the work, the Contractor shall accept the Contract unit prices for the actual quantities of work performed as payment in full, except as provided for by supplemental agreement and except that should any alteration directly cause the loss of any work or material that the Contractor has already furnished under the terms of the original Contract, the Department will

reimburse the Contractor for the actual cost of such work or of salvaging such material. The Department may purchase any such material at the Contractor's actual salvage cost.

109.04 EXTRA WORK. The Department will pay for extra work performed according to Subsection 104.03 at a lump sum price or at unit prices stipulated in a supplemental agreement; or, in lieu of such agreement, the Department may require the Contractor to perform such work on a cost-plus basis.

109.04.01 Supplemental Agreement. The Department may enter into a supplemental agreement with the Contractor to perform work which is not included in the original Contract, or as provided in Subsection 104.02. Both the Department and the Contractor will execute the supplemental agreement. An executed supplemental agreement immediately becomes a part of the original Contract, and is subject to all general and special provisions of the original Contract.

109.04.02 Cost-Plus Work. When the Contractor and the Department cannot agree to either a lump sum price or unit price for extra work, the Department may authorize the Contractor to perform such work on a cost-plus basis. The Department will pay for extra work on a cost-plus basis as outlined hereinafter, only when all items of work are agreed to in writing before the Contractor begins the work.

A) Labor. For all labor and for foremen in direct charge of the specific operations, the Department will pay the Contractor:

1) the actual cost of wages paid, but at rates not to exceed those for comparable labor currently employed on the project, as the Engineer determines;
2) an amount equal to the sum of the products of established labor burden percentages and the actual cost of wages. The amounts determined by the established labor burden percentages constitute full compensation for the cost of workers compensation insurance, social security taxes, unemployment compensation insurance, public liability insurance; and any other taxes or insurance which are added to labor costs; and
3) an amount equal to 25 percent of the actual cost of wages and the other costs identified above. This amount is full compensation for office overhead and general superintendence.

B) Materials. For all materials that the Contractor incorporates into the work and the Engineer accepts, the Department will pay the actual cost of such material, including transportation charges and sales taxes, to which the Department will add a sum equal to 15 percent.

C) Equipment and Tools. For any machinery or special equipment that the Engineer has authorized for use and the Contractor has used, the Department will pay the rental rate stated on the rental company invoice for the actual agreed time and rate that such equipment is required on the work.

The Department will pay rental rates for equipment that the Contractor is already using on the project, and which is not obtained specifically for the cost-plus work, based on an hourly rate derived by dividing Blue Book monthly rental rates by 176. The Department will pay rental rates for equipment required to be on standby at one half the normal rate and pay for standby time for a maximum of 8 hours per day and 40 hours per week.

The Engineer will measure the rental of equipment by time in hours of actual working time and the necessary traveling time of the equipment within the limits of the project, unless the Engineer has ordered special equipment in connection with cost-plus work, in which case the Engineer will also include travel time and transportation to the project.

The Department will add an amount equal to 15 percent of the rental sum, as full compensation for fuel, lubricants, and filters.

The Department will not pay rental rates or percentages for the use of small tools and manual equipment.

D) Bonds. The Department will pay an amount equal to the product of an established percentage and the summation of the total cost of the foregoing items. This amount constitutes full compensation for the Contractor's bond costs.

E) Records and Statements. Compare all records of cost-plus work with the Engineer at the end of each day. Prepare all cost-plus records on suitable forms that the Engineer will provide for this purpose. Sign and obtain the Engineer's signature on each form. Retain one copy and provide the original to the Engineer at the end of each day. Certify and submit all requests for payment of cost-plus work, with signed records of the costs, to the Engineer no later than one week before the closing date of the current pay estimate period, or other designated periods as directed.

Furnish satisfactory evidence of the actual rates paid for workers compensation insurance, social security tax, unemployment insurance, public liability insurance, and bonds.

Furnish statements, accompanied and supported by original receipted invoices, for all materials used, including transportation charges. When the Contractor does not specifically purchase materials for the cost-plus work and uses materials from his stock, the Contractor shall include, in lieu of the original invoices, an affidavit certifying that the Contractor took such materials from stock, that the Contractor actually used that quantity in the cost-plus work, and that the cost for which the Contractor is requesting payment represents his actual cost.

109.05 PARTIAL PAYMENTS. The Department will make partial payments bi-weekly as the work progresses. The Department will base the partial payments on estimates that the Engineer prepares of the value of the work performed, materials placed, and for materials delivered for which the Department allows payment.

For each partial payment, the Department will pay 100 percent of the value computed from the bi-weekly estimate as due, less any previous partial payments.

The Engineer will furnish to the Contractor a copy of each pay estimate, which will show in detail the amount of all quantities that the Department will pay.

109.05.01 Materials on Hand.

A) General. The Department will make partial payments only after the materials are delivered to a site that the Department owns or controls, and stored in a manner that protects them from theft or damage. The Engineer may require the Contractor to submit certified statements showing the actual cost of each material for which the Contractor requests partial payment and the quantity of material delivered.

A storage site owned or controlled by the Department is a site on land owned by the Department or on land for which the Department has been granted a temporary easement. When a temporary easement is necessary for the storage site, obtain a lease for the site, and grant the Department a temporary easement at no charge. In such cases, obtain a lease for the duration of the Contract and grant a temporary easement that gives the Department full control of the site.

The Department's partial payments for materials on hand do not constitute final acceptance of those materials and do not relieve the Contractor of any responsibility for the loss or deterioration of the materials due to any cause. Replace, at no expense to the Department, any materials lost or rejected for noncompliance with the Contract as a result of segregation, mixing with foreign materials, deterioration, or other causes. The Department will have full control of the disposition or use of all materials for which the Department makes partial payments.

The Department will make payments only for such materials which

conform to the Contract. The Engineer will base payments upon the quantity of materials stored on the closing date of the pay estimate. The Department will not pay for any stored material in excess of that required for the project; the maximum quantity the Department will pay for will be the design quantity as increased or decreased by approved changes. The Department will not compensate the Contractor for additional haul or extra handling charges.

B) Payments. The Department will make partial payments for nonflammable and nonperishable materials that the Contractor will be incorporating into Contract items for the project, which conform to the Contract, for which the Contractor has documented and certified the delivered quantities, and which the Contractor has stockpiled and protected as required herein and as required by the Engineer. Upon written request from the Contractor, the Department will make partial payments for up to 95 percent of the Contractor's documented cost of each stockpiled material when the total documented cost of all the units of the material is more than $10,000.00. Support the documented costs by copies of receipts showing the Contractor's payment for the stockpiled material. Provide the receipts to the Engineer no later than 30 days after the Department makes payment. However, the Department will not allow the total amount for partial payments for the materials for a Contract item to be more than 75 percent of the Contract unit cost of the item that the Contractor is constructing with the materials.

When the Contractor has completely erected and connected all structural steel, as specified in the Plans, the Department will make an additional partial payment. The Department will make partial payments for structural steel only after the Contractor completes and the Engineer approves both the fabrication and shop painting, and after the Engineer approves the manner of storing the steel. The Department will make this payment in an amount such that the total partial payments through the erection stage are 97 percent of the Contract price for structural steel. The Department will pay for the remaining 3 percent when the Contractor has satisfactorily completed the painting of the structural steel.

109.06 ACCEPTANCE AND FINAL PAYMENT. Within 180 days after the Engineer has completed final inspection and acceptance of the work, the Engineer will compile a final estimate for the Contract, showing the final quantities of all work performed, all retained percentages, and all deductions from the final amount for liquidated damages and any other deductions provided for in the Contract. The Engineer will submit the final estimate to the Contractor for his review. Within 60 calendar days after receiving the final estimate, submit to the Engineer a written statement of agreement with the final estimate or a written statement of disagreement with the final estimate. Upon the Contractor's agreement with the final estimate, or when the Contractor makes no acceptable statement of disagreement within the 60 calendar days provided herein, the Engineer will process the final estimate for payment. The Department will consider the Contractor's written statement of disagreement with the final estimate acceptable only if it contains an item-by-item list of the items that the Contractor does not agree with and the reasons for disagreeing with each listed item. When the Contractor submits an acceptable statement of disagreement with the final estimate, the Engineer will withhold payment of the final estimate to determine the validity of the Contractor's disagreement(s). After consideration of the Contractor's statement, the Engineer may revise the final estimate according to the judgment of the validity of the Contractor's disagreement(s).

Upon the Commissioner's approval, and after the Department deducts the total amount of all previous payments, liquidated damages, and any other appropriate deductions, the Department will certify the amount of money due the Contractor for payment to the Commonwealth as required by law. The Contractor's acceptance of payment for the final quantities constitutes as a release to the Commonwealth and the Commissioner.

When the final release is sent to the Contractor shows that he has been overpaid, then he has 60 days to refund the overpayment or submit a written statement of

disagreement with the estimate. Failure to make this restitution will subject the Contractor to the provisions of Subsection 102.04. The Department does not waive any rights to recover the overpayment.

When the amount of the final payment due the Contractor, or refund due the Department for a previous overpayment, is less than $10.00, the Department will not pay or require a refund unless the Contractor requests one in writing.

109.07 PRICE ADJUSTMENTS. Due to the fluctuating costs of petroleum products, the Department will adjust the compensation of specified liquid asphalt items and diesel fuel in contracts when one of the following conditions exists.

A) Completion Date Contract. The Department issues the Notice to Begin Work in a calendar year other than that of the specified completion date.

B) Working Day Contract. When there are more than 75 working days set up in the Contract.

C) Calendar Day Contract. When there are more than 180 calendar days set up in the Contract.

109.07.01 Liquid Asphalt. The Department will list a base price for liquid asphalt products in the Bid Proposal for applicable projects. The Department will compare the Kentucky Average Price Index, for the month that the Contract is let, to the index for the month that the Contractor places the material on the project to determine the percent change. When the original contract quantity for asphalt items is equal to or greater than 3,000 tons and when the average price of the liquid asphalt products increases or decreases more than 10 percent, the Department will adjust the Contractor's compensation. The Kentucky Average Price Index is calculated monthly using the weighted average price, per ton at the terminal, from the active suppliers of liquid asphalt.

Adjustable Contract Items:

- Asphalt Curing Seal
- Asphalt Material for Prime
- Asphalt Material for Tack
- Asphalt Base, All Classes
- Asphalt Binder
- Asphalt Surface, All Classes
- Sand Asphalt Surface
- Asphalt Open-Graded Surface
- Asphalt Seal Coat
- Asphalt Mixture for Leveling and Wedging
- Drainage Blanket - Type II - Asphalt

The Department will determine the price adjustment using the following formula:

$$\text{Asphalt Price Adjustment} = \frac{T \times A}{100} \times B \times \frac{C-10}{100}$$

Where:
T = Tons of material or mixture placed each month.
A = Percent of material or mixture that is asphalt.
B = Base price established by the Department.
C = Change in asphalt average price for each month in percent.

The job-mix formula for asphalt base, binder, and surface mixtures determines "A", which is the percent of asphalt. For recycled mixtures, the Department will determine the adjustment for the new asphalt cement only. The Department will consider materials for prime, tack, and seal as 100 percent asphalt.

109.07.02 Fuel. The Department will adjust the Contractor's compensation when the average price of diesel fuel increases or decreases more than 5 percent and the

original Contract quantity for the item on which the fuel is consumed is equal to or greater than the threshold quantities listed in the following table. The change in average fuel price is the average reseller price of diesel fuel, excluding taxes, discounts, and superfund line items, in the Kentucky region for the month that the Contract is let compared to the average reseller price of diesel fuel, excluding taxes, discounts, and superfund line items, in the Kentucky region for the month that the Contractor uses the fuel on the project.

Item	Threshold Quantity
Roadway Excavation	10,000 cubic yards
Embankment-in-Place	10,000 cubic yards
Borrow Excavation	10,000 cubic yards
DGA Base or Crushed Stone Base	5,000 tons
Gravel Base, Type III	5,000 tons
Stabilized Aggregate Base	5,000 tons
Drainage Blanket, Treated or Untreated	5,000 tons
Crushed Sandstone Base (Cement Treated)	5,000 tons
Hot-Mixed Asphalt Mixtures for Pavements or Shoulders	3,000 tons [(1)]
PCC Pavement, Base, or Shoulders	2,000 square yards [(2)]

[(1)]Total of all hot mixed asphalt Contract items.
[(2)]Total of all PCC pavement, base, and shoulder Contract items.

The Department will determine the price adjustment using the following formula:

$$\text{Fuel Price Adjustment} = E \times \frac{P}{100} \times \frac{C-5}{100}$$

Where:

E = Sum of amounts earned for each applicable item placed or performed each month.

P= The fuel cost percentage for each applicable item. The percentages are as follows:

Earthwork Items	5.0%
Aggregate Base Items	3.5%
Hot-mixed Asphalt Items	3.5%
PCC Pavement Items	0.5%

C = Change in average fuel price for that month in percent.

109.07.03 Payments and Deductions. The Department will adjust the Contractor's compensation, based on the sum of the fuel adjustments for all eligible pay items each month, paid or deducted, under one lump sum price for "Fuel Price Adjustment." The Department will adjust the Contractor's compensation, based on the sum of the asphalt adjustments for all eligible pay items each month, paid or deducted, under one lump sum price for "Asphalt Price Adjustment". The Department will pay full price adjustments on the final estimate.

If later price decreases indicate that the Department made an overpayment, the Department will withhold the overpayment from succeeding pay estimates on the project, or the Contractor shall immediately refund the over payment to the Department.

When the Contractor places materials during any month after the month that the Contract time (including all approved time extensions) expires, the Department will use the average price for the month that the Contractor places the material or the average price for the last month of the Contract time; whichever is least.

The Department will not grant a time extension for any overrun in the Contract amount due to payments made according to this section. The Department will not make any additional compensation due to adjustments made according to this section.

The Department will adjust the Contractor's compensation on the following months pay estimate and on the final pay estimate. The Department will make the final adjustment of the Contractor's compensation on the final estimate for the project.

SECTION 110 ¾ MOBILIZATION AND DEMOBILIZATION

110.01 MOBILIZATION. This subsection describes the requirements for mobilization when "Mobilization" is included in the Bid Proposal as a separate bid item.

Perform all preparatory work and operations necessary to move personnel, equipment, supplies, and incidentals to the project site; to establish offices, buildings, and other facilities that are necessary for performing the work; and to accomplish all other work or operations that must be performed, including costs that must be incurred, to begin work on the project.

Do not bid an amount for Mobilization that exceeds 3 percent of the sum of the total amounts bid for all other items, excluding Mobilization and Demobilization, in the Bid Proposal. The Department will automatically adjust any bids in excess of this amount to 3 percent for bid comparisons. The Department will base the award on the maximum allowable bid of 3 percent. If any errors in unit bid prices for other Contract items in a Contractor's Bid Proposal are discovered after bid opening and such errors reduce the total amount bid for all other items, excluding Mobilization and Demobilization, so that the percent bid for Mobilization is larger than 3 percent, the Department will adjust the amount bid for Mobilization to 3 percent of the sum of the corrected total bid amounts for all other items in the Bid Proposal.

110.02 DEMOBILIZATION. This subsection describes the requirements for demobilization when "Demobilization" is included in the Bid Proposal as a separate bid item.

Perform all work and operations necessary to accomplish Final Cleaning-Up as specified in Subsection 104.05; to move personnel, equipment, supplies, and incidentals from the project site; to remove all offices, buildings, and other facilities that were necessary for performing the work; and to accomplish all other work that must be performed, including costs that must be incurred, after acceptable completion of construction operations on the project.

Do not bid an amount for Demobilization that is less than 1.5 percent of the sum of the total amounts bid for all other items, excluding Mobilization and Demobilization, in the Bid Proposal. The Department will automatically adjust any Bid Proposals that are less than this amount up to 1.5 percent to compare Bid Proposals and award the Contract. The Department will award a Contract for the actual amount bid when the amount bid for demobilization exceeds 1.5 percent, or the Department will award the Contract for the adjusted bid amount when the amount bid for demobilization is less than 1.5 percent.

110.03 MEASUREMENT. The Department will measure all work performed as part of Mobilization as a lump sum, when Mobilization is included in the Bid Proposal as a separate bid item.

The Department will measure all work performed as part of Demobilization as a lump sum, when Demobilization is included in the Bid Proposal as a separate bid item.

110.04 PAYMENT. The Department will pay for the quantities at the Contract unit price as follows.

When Mobilization is included in the Bid Proposal as a separate bid item, the Department will make partial payments for Mobilization in 2 equal or approximately equal payments. The Department will make the first payment on the first pay estimate on which the Contractor's total earned value on Contract items, other than Mobilization, exceeds $1,000.00. The Department will make the second payment on the first pay estimate on which the Contractor has earned 5 percent or more of the total Contract amount for Contract items, other than Mobilization. The Department will make both payments simultaneously when these requirements are met at the same time. When Mobilization is not included in the Bid Proposal as a separate bid item, then the Department will consider all costs associated with mobilization incidental to the Contract and will make no separate payment for mobilization.

When Demobilization is included in the Bid Proposal as a separate bid item, the Department will pay for Demobilization according to the following schedule:

1) 25 percent upon formal acceptance of the project
2) 50 percent when the final estimate is submitted to the district office
3) 25 percent when the final estimate is paid

When Demobilization is not included in the Bid Proposal as a separate bid item, then the Department will consider all costs associated with demobilization incidental to the Contract and will make no separate payment for demobilization.

When Mobilization and Demobilization are included in the Bid Proposal as separate bid items, the Department will make payment under:

Code	Pay Item	Pay Unit
2568	Mobilization	Lump Sum
2569	Demobilization	Lump Sum

SECTION 111 ¾ VALUE ENGINEERING

111.01 DESCRIPTION. Value engineering is producing an equivalent or better option to that specified in the Contract at a lesser cost. The Department may consider as a value engineering proposal any cost reduction proposal that is initiated, developed, and submitted to the Engineer for modification of the Contract resulting in an immediate net savings to the Department. The Department will share equally the net savings resulting from a value engineering proposal that the Department approves.

The Department will only consider value engineering proposals that may potentially result in savings to the Department without impairing essential functions and characteristics of the facility. Essential functions and characteristics include but are not limited to service life, reliability, economy of operation, ease of maintenance, standardized features, safety, satisfaction of customer needs, desired ability, and special design requirements.

The Department will process value engineering proposals in the same manner as prescribed for any other alterations of the Contract that would require a supplemental agreement.

111.02 MATERIALS AND EQUIPMENT. Reserved.

111.03 PROCESS.

111.03.01 Conceptual Submittal and Review of the Value Engineering Proposal. As a minimum, submit the following information:

1) A statement that the proposal is submitted as a value engineering proposal.
2) A brief letter proposal with graphics to illustrate the concept or idea.
3) A brief description of the existing work and the proposed changes for performing the work. Include a discussion of the comparative advantages and disadvantages of each.
4) An approximate cost estimate for performing the work under the existing Contract and under the proposed change.
5) An approximate estimate of any effects the proposed changes would have on Department costs other than those in the Contract such as future construction, design, right-of-way, utilities, maintenance, and operations costs.
6) A statement of the time by which the Department must execute an agreement adopting the proposal to obtain the maximum cost reduction during the remainder of the Contract, and the reasoning for this time schedule.
7) An approximate estimate of the effect the proposal would have on the time for completion of the Contract.

The Department will review the conceptual proposal. The decision of the Department to accept or reject a value engineering proposal will be final and will not be subject to the provisions of Subsection 105.13. The Engineer will make written notification of the Department's decision to accept or reject each conceptual value engineering proposal submitted under the provisions of this section. The Department reserves the right not to consider any value engineering proposal.

111.03.02 Formal Submittal and Review of Value Engineering Proposal. When the Department accepts a conceptual proposal, as a minimum, submit the following information:

1) A detailed description of the existing work and the proposed changes for performing the work.
2) A complete set of Plans and construction details when necessary, showing proposed revisions to the original Contract.
3) A detailed cost estimate for performing the work under the existing Contract

and under the proposed change. Include pay items, pay units, quantities, and unit prices. Include in the unit prices all costs for labor, materials, supplies, equipment, tools, and all incidentals required for the complete incorporation of the option into the work.

4) A detailed cost estimate for costs other than those in the Contract such as future construction, design, right-of-way, utilities, maintenance, and operations costs, and the cost to prepare the value engineering proposal.
5) A prediction of any effects the proposed changes would have on Department costs other than construction, such as maintenance and operating costs and life cycle costs.
6) A statement of the effect the proposal would have on the time for completion of the Contract.

The Department will review the formal proposal and if acceptable will execute a supplemental agreement that incorporates the necessary Contract modifications. Unless and until the Department executes a supplemental agreement, perform all work according to the terms of the existing Contract. The Department reserves the right to include in the supplemental agreement any conditions it deems appropriate for consideration, approval, and implementation of the value engineering proposal.

The Department's approval of a value engineering proposal voids any restrictions that the Contractor had imposed on the use or disclosure of the information that the Contractor included in the value engineering proposal, and the Department then has the right to use, duplicate, and disclose, in whole or in part, any data necessary to implement any portion of the proposal on this project and all other Department projects.

The Department will not be liable for any delay in acting upon any submitted proposal. The Department will allow the withdrawal, in whole or in part, of any value engineering proposal that the Department has not accepted within the period specified in the proposal.

111.03.03 Contract Time. The Department will adjust the Contract completion time for any time savings realized by implementing a value engineering proposal. The Department will not provide any incentive pay for early completion days resulting from a time savings related to an approved value engineering proposal. The Department will grant additional contract time when specified in the supplemental agreement.

111.04 MEASUREMENT.

111.04.01 Revised Work. The Department will measure the quantities for all revised work specified in the supplemental agreement according to Section 109.

111.04.02 Net Savings. The Department will measure the net savings in cost by subtracting the estimated construction costs of the proposed and accepted option and all other costs associated with the option, such as design, right-of-way, utilities, the cost of preparing the value engineering proposal, and the Department's review costs from the estimated construction costs in original Contract for the option.

111.05 PAYMENT.

111.05.01 Revised Work. The Department will make payment directly for all completed and accepted revised work specified in the change order or supplemental agreement according to Subsection 109.04.

111.05.02 Net Savings. The Department will make payment for 50 percent of the net savings in cost.

The Department will consider payment as full compensation for all work required under this section.

SECTION 112 ¾ MAINTENANCE AND CONTROL OF TRAFFIC DURING CONSTRUCTION

112.01 DESCRIPTION. Maintain, control, and protect vehicular and pedestrian traffic adjacent to and within the construction area.

112.02 MATERIALS AND EQUIPMENT.

112.02.01 Channelization Devices.

A) Traffic Cones, Drums, Barricades, Tubular Markers, Vertical Panels, and Object Markers. Conform to the Standard Drawings and the MUTCD.
B) Temporary Concrete Barrier. Conform to Subsection 509.02.

112.02.02 Retroreflective Material. Conform to Section 830.

112.02.03 Lighting Devices. Conform to the MUTCD.

112.02.04 Signs.

A) Warning Signs. Conform to Section 830, the Standard Drawings and the MUTCD. Use wide angle prismatic sheeting (WAP).
B) Low Shoulder Signs. Conform to Section 830, the Standard Drawings and the MUTCD. Use wide angle prismatic sheeting (WAP).
C) Guide Signs. Conform to Section 830, the Standard Drawings and the MUTCD. Use Type III sheeting.
D) Portable Variable Message Signs. Conform to the requirements the Contract specifies.
E) Flashing Arrows. Conform to the Standard Drawings and the MUTCD. Mount on traffic-worthy carriages that meet all applicable safety standards. Use either diesel powered, electric, or solar powered.

112.02.05 Temporary Pavement Markings.

A) Delineators. Conform to Section 830, Type A or B.
B) Delineator Posts. Conform to Section 832.
C) Temporary Striping.

1) Paint Application Equipment. Conform to Subsection 713.02.
2) Paint. For paint applied on courses to be overlaid, use a material that either conforms to Federal Specification T-P-85, Federal Specification TT-P-115, and AASHTO M 248, or conform to Section 842.
3) Drop on Glass Beads. Conform to Section 839.
4) Tape. Conform to Section 831.

D) Temporary Raised Pavement Markers, Type IVA. Select from the Department's List of Approved Materials.

112.02.06 Asphalt Surfacing Materials. Conform to materials requirements in Division 400 for the mixture the Contract specifies.

112.02.07 Asphalt Base Materials. Conform to materials requirements in Divisions 300 and 400 for the bases the Contract specifies.

112.02.08 Water for Dust Control. Conform to Section 803.

112.02.09 Crash Cushions. Conform to the requirements the Contract specifies.

112.02.10 Temporary Traffic Signals. Conform to the MUTCD. Furnish signals with lenses having a diameter of 12 inches. Furnish controllers having timing intervals and cycle lengths that are changeable without special tools and the following:

A) Two Phase.

1) An adjustable cycle length from 40 seconds to 240 seconds in maximum 10 second increments.
2) Adjustable signal split intervals for two phases.
3) Adjustable yellow clearance intervals for two phases to include the range from 3 seconds to 5 seconds.
4) Adjustable all-red clearance intervals for two phases to include the range from 20 seconds to 60 seconds.
5) Capability of adjusting the above interval functions by changing keys or pins, or by keyboard entry of the desired timing.
6) Capability of adjusting the cycle length by changing a gear or by keyboard entry of the desired cycle length.

B) Multiple Phase.

1) Capability of handling vehicular and pedestrian traffic.
2) An adjustable cycle length from 0 to 255 seconds in one second increments.
3) An adjustable signal split interval for 8 phases in a standard dual-ring configuration.
4) An adjustable yellow clearance interval for all phases in the range of 3 to 5 seconds.
5) An adjustable all-red clearance interval in the range of 0 to 5 seconds.
6) Capability of implementing a minimum of three separate timing plans.
7) Capability of actuated operation.

112.02.11 Truck Mounted Attenuator (TMA). Conform to the requirements the Contract specifies.

A) Truck. Furnish a truck for mounting the TMA that conforms to the requirements the Contract specifies.
B) Anchors. Furnish an anchor that conforms to the requirements the Contract specifies.

112.03 CONSTRUCTION.

112.03.01 General Traffic Control. Maintain the portion of the project used by public traffic, and adequately accommodate through and local traffic. The Department will be responsible for normal routine maintenance according to Subsection 105.11.

Furnish, erect, and maintain all traffic control devices, including signs, signals, channelization devices, temporary pavement markings, pilot cars and other items necessary to maintain traffic according to the Standard Drawings, MUTCD, plans, TCP, and the ATSSA "Quality Standard for Work Zone Traffic Control Devices" manual throughout the duration of the project.

The Department will specify in the Contract either to close all or a portion of the section of highway under construction to through traffic, or to maintain traffic through the project. The Department will outline specific requirements to properly maintain and control traffic in a Traffic Control Plan (TCP). The TCP will include the traffic control scheme and phasing. The Department will consider a deviation from the TCP. Submit the proposed changes in the TCP to the Engineer in writing. If the Department approves the alternate TCP, the Engineer will remit approval to the Contractor, in writing.

Make provisions for the timely passage of an emergency vehicle through the work zone. When maintaining traffic over a section of highway or a bridge, provide facilities for the safe movement of traffic at all times.

Notify the Engineer before erecting traffic control devices, changing the location of devices in place, or beginning a traffic operation of any kind, except in case of an emergency. In the case of an emergency, the Engineer may direct immediate procurement of safety and warning devices as necessary to safeguard traffic. Notify the Engineer in writing a minimum of one week in advance, when it is necessary for the Department to do work such as detour signing outside the limits of the project.

Place all traffic control devices starting and proceeding in the direction of the flow of traffic. Remove traffic control devices starting and proceeding in the direction opposite to the flow of traffic.

Take responsibility for all damage caused by the failure of any traffic control device or person protecting it. Whenever evidence of damage is found before the job is called complete, the Engineer may order immediate removal and replacement of the damaged portion of the work.

Remove all traffic control devices when they are not needed for the project. Take ownership of the devices, unless the Contract specifies otherwise.

A) Approach Roads and Intersections. Furnish, install, and maintain traffic control devices required on approach roads and all intersecting roadways. Install these devices a minimum of 1,500 feet from the construction limits of the project. Ensure the condition of all traffic control devices conform to the ATSSA "Quality Standard for Work Zone Traffic Control Devices" manual throughout the duration of the project. Traffic control devices include channelization devices, signs, and detour signs, temporary pavement markings, and other items necessary to maintain and control traffic in the construction zone.

B) Lighting Devices. Ensure lighting devices are visible every night between sunset and sunrise.

C) Route Markers. Maintain Department owned route markers and signs that will remain within the limits of construction.

D) Pavement Openings. Barricade all pavement openings and other hazards. Provide them with warning signs that are visible at night.

E) Low Shoulder Signing. Provide these signs where the shoulders are low or where traffic diverts through channels other than the normal lanes. Provide signs for all surfacing, resurfacing, or widening projects that require maintenance of traffic adjacent to shoulder construction. When shoulder work is part of the Contract, remove the low shoulder signs after shoulder work is complete. Retain ownership of the signs unless the Contract specifies otherwise.

Provide signs for resurfacing projects without shoulder work, if a substantial portion of the shoulders remains 2 inches or more below the road surface after resurfacing. If shoulder work is not a part of the Contract, leave all low shoulder signs in place. The Department will take ownership of these signs.

The Engineer will designate the actual location of the signs. Conform to the following for sign sizes:

Type of Roadway	Size of Sign (inches)
All four-lane or more divided and five-lane	48 by 48
All other roadways	30 by 30

Install a black on orange construction sign, of the size noted above, with the message "LOW SHOULDER" and a supplemental panel underneath displaying "NEXT ____ MILES", according to the MUTCD. Ensure that the distance stated on the supplemental panel covers the length of the Project. The Engineer may require additional Low shoulder signs after major crossroads.

F) Pavement Edge Drop-Off Signing and Protection. Place warning signs in advance of the drop-off area and throughout the drop-off area. Protect areas where traffic is expected to cross a pavement drop-off, as specified in the Contract.

In areas, where traffic is not intended to cross a pavement drop-off, protect as the Contract specifies.

G) Signs. Completely cover all signs, either existing, permanent, or temporary, which do not properly apply to the current traffic phasing, and maintain the covering until the signs are applicable or are removed.

With the Engineer, review all signing before traffic uses any lane closures, crossovers, diversions, or detours. Do not begin work until the Engineer has approved all signing. Maintain all signs, including cleaning or renewing the surfaces as necessary to provide clear visibility at all times.

Place temporary signing in locations that do not obstruct the visibility of existing signs.

Unless the Engineer directs otherwise, post mount all signs intended to remain in place for more than 3 days.

H) Portable Flashing Arrows. Have available one portable flashing arrow in reserve. Place the reserve arrow in operation if one is damaged or if there is mechanical or electrical failure.

I) Temporary Traffic Signals. Construct temporary traffic signals according to the MUTCD, Section 4B and as the Contract specifies. Submit proposed layouts for temporary signal head placement in writing to the Engineer for written approval. Use a central controller using a hard wire or radio connection to coordinate the signal indications at all approaches of the intersection. Mount the signal indications according to one of the following:

1) One signal indication on each side of the highway on each approach;
2) Two signal indications suspended on a span wire over the highway on each approach; or
3) One signal indication mounted on a mast arm or span wire above the highway with a second signal indication mounted on the right side of each approach.

J) TMAs. Mount the attenuator on a truck, whose requirements are specified in the Contract. Prevent shifting during impact. Furnish installation details to the Engineer before installing the TMA on the project.

112.03.02 Long Term Lane Closure. A long term lane closure is defined as a lane closure that remains for more than 3 days and is not taken down at the end of each day's work.

112.03.03 Equipment and Traffic Control Devices Not In Use. When construction equipment and/or traffic control devices are not in use, place them outside the clear zone, beyond the ditch line, behind guardrail, or off existing right-of-way. The Engineer will approve these locations if they are within the existing right-of-way. The Engineer will designate specific areas within the right-of-way where personal vehicles may park. Move vehicles and construction equipment with the flow of traffic, not against the normal traffic flow. When entering and leaving the work zone, do not interfere with or cause hazard to traffic flow.

112.03.04 Temporary Facilities or Crossings. Provide and maintain temporary facilities, including approaches and crossings in a safe condition. Provide and maintain intersections with roads, streets, trails, and entrances to businesses, parking lots, residences, and farms.

Construct temporary approaches and bridges according to the Contract including all grading and necessary drainage.

Construct or reconstruct diversions (by-pass detours), detours, and median crossovers including associated earthwork, for the handling of traffic across new pavements as specified in the Standard drawings, in the Plans, in the TCP or elsewhere in the Contract. The Department will be responsible for snow removal on these facilities.

Obtain the Engineer's approval for temporary facilities constructed solely to accommodate construction operations. When approved, construct and maintain such temporary facilities, including furnishing and applying surfacing and dust control materials.

When temporary facilities are no longer needed, remove facilities and restore the area. Pave all temporary roadways intended for public traffic with asphaltic materials as the Contract specifies or as the Engineer directs.

112.03.05 Roadways Closed to Through Traffic. Obtain the Department's permission before closing a roadway or limiting public traffic on the roadway.

When a section of highway closes to through traffic, provide and maintain satisfactory temporary facilities for the maintenance of local traffic. Provide and maintain satisfactory crossings for all cross roads and cross streets kept open to traffic.

When the Department closes the road under construction to through traffic, the Department will relieve the Contractor of the responsibility for maintaining the road and marking suitable detours for through traffic.

112.03.06 Pavement Edge Drop-Offs. Conform to the requirements the Contract specifies.

112.03.07 Temporary Barrier Walls. Construct temporary barrier walls according to Subsection 509.03.

112.03.08 Temporary Crash Cushions. Construct temporary crash cushions as the Contract specifies.

112.03.09 Blasting. During blasting operations, halt traffic no more than the time the Contract specifies to allow the execution of the shot and for removal of rock fragments and debris. The Contract will also specify hours when blasting is not allowed. When using explosive charges, halt all traffic on either side of the impending explosion. Have suitable equipment at the site for removing blasted material, debris, and for cleaning the existing pavement and shoulder area. After all blasts, inspect the pavement for debris and damage that may be a hazard to traffic. Clear debris before allowing traffic to proceed on the affected section.

112.03.10 Removal of Permanent Pavement Markings. Remove all permanent markings and raised pavement markers that do not conform to the traffic operation in use according to Section 713.

In areas where the marking will conform to the final marking scheme or for other reasons need not be removed, ensure that markings are of a permanent type pavement marking material.

112.03.11 Temporary Pavement Markings.

A) Placement and Removal of Temporary Raised Pavement Markers. Place and remove temporary raised pavement markers when the Contract specifies. Install temporary pavement markers according to the manufacturer's recommendations. Replace missing or damaged temporary markers within 3 calendar days. After completion of the work, remove the markers from the job site, including the primer and adhesive. Take ownership of the temporary markers at the end of the project.

B) Placement and Removal of Temporary Striping. Place temporary striping on new construction, resurfacing, pavement restoration, pavement rehabilitation and other projects that have existing pavement markings as the Contract specifies.

Except on new construction or where markings do not exist, prepare and keep a written record of the existing pavement markings locations, and furnish a copy to the Engineer before removing or obliterating the markings.

Apply temporary striping when any course of a new pavement is to be driven over by the public, including patching, milling, leveling, and wedging courses, except when existing centerline markings are plainly visible and not obscured. Install the pavement marking material for centerlines and lane lines every day before sunset that day. The Department will defer installation of edgeline markings until all shoulder paving is complete, except on Interstate and Parkway roads or when the Contract specifies otherwise. When rain or other unavoidable occurrences prevent marking before sunset, mark the pavement during daylight hours as soon as conditions permit. Locate no passing zones as the Engineer directs.

1) Removable Striping. Use removable striping tape when different phases of construction will require the relocation of striping to different positions on the same pavement. Relocate lane lines, edgelines, and other pavement markings as the Standard Drawings and the Contract specify. Do not use removable material as a permanent marking unless the Engineer directs.
2) Non-removable striping material. Use either tape or paint where the striping is to be covered by subsequent paving courses and for temporary paved facilities which will be removed before completing the project. Apply paint according to Section 713.

Maintain all markings throughout the duration of the project. Replace missing or damaged stripes or tape within 3 days. Remove all markings placed in error or markings that do not conform to the traffic scheme in use.

112.03.12 Traffic Control Coordinator. When the Contract requires, designate an employee to be traffic control coordinator. Ensure that the traffic coordinator inspects the project traffic control scheme daily. Report all incidents within the work zone to the Engineer. Perform all other duties the Contract specifies. Furnish the name, and telephone number of the traffic control coordinator, where he can be reached at all times. Furnish this information to the Engineer.

112.03.13 Existing Signalized Intersections. Use traffic signals for the control of traffic through presently signalized intersections. Use flaggers to expedite the flow of traffic, if directed by the Engineer or as specified in the Contract.

Cover, turn, or take down all signal heads that are not in use. Clearly indicate the signals are not in operation. Install new signal conductors with sufficient slack in the cable to allow for a lateral movement of the signal indication of at least 15 feet in either direction from the specified location.

During construction, the Department will allow the traffic signal controller to operate in the pre-timed mode using the recall ability of the signal controller. The Department will provide assistance in adjusting signal controller timing, when requested. Submit a request for assistance in writing to the Engineer.

Cover and leave in place left turn signals when left turn lanes are used for through and left turning traffic. Shift through traffic signals to the left to a position that will provide visible signal indications for through and left turning traffic.

When the signals are relocated, locate them within or on the projected lane lines for each lane of traffic as directed by the Engineer. Submit proposed layouts for temporary signal head placement in writing to the Engineer for written approval.

After roadway work within the intersection is completed, adjust traffic signal indications back to their permanent locations as specified in the Contract. Remove excess lengths of signal conductors and permanently connect the signals.

112.03.14 Department Ordered Opening Before Completion. When any section of roadway is in acceptable condition and the Commissioner determines that the public convenience demands it, the Commissioner may allow the roadway to open to public traffic. Correct construction deficiencies found during interim project inspections and final inspection. After the opened section of roadway is inspected and accepted, the Department will take responsibility for further expenditures for that accepted section.

112.04 MEASUREMENT.

112.04.01 Maintain and Control Traffic. The Department will measure the quantity by the lump sum. The Department will not measure traffic control devices such as drums, traffic cones, barricades used for channelization purposes, delineators, object markers, lane closures not left in place more than 3 days and nights, temporary facilities constructed solely for construction traffic and vertical panels and will consider them incidental to this item of work. The Department will not measure the flaggers; traffic control coordinator; removal of pavement striping or removal of pavement markings, and will consider these items incidental to this item of work.

112.04.02 Signs. The Department will measure the quantity in square feet. The Department will measure each individual sign the first time it is installed and each additional time that it is installed and remains in place continuously for more than 3 days and nights. The Department will not measure sign maintenance or subsequent relocation of original signs and will consider them incidental to this item of work. The Department will measure signs for payment when they are required by the MUTCD, Standard Drawings, TCP, the Contract, or the Engineer. Additional signs will be considered incidental to this item of work. The Department will measure replacement units for payment, only when the Engineer determines replacement is required resulting from normal deterioration of the signs due to environmental conditions.

112.04.03 Low Shoulder Sign. The Department will measure the quantity of the low shoulder signs left in place in individual units. The Department will consider a low shoulder sign with a supplemental panel to be one unit. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.04 Tubular Markers. The Department will measure the quantity by each individual unit, including replacement unit. The Department will not measure installation or removal for payment and will consider them incidental to this item of work.

112.04.05 Barricades. The Department will measure the quantity by each individual unit not used for channelization purposes and not specified in the Standard Drawings. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.06 Flashing Arrow. The Department will measure the quantity by each individual unit. The Department will not measure the reserved flashing arrows for payment and will consider them incidental to this item of work. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.07 Portable Variable Message Sign. The Department will measure the quantity by each individual unit. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.08 Temporary Pavement Striping. The Department will measure the quantity in linear feet. The Department will measure the quantity for payment only once per course. The Department will not measure maintenance of markings or the removal of striping tape for payment and will consider them incidental to this item of work.

112.04.09 Temporary Pavement Marker Type IVA. The Department will measure the quantity by each individual unit, including replacement unit. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.10 Temporary Relocation of Signal Heads. The Department will measure the quantity of temporary relocation of existing signal heads by each individual unit. The Department will not measure temporary relocation of new signal heads for payment and will consider it incidental to the traffic signal bid items.

112.04.11 Temporary Traffic Signals-Two Phase. The Department will measure the quantity by each individual unit, not including signals that are to become permanent. The Department will not measure installation, maintenance, timing adjustment, electrical service, or removal for payment and will consider them incidental to this item of work.

112.04.12 Temporary Traffic Signals-Multi-Phase The Department will measure the quantity by each individual unit, not including signals that are to become permanent. The Department will not measure installation, maintenance, timing adjustment, electrical service, or removal for payment and will consider them incidental to this item of work.

112.04.13 Temporary Crash Cushions. The Department will measure the quantity according to the Contract. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.14 Truck Mounted Attenuator (TMA). When listed as a bid item, the Department will measure the quantity by each individual unit.

112.04.15 Pavement Striping Removal. When listed as a bid item, the Department will measure the quantity of Department authorized pavement striping and marking removal by the unit listed in the Contract. The Department will not measure the unauthorized removal of pavement striping or markings for payment. When not listed as a bid item, the Department will consider removing pavement striping and markings incidental to Maintain and Control Traffic. The Department will not measure any corrective work required due to the removal process for payment and will consider it incidental to this item of work.

112.04.16 Temporary Concrete Barrier. The Department will measure the quantity according to Subsection 509.04. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.17 Water for Dust Control. When listed as a bid item the Department will measure the quantity in gallons.

112.04.18 Lane Closures. The Department will measure the quantity of Long Term Lane Closures by each individual unit installed, and accepted. The Department will not measure maintenance or removal of each lane closure and will consider it incidental to this item of work. The Department will not measure traffic control devices such as cones, barrels, and barricades used for delineation in conjunction with the

Lane Closure and will consider them incidental to this item of work. The Department will measure signs, striping, barrier wall and other traffic control devices listed as bid items in the Contract separately for payment.

The Department will not measure lane closures other than Long Term Lane Closures for payment and will consider them incidental to Maintain and Control Traffic.

112.04.19 Diversions (By-Pass Detours). The Department will measure the quantity by lump sum completed, accepted, and then removed. The Department will not measure grade and drain work for payment and will consider it incidental to this item of work. The Department will measure base course and surface course items for payment according the applicable sections of Divisions 300 and 400. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.20 Temporary Median Crossovers. The Department will measure the quantity by lump sum completed, accepted, and then removed. The Department will not measure grade and drain work for payment and will consider it incidental to this item of work. The Department will measure base course and surface course items for payment according the applicable sections of Divisions 300 and 400. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.21 Temporary Approaches. The Department will measure the quantity under the appropriate sections for grade, drain, and surface. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.04.22 Temporary Bridges. When listed as a bid item, the Department will measure the quantity by each individual unit completed, accepted, and then removed. Otherwise, the Department will consider temporary bridges incidental to Diversions, Temporary Median Crossovers, or to grade and drain work for temporary approaches. The Department will not measure installation, maintenance, or removal for payment and will consider them incidental to this item of work.

112.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2650	Maintain and Control Traffic[1]	Lump Sum
2562	Signs	Square Foot
3230	Low Shoulder Sign	Each
3225	Tubular Markers	Each
2012, 2013, 2014	Barricades, Type	Each
2775	Flashing Arrow	Each
2671	Portable Variable Message Sign	Each
----	Removable Striping Tape, Size and Color	Linear Foot
----	Temporary Pavement Striping	Linear Foot
----	Permanent Pavement Striping	Linear Foot
6585-6588	Temporary Pavement Marker, Type IVA	Each
----	Temporary Relocation of Signal Heads	Each
----	Temporary Traffic Signal - Two Phase	Each
----	Temporary Traffic Signal - Multi-Phase	Each
----	Temporary Crash Cushions	See Contract
----	Pavement Striping Removal	See Contract
----	Temporary Concrete Barrier	See Subsection 509.05
2242	Water	M Gallon
----	Lane Closures	Each
2651	Diversions (By-Pass Detours)	Lump Sum

----	Crossovers	Lump Sum
----	Temporary Approaches	See Applicable Sections
----	Temporary Bridges	Each
----	Truck Mounted Attentuator	Each

[1] *The Department will make partial payments for Maintain and Control Traffic according to Subsection 109.05.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 113 ¾ QUALITY CONTROL / QUALITY ASSURANCE

113.01 GENERAL. Take responsibility for the quality of construction and materials incorporated into the work. Perform all quality control inspection, sampling, and testing. The Department will verify the acceptability of all construction and materials. The Department may use the verified results of the Contractor's inspection, sampling, and testing as a part of its acceptance procedures, provided the Contractor maintains a Department-approved Quality Control Plan (QCP).

113.02 COORDINATION MEETING. Meet with the Engineer either as part of the preconstruction conference, or as a separate meeting, before the start of construction, and discuss the QCP. During the meeting, a mutual agreement of the plan details will be developed, including the forms for recording the operations, control activities, testing, administration, and the interrelationship of the QCP. Minutes of the coordination meeting shall be prepared by the QCP Manager, signed by the Contractor and the Engineer, and filed separately as part of the QCP. Subsequent conferences may be called by the Contractor or the Engineer to reconfirm mutual agreement and address deficiencies in the QCP or procedures which may require corrective action by the Contractor. Nothing in this section shall be construed to override the preconstruction conference or the preconstruction conference minutes. Do not start work without an approved QCP.

113.03 QUALITY CONTROL (QC). Provide and maintain a quality control system that will assure all materials and products submitted to the Department for acceptance will conform to the Contract requirements whether manufactured or processed by the Contractor, or procured from producers, subcontractors, or vendors. Perform the inspections and tests required to substantiate product conformance to the Contract. Document all quality control inspections and tests, and provide a copy to the Engineer. Maintain adequate records of all inspections and tests. Include in the records the nature, number, and type of deficiencies found, the quantities rejected, and the nature of corrective action taken. Perform equipment calibrations and maintain qualified personnel as the Contract requires to ensure conformance to Contract requirements. Procedures will be subject to Department approval.

Develop, furnish, execute, and maintain a QCP including, but not limited to, inspecting, testing, and ensuring conformance to the Contract, in order to establish an effective level of quality control. Prosecuting the QCP shall include all on-site materials testing and monitoring of the producer's testing such as hot-mix asphalt plant testing, aggregate plant testing, and concrete plant testing. Include the following:

A) QCP Submittal. Submit the QCP to the Engineer before beginning work. After beginning work under the approved QCP, continuously prosecute the work in accordance with this QCP. Obtain approval from the Engineer before implementing any changes to the QCP.

B) Documentation. Maintain all records that provide factual evidence that quality control activities and test have been performed. Include in these records the work of Subcontractors and suppliers. Forms for these records shall be as approved by the Department.

C) Personnel. After approval of the QCP by the Engineer, maintain the QCP staff at approved plan levels at all times until the demobilization of the Contractor forces upon project completion.

The primary duty of the QCP personnel on the project is implementing the QCP. Provide a QCP organization consisting of a QCP Manager and sufficient number of qualified personnel to ensure Contract compliance.

113.04 QUALITY ASSURANCE (QA). The Department will be responsible for determining the acceptability of the material produced. The Quality Assurance Team

(QAT) will check the validity of the QCP through an appropriate review of documentation and random quality assurance testing.

The QAT will conduct random QA inspections for the duration of the Contract; inspect the full spectrum of on-going construction activities; review documentation; compare inspections and testing results with the QCP results; and prepare a written report of the results. Testing by the QAT will be performed at 25 percent of the rate specified in the Field Sampling Manual. Testing may be increased at the discretion of the Engineer. Testing will be performed at randomly selected locations without prior notification of the Contractor.

When the QAT testing results show work to be outside of specification requirements or not in agreement with the QCP results, the Department may shut down that portion of the work or the entire project until the cause of the failure or discrepancy is determined and procedures are corrected.

113.05 ACCEPTANCE. The Department will make final acceptance according to Subsection 105.12.

113.06 CLAIMS. The Department will handle claims according to Subsection 105.13.

113.07 DISPUTE RESOLUTIONS. As part of Quality Control/Quality Assurance (QC/QA) for pay items and materials, both the Department and the Contractor will perform inspections and tests. The Contractor will perform the acceptance tests, and the Department will perform verification tests of the Contractor's acceptance test results at a reduced frequency. The Department will base the pay or material acceptance on the Contractor's acceptance test results if the Contractor's results are within a specified tolerance of the Department's verification tests. For a particular pay item or material, the appropriate section or subsection will specify testing frequencies and tolerances.

A) Avoidance of Disputes. Make every effort to avoid disputes. Use partnering concepts to aid in preventing or resolving any dispute. Monitor as follows to ensure that all data are reliable, unbiased, and truly representative of the product quality:

1) Ensure personnel and laboratory facilities meet the specified certification requirements.
2) Ensure all samples are obtained according to KM 64-113, Sampling Materials by Random Number Sampling.
3) Ensure communication of test results between parties occurs within the specified time limits.
4) Discuss all questions regarding the specifications, KM's, or sampling and testing procedures during the preconstruction, pre-paving, or similar type of meeting to clarify any confusion.
5) Resolve disputes at the lowest appropriate level of authority.

B) Procedures. When the Contractor's acceptance test results and the Department's verification test results are not within the specified tolerances, and a dispute is therefore unavoidable, use the following procedures to resolve the dispute:

1) Project Level Dispute Resolution. Together with the Engineer, attempt to determine the reason for the discrepancy at the project level by having testing personnel review previous tests and other possible factors.
2) Materials Central Laboratory (MCL) Level. If the dispute is not resolved at the project level, the MCL will conduct further investigation. In this investigation, the MCL will include the following, when applicable:

    1) Review of all available test data, including the following:

- current disputed results;
- prior acceptance testing data;
- Contractor's process control documentation; and
- Department's Independent Assurance (IA) sampling and testing results.

2) Check of Contractor and Department calculations. Compare conflicting data by statistical means (e. g., f-test and t-test).
3) Evaluation of Contractor and Department sampling procedures.
4) Inspection of the equipment setup, calibration, and maintenance.
5) Retesting of all retained samples available.
6) Monitoring of the specified testing procedures.
7) Evaluation of the history of performance of the Contractor and the Department personnel and testing equipment involved. Review of test results from previous projects. Review of the results of previous dispute resolutions.
8) Additional comparative or split-sample testing.

At the conclusion of the investigation, MCL personnel will make a recommendation of resolution to the Contractor and the Engineer.

C) Third Party Resolution Level. If the dispute is not resolved at the MCL level, the Department and Contractor will use a mutually agreed upon laboratory. The results from the mutually agreeable laboratory will be final and binding.

The Department will prepare a written report describing the dispute, all subsequent actions, and the final resolution for inclusion in the project documentation.

113.08 MEASUREMENT.

113.08.01 QC. When listed as a bid item, the Department will measure the quantity by the lump sum. The Department will not measure the QCP, any actions and personnel required to carry out the QCP, any testing, any testing equipment, or any other work necessary to perform the specified QC/QA procedures for payment and will consider them incidental to this item of work.

113.08.02 Dispute Resolution. If the independent laboratory testing and investigation indicates that the Department's tests are correct, pay the cost of the investigation. If the independent laboratory testing and investigation indicates that the Department's tests are not correct, the Department will pay the cost of the investigation.

When the dispute is resolved at any level, and the Department's verification tests are correct, the Department will base the Contractor's pay on the Department's verification test results rather than on the Contractor's acceptance test results. When the Department's verification tests are not correct, the Department will base the Contractor's pay on the Contractor's acceptance test results as the appropriate section or subsection specifies.

113.09 PAYMENT.

Code	Pay Item	Pay Unit
----	QC	Lump Sum

SECTION 114 ¾ PARTNERING

114.01 DESCRIPTION. The partnering concept is intended to encourage the foundation of a cohesive partnership between the Department and the Contractor. The partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. Common objectives will be structured to meet each project's needs, but will include such basic criteria as effective and efficient contract performance, safety, and contract completion on schedule and within budget.

114.02 FORMAL PARTNERING. Within sixty (60) days of the Notice of Award, the Contractor's on-site project manager and the Department's on-site representative will attend a partnership development conference. Upon completion of this initial conference, the Contractor's key on-site staff, subcontractors, the Department's personnel, and other individuals as needed and agreed upon at the partnership development conference will attend a team building workshop.

Schedule on-site project partnering meetings at regular intervals to discuss and resolve issues regarding the project throughout the duration of the contract. Contractor, subcontractor, and Department personnel will attend these meetings, and if need be, any appropriate persons needed to discuss specific issues. Prior to the meeting, the Contractor's on-site project manager and the Department's on-site representative will jointly develop an agenda. Minutes of each meeting will be recorded and kept in the project's file. It will be the responsibility of the Contractor and the Department to equally act in hosting these meetings and recording these events.

114.02.01 Partnership Development Conference. To implement this partnering initiative, the Contractor's on-site project manager and the Department's on-site representative will meet to discuss and share equally in the development of a team building workshop.

114.02.02 Team Building Workshop. The Team Building Workshop shall foster and encourage the partnering concept so that the Contractor and the Department are a cohesive unit willing to work together to achieve a combined goal. An independent facilitator who is mutually satisfactory to the Contractor and the Department will facilitate the workshop, or the workshop may be co-facilitated by the Contractor and Department.

The workshop will include a team building exercise, development of a chain of command to resolve issues at their lowest possible level, development of an escalation ladder for issue resolution, and an opportunity to discuss any outstanding issues in regard to the project that is of major concern.

Hold additional team building workshops periodically throughout the duration of the contract to provide opportunity to discuss project status, issues important to the project, accomplishments, or other events.

114.03 INFORMAL PARTNERING. When Formal Partnering is not designated in the Contract, informal partnering will be encouraged. Schedule on-site project partnering meetings at regular intervals to discuss and resolve issues regarding the project throughout the duration of the Contract. Contractor, subcontractor, and Department personnel should attend these meetings, and if need be, any appropriate persons needed to discuss specific issues. Record the minutes of each meeting and keep them in the project's file. It will be the responsibility of the Contractor and the Department to act equally in hosting these meetings and recording these events.

114.04 MEASUREMENT. All costs associated with developing and maintaining a Formal Partnership will be agreed to by both parties and will be shared equally.

Informal Partnering will not be measured for payment and the Department will consider all costs associated with the informal partnership incidental to the project.

114.05 PAYMENT. For Formal Partnering the Department will pay 50 percent of the costs to develop and maintain this partnership. The Department will make the

payment under a Supplemental Agreement. The Department will consider payment as full compensation for all work required under this section.

DIVISION 200

EARTHWORK

SECTION 201 ¾ STAKING

201.01 DESCRIPTION. When listed as a bid item, furnish all personnel, equipment, stakes, and hubs necessary to construct the roadway and appurtenant structures to the grade and alignment specified in the Contract. When no bid item is listed, the Department will perform staking.

201.02 MATERIALS AND EQUIPMENT. Reserved.

201.03 CONSTRUCTION.

201.03.01 Contractor Staking. Perform all necessary surveying under the general supervision of a Professional Engineer or licensed Land Surveyor. Correct any errors or inaccuracies resulting from construction operations.

The Engineer will perform the following:

1) The Engineer will establish the right-of-way limits by setting hubs and tacks at locations shown on the Plans.
2) Provide adequate referencing of control points to allow prompt re-establishment of the survey centerline, ramps, crossroads, and frontage roads during construction.
3) Set permanent or temporary bench marks as required.
4) Take any cross sections necessary to verify the accuracy of the original ground information.
5) Take "check sections" to verify construction to grade and alignment specified in the Contract.

201.03.02 Department Staking. The Engineer will set all stakes necessary for the construction of the roadway and appurtenant structures to the proper grade and alignment in accordance with the Contract.

201.04 MEASUREMENT.

201.04.01 Contractor Staking. When listed as a bid item, the Department will measure staking as lump sum. The Department will not measure surveying required to correct any errors or inaccuracies resulting from construction operations for payment.

201.04.02 Department Staking. The Department will not measure quantities for payment. When any stakes are disturbed due to unwarranted negligence of the Contractor, the Department will measure the work required to reset the stakes and deduct the cost from monies due the Contractor.

201.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2726	Staking	Lump Sum

The Department will consider payment as full compensation for all work required under this section.

SECTION 202 ¾ CLEARING AND GRUBBING

202.01 DESCRIPTION. Clear, grub, remove, and dispose of all vegetation, buildings and foundations not removed by others, and debris within designated limits inside the right-of-way and easement areas. Do not remove objects designated to remain or to be removed according to other provisions of the Contract. Also, protect from injury or defacement all vegetation and objects designated to remain.

202.02 MATERIALS AND EQUIPMENT. Reserved.

202.03 CONSTRUCTION. Notify the Natural Resources and Environmental Protection Cabinet, Division of Air Quality in writing before demolishing any building located within the right-of-way.

When unexpected asbestos, underground storage tanks, or other hazardous materials are encountered, cease operations and notify the Engineer.

The Engineer will designate all trees, shrubs, plants, and other items to remain. For cut or scarred surfaces of trees or shrubs selected for retention, perform tree trimming surgery as the Engineer directs.

202.03.01 Clearing and Grubbing. Clear the entire area of the right-of-way of all weeds, brush, briers, bushes, trees, stumps, and other protruding obstructions, except within areas the Engineer designates to remain undisturbed. In addition, grub all bushes, trees, roots, and stumps within the line of slope stakes, except undisturbed stumps, roots, and nonperishable solid objects which will be a minimum of 3 feet below subgrade or slope of embankments. Remove stumps and nonperishable solid objects under embankments more than 6 inches above the groundline or low water level.

Perform all clearing and grubbing operations according to Sections 212 and 213.

Completely dispose of any materials resulting from clearing and grubbing by approved methods at approved locations. The Department will allow burning of perishable material when performed according to Subsection 107.01.04. When disposal is by burying, provide a cover of at least one foot, and grade and shape as the Engineer directs.

Do not place any material resulting from clearing and grubbing off the right-of-way without written permission from the property owner. Furnish a copy of the owner's written permission to the Engineer.

Do not place material resulting from clearing and grubbing on the right-of-way within view of any public road, without written approval. The Engineer may require the material placed within view of a public road to be covered with soil that will support vegetation. Seed and protect the soil as required by the Contract.

Take ownership of all merchantable timber in the clearing area that has not been removed from the right-of-way before starting construction.

Remove low hanging, unsound, and unsightly branches on trees and shrubs designated to remain, as directed. Trim branches of trees extending over the roadbed surface to provide a minimum clear height of 20 feet.

When specified in the Plans or required by the Engineer, construct brush barriers according to Subsection 212.03.01.

202.03.02 Removing Trees or Stumps. Remove and dispose of the tree, stump, and roots.

202.04 MEASUREMENT. The Department will not measure both Clearing and Grubbing and Removing Trees or Stumps on the same area. The Department will not measure necessary Clearing and Grubbing or Removal of Trees or Stumps when not listed as a separate bid item.

202.04.01 Clearing and Grubbing. The Department will specify in the Plans the

quantities of the entire area of right-of-way, including all easements, in acres, but will measure by lump sum.

202.04.02 Removing Trees or Stumps. The Department will measure the quantity by each individual unit when included as a bid item. The Department will include only trees or stumps one foot in diameter or larger, measured 2 feet above the ground or across the top of existing stumps less than 2 feet in height. The Department will not measure the removal of smaller trees or stumps for payment and will consider their removal incidental to this item of work.

202.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2545	Clearing and Grubbing	Lump Sum
2460	Removing Trees or Stumps	Each

For changes in payment for Clearing and Grubbing, due to approved plan changes, the Department will compute these changes at a unit price rate based on the lump sum price bid divided by the total estimated area of Clearing and Grubbing specified in the original Plans.

The Department will consider payment as full compensation for all work required under this section.

SECTION 203 ¾ REMOVAL OF STRUCTURES AND OBSTRUCTIONS

203.01 DESCRIPTION. Remove, wholly or in part, and dispose of fences, structures, pavements, abandoned pipelines, and any other obstructions outside the typical section that are not designated or allowed to remain. Also, salvage designated materials, and backfill the resulting trenches, holes, and pits.

203.02 MATERIALS AND EQUIPMENT. Reserved.

203.03 CONSTRUCTION. Raze, remove, and dispose of all structures, fences, and other obstructions, any portions of which are on the right-of-way. Remove all designated salvable material without damage and store within the project limits, as the Engineer directs.

Fill basements or cavities left by structure removal to the level of the surrounding ground and, when within embankment limits, fill according to Section 206.

Clean all septic tanks within the permanent right-of-way according to Subsection 107.01, and fill them with granular material or remove them as the Engineer directs.

Except for removing structures or pipe, backfilling cavities left by structure removal, and removing or filling septic tanks, perform all work described in this section only in areas that are outside the typical section. Perform removal work within the typical section according to Sections 202, 204, 206, 206, and 603.

203.03.01 Existing Bridges. Remove all existing structures, including foundations, conforming to the definition of a bridge.

Take ownership of existing structures, and dispose of them according to Subsection 202.03. Immediately remove any material entering the stream due to removing the existing structure from the waterway.

When specified in the Contract, remove the members of the superstructure, without damage, in transportable sections, and carefully store them on the right-of-way at an accessible location above high water. Before removing the superstructure, matchmark the parts with paint.

Remove all portions of abutments exposed in the finished work, all of the piers above the stream bed, and any parts of either abutments or piers that interfere with planned construction of the new work.

Excavate existing embankment approaches to structures removed, and lying outside the limits of the new construction, to a minimum slope of 2:1.

203.03.02 Masonry Structures other than Bridges. Completely remove existing structures, including their foundations, as specified in the Contract. Dispose of the resulting material, and fill any resulting holes or pits. Excavate all slopes that may result, such as stream sides, that lie outside the limits of new construction to a minimum slope of 2:1.

203.03.03 Partial Removal of Structures. When the Contract specifies using any parts of an existing structure as permanent parts of a new structure, remove only such portions specified in the Contract. Repair all damage caused to the portion remaining.

In removing manholes, catch basins, and inlets, connecting live sewers, rebuild and properly reconnect them. Maintain satisfactory by-pass service during such construction operations.

203.03.04 Removing Pipe. Conform to Section 701.

203.03.05 Removing Guardrail. Conform to Section 719.

203.03.06 Pavement, Sidewalks, Curbs, and Similar Items. Completely remove all cement concrete pavement or base, sidewalks, curbs, gutters, paved ditches,

asphalt pavements, granular bases, and similar items.

When the Contract specifies leaving portions of the existing structures in place, remove the old structures to an existing joint, or cut them to a true line with a vertical face. Remove structures to provide for proper grades and connections in the new work.

203.04 MEASUREMENT. The Department will not measure for payment items removed from within the typical section, except for structures, guardrail, and septic tanks.

The Department will measure removing pipe according to Section 701 and removing guardrail according to Section 719.

When only removing a portion of an existing structure, the Department will measure the various items separately.

203.04.01 Removing Existing Structure. Unless a bid item is included in the proposal, the Department will not measure structures other than bridges for payment. When a bid item is included in the proposal, the Department will measure the quantity as the number of structures of the type specified actually removed.

The Department will not measure excavation for removing and shaping slopes for payment and will consider it incidental to this item of work.

203.04.02 Removing Concrete Masonry. The Department will not measure removing concrete masonry but will make final payment at the Contract unit price for the design quantity specified in the plans. When it can be shown actual quantities vary from the design quantity by more than 10 percent, the Department will measure the actual quantity in cubic yards.

203.04.03 Removing (Wet or Dry) Stone Masonry. The Department will measure the quantity in cubic yards.

203.04.04 Septic Tank Treatment. The Department will measure the quantity by each individual unit treatment, cleaning and filling, or removing.

203.04.05 Other Items as Listed in the Contract. The Department will measure these quantities in the units established in the Contract.

203.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2731	Removing Existing Structure	Lump Sum
2403	Removing Concrete Masonry	Cubic Yard
2402	Removing (Wet or Dry) Stone Masonry	Cubic Yard
2404	Septic Tank Treatment	Each
----	Other items as listed in the Contract	As established in the Contact

The Department will consider payment as full compensation for all work required under this section.

SECTION 204 ¾ ROADWAY AND DRAINAGE EXCAVATION

204.01 DESCRIPTION. Remove and dispose of all materials taken from within limits of the work contracted, meaning the calculated material lying between the original groundline and the excavation limits established or approved by the Engineer as shown on the final cross sections.

204.02 MATERIALS AND EQUIPMENT. Reserved.

204.03 CONSTRUCTION. Excavate for cuts and roadbeds, embankment foundation benches, embankment subgrades, under-cutting subgrades in cut sections, shoulders, slopes, ditches, waterways, intersections, approaches, balance excavation, inlet and outlet ditches, and channel changes, all as specified in the Contract.

Remove and dispose of miscellaneous structures from within the limits of the typical section according to Section 203.

Protect and preserve all existing culverts, pipelines, conduits, subdrains, or parts there of that may continue to be used without any change. Repair or replace any culvert, pipeline, conduit, or subdrain damaged from operations or negligence during the life of the Contract.

During construction, ensure that the roadway is well drained at all times.

204.03.01 Classification. Without regard to the materials encountered, all roadway and drainage excavation is unclassified and the Department will consider it Roadway Excavation. Any reference to rock, earth, or any other material on the Plans or cross sections, whether in numbers, words, letters, or lines, is solely for the Department's information and is not an indication of classified excavation or the quantity of either rock, earth, or any other material involved. The bidder must draw his own conclusions as to the conditions to be encountered. The Department does not give any guarantee as to the accuracy of the data and will not consider any claim for additional compensation when the materials encountered are not in accord with the classification shown.

204.03.02 Slopes. Do not remove or loosen any material outside of the required slopes. Leave all rock cut slopes with a uniform surface, and remove all loose or overhanging rock. Do not gouge or dig holes in back slopes or in embankment slopes.

The Engineer may vary the slopes in cuts during construction, depending upon the material encountered in excavation to secure sufficient material for the formation of embankment and shoulders, to prevent landslides, to improve sight distance, or for any other reasons widening or variations are deemed to be to the best advantage of the work. When making a cut on any section of the roadway in any material that may slide, excavate to the slope lines as specified in the Plans or as the Engineer directs. Do not form vertical slopes during the process of excavation of such cuts, except in stage construction when leaving material in cuts for future shoulder construction.

204.03.03 Serrated Slopes. When the Plans designate locations to construct serrated slopes and when soft rock or shale are encountered at the designated locations, excavate these materials by bulldozing or ripping, without drilling and blasting, in a manner that serrates the cut faces to a stepped pattern.

Round all soil overburden and talus material above the serrated slopes to blend with the original ground. Construct the top half step tread of a serrated slope just below the surface where the soil overburden contacts the soft rock or shale and continue the steps to the bottom of the cut slope, unless hard rock or hard shale formations are encountered which indicate that the lower limits of the rock disintegration zone have been reached. When hard rock or hard shale formations which must be blasted are encountered within the cuts being serrated, end the steps of the serrated slope by blending them into the hard rock or shale. Construct the step risers in the serrated slopes to the height specified in the Plans with the approximate width of the step treads being the height of the risers multiplied by the designated cut

slope ratio. Make the midpoints of treads of the steps coincide approximately with the staked slope lines. Blend the first and last steps of a serrated slope into the staked slope line. Construct the first and last steps of a serrated slope to a width of approximately one-half the normal step tread width. Construct the step treads approximately level rather than parallel to the ditch line grades. When the steps extend throughout the length of a cut, round the ends of the steps and blend them into the adjacent ground.

The Engineer will not require thorough final dressing of the serrated slopes. However, remove large pieces of rock or other dangerous material which might fall from the steps and create safety hazards or maintenance problems. Seed and protect the serrated slopes according to the Plans and Section 212.

204.03.04 Presplitting. Presplit all rock and shale formations within the roadway excavation limits that are conducive to excavation by drilling and blasting at the designated slope lines. Perform the presplitting before blasting and excavating the interior portion of the specified cross section at any location.

Perform presplitting to obtain smooth faces in the rock and shale formations. Develop presplit faces that are free of all loose or crushed pieces and do not deviate more than 6 inches inwardly from the designated slope lines or offset drill holes, nor more than one foot outwardly, except where seams, broken formations, or earth pockets may cause unavoidable irregularities. The Engineer may stop the presplitting when he determines that materials have become unsuitable for presplitting. The Department will measure for payment material lying outside the typical section that must be removed due to seams, broken formations, or earth pockets, including any earth overburden removed with this material.

204.03.05 Landslides. When directed, remove and dispose of all landslides. The Department will measure landslides in place, by the cross section method, before removal of material.

204.03.06 Ditches. Ditches include channel changes, inlet and outlet ditches, side ditches, surface ditches, wing ditches, and such other required ditches.

Construct side ditches draining from cuts toward embankments to avoid erosion damage to embankments by directing water coming from cuts away from fills.

Do not place material removed in cleaning or opening of ditches on cut slopes. Remove all debris from ditches before requesting formal acceptance.

204.03.07 Use of Excavated Materials. Use all suitable excavated material in the formation of embankments, subgrade, or shoulders; as backfill for structures; or for other purposes specified in the Contract.

Remove and dispose of all sod and soft or spongy material. Do not use such materials in the construction of the grade, except as provided in Subsection 206.03.

Take ownership and dispose of any coal excavated from the project within the typical section, or as directed. Do not use coal in embankments except in small quantities and then only when thoroughly mixed with other materials.

Do not waste excavated material without permission. When approved, waste excess material adjacent to the embankment or incorporate it in the normal embankment construction within the right-of-way limits. Do not perform irregular or partial widening of embankments. Do not waste excess material between cut slopes and the right-of-way limits, except for the purpose of filling depressions, gullies, and other cavities; and, when so wasted, shape the material to conform with the adjacent ground.

A) Channel Lining, Class IV. Prepare broken stone from formations consisting primarily of limestone, or if specified in the Plans, durable sandstone or durable shale (SDI equal to or greater than 95 according to KM 64-513) that are encountered in roadway excavation or obtained from borrow excavation.

Provide stone so that at least 80 percent, by volume, of individual stones range in size from 1/4 to 1 1/2 cubic foot. Use smaller sized stones for filling

voids in the upper surface and dressing to the proper slope. The Engineer will accept the size and gradation of the material based on visual inspection. The Engineer may allow material not conforming to the specified size and gradation when it is acceptable for the intended use.

Shape ditches and channels as specified to receive the channel lining. Unless solid rock is encountered, begin the channel lining in a trench 2 feet below the natural ground or 2 feet below the channel flowline when the flowline is not lined. Where encountering solid rock, end the slope protection at the solid rock line.

Construct Channel Lining, Class IV to the minimum thickness specified in the Plans. Place the stone in a manner to produce a surface not varying more than 6 inches from a true plane.

B) Spreading Stockpiled Topsoil. If the Contract includes Spreading Stockpiled Topsoil as a bid item, or when otherwise specified in the Contract, salvage topsoil from within the limits of the slope lines and store it in stockpiles. Before removing the topsoil, clear the areas of all weeds, brush, stumps, stones, and other debris. Remove the topsoil only from areas and to depths specified in the Plans or as the Engineer directs. Avoid mixing subsoil or other unsuitable material with the topsoil. Place sod removed from embankment areas according to Subsection 206.03 in the topsoil stockpiles. Place the stockpiles along the project at approved locations. Neatly dress each stockpile, when completed. Perform temporary or permanent seeding on the stockpiles.

When Spreading Stockpiled Topsoil is a bid item, the Department will allow the topsoil to be spread directly on the areas designated to receive the topsoil, without stockpiling, provided that seeding and protection operations are ready to begin.

204.03.08 Disposal of Wasted Material. Obtain approved sites for wasting material off the right-of-way. When placing material within public view, avoid an unsightly appearance. Place all waste to avoid the obstruction of drainage. Seed and protect the wasted material and all temporary haul roads.

Submit for approval drawings of proposed waste areas, showing the configuration of the original ground and the anticipated configuration of the area upon completion of the waste operation; any preparatory work such as benching; provisions for surface and subsurface drainage of the area after wasting is completed; and any other necessary information.

Furnish cross sections and hydraulic computations for waste area sites situated in the flood plain of any stream. For these computations, define this flood plain as that area required to pass the 100 year flood. Indicate with the computations the effect that the waste site will have on both the design flood and the 100 year flood.

Furnish copies of a written agreement with the property owner, approval of the owner(s) of utilities of any nature existing within the proposed waste area, and approvals from all applicable regulatory agencies including the Natural Resources and Environmental Protection Cabinet, US Forest Service, US Coast Guard, Planning and Zoning Commissions.

When encountering unanticipated waste material resulting from landslides or approved slope changes, waste it within the right-of-way at sites designated by the Engineer, or dispose of it off the right-of-way at sites acquired or approved by the Department.

204.03.09 Roadbed. In addition to the limits of the roadbed as defined in Subsection 101.03, extend the roadway excavation to the ditch lines in cuts. Conduct roadway excavation operations to make available a sufficient quantity of selected materials to complete the roadbed.

Remove all rock between ditch lines to a depth below the required grade as specified in the Plans or as staked. Leave the final surface of the rock to provide complete drainage. Construct the refill over this surface with select material having no stone or spalls larger than 4 inches. Place all refill in lifts not exceeding one foot in

depth, loose measurement, and compact according to Subsection 206.03. The Engineer will make no allowance for excavation and refill material to a greater depth below the required grade than as specified in the Plans or as staked.

When encountering unsuitable material at subgrade elevation, remove the material to the depths specified in the Plans or as directed. Dry and use material that is unstable due to excessive moisture but otherwise suitable. Waste the material or use the material as refill or in embankments as the Engineer directs. Refill with suitable material.

A) Rock Roadbed. Conduct roadway blasting and excavation operations to make available a sufficient quantity of rock to complete the roadbed.

Prepare rock from formations consisting primarily of limestone, durable sandstone, or durable shale (SDI equal to or greater than 95 according to KM 64-513) that are encountered in the roadway excavation or that are obtained from borrow excavation. Do not use rock fragments exceeding one foot.

Excavate all cuts to a minimum of 2 feet below the final subgrade elevation and refill with the broken stone in 2 lifts, each approximately one foot thick. Leave the excavated surface to provide complete drainage. If excavation is deeper than 2 feet below subgrade, construct the top 2 feet in 2 lifts, each approximately one foot thick and the remaining in lifts not exceeding one foot using rock conforming to this section.

Construct rock roadbed from ditch line to ditch line in cuts, from shoulder to shoulder in fills, and throughout the entire project including mainline, ramps, and approach roads.

Perform all handling, stockpiling, or hauling manipulations, including overhauling, necessary to provide for the proper distribution of the broken stone.

In all instances, dump, spread, and smooth each one-foot lift, and compact each lift by vibratory rollers weighing at least 5 tons to minimize voids and bridging.

B) Chemically Stabilized Roadbed. Construct according to Section 208.

204.03.10 Construction Tolerances. Make every reasonable effort to construct the project uniformly within the following allowable tolerances and in a manner that will minimize the field measurements and computations required to determine if the work is satisfactory.

The Department will allow the following tolerances before making payment for any decreases in the quantity or before requiring the rework of the constructed item:

1) Do not deviate the distance from centerline to the ditch lines in cuts and the shoulder lines in fills more than one foot from the dimension specified in the Plans. Ensure that the total width of the roadbed is not deficient by more than one foot at any location.
2) Ensure that the sloped surfaces between the ditch lines or shoulder lines and the original ground are not inside the specified slope limits more than 6 inches or outside the specified slope limits more than one foot, both measured horizontally.
3) Excavate cut benches to within one foot above or below the bench elevation specified in the Plans or established by the Engineer.
4) The Department will not make payment for any earthwork performed outside the limits specified by the neat lines of the cross sections on the Plans or by the Engineer. Do not remove or place any extra material more than one foot outside of these limits without permission, except as provided in Subsections 204.03.04 and 206.03.
5) On grade and drain projects, complete the subgrade to within ± 0.1 foot of the designated grade at the time of final acceptance, except that when rock roadbed is specified, complete it to within ± 0.2 foot. Uniformly finish the subgrade across the typical section. When chemically modified roadbed is specified, ensure that the target subgrade elevation is 0.1 foot below plan

elevation.

6) Ensure that all subgrades being prepared for base or surface courses, except traffic bound courses, are within ± 1/2 inch of the specified crown section. Uniformly construct these subgrades so the subsequent base and surface courses can be constructed within their specified tolerances.

204.04 MEASUREMENT.

204.04.01 Payment for Design Quantities. Unless the Contract provides for payment based on field measurements of material excavated, the Department will not measure Roadway Excavation but will make final payment at the Contract unit price for the design quantity specified within the neat lines of the cross sections on the Plans, increased or decreased by authorized adjustments.

The Department will determine the final quantity of Embankment-in-Place as the design quantity, increased or decreased by authorized adjustments.

The Department will not consider any quantity specified in the Plans for contingencies to be part of the design quantity. The Department will include only the portion of the contingency quantity actually used, as determined by the Engineer's measurements.

204.04.02 Authorized Adjustments. The Department will only make adjustments to the design quantities of Roadway Excavation or Embankment-in-Place authorized by the Engineer for the following reasons:

1) Changes in the quantity of work due to benching, undercutting, changing slopes or grades, removing slides, and any other required procedures.
2) Decreases in the quantity because of acceptable work not conforming to established tolerances.
3) Corrections of major errors on the Plans. Major errors are defined as individual mistakes of 5 percent or more in the quantity of earthwork between 2 consecutive cross sections, for omissions, duplications, or other errors in the survey or on the Plans, but not for minor discrepancies in the plotting of cross sections, in the planimetering of cross sections, and in the resulting computation of the volume of earthwork. When errors in the lines or grades specified in the Plans cause major errors in earthwork quantities, the Department will correct the earthwork quantities throughout the entire span of the errors. The Department will not adjust earthwork quantities when errors in the lines or grades do not cause major errors in the earthwork quantities.
4) Arithmetical mistakes.

204.04.03 Serrated Slopes. The Department will not measure this work for payment and will consider it incidental to either Roadway Excavation or Embankment-in-Place, as applicable.

The Department will not measure for payment any breakage of the soft rock or other material outside the staked slope line.

204.04.04 Presplitting. The Department will not measure this work for payment and will consider it incidental to either Roadway Excavation or Embankment-in-Place, as applicable. However, if the Engineer directs in writing slope changes, then the Department will pay for the second presplitting operation as Extra Work.

The Department will not measure for payment any extra material excavated because of the drill holes being offset outside the designated slope lines.

The Department will not measure for payment any material including any earth overburden necessary to be removed due to the Contractor's faulty blasting practices.

204.04.05 Roadbed. The Department will measure the quantity in cubic yards as Roadway Excavation, Borrow Excavation, or Embankment-in-Place, as applicable. The Department will not measure any special work necessary to perform rock roadbed

construction for payment and will consider it incidental to the earthwork bid item.

The Department will measure the removal of unsuitable material as Roadway Excavation. The Department will measure any additional material necessary for refill as Roadway Excavation or Borrow Excavation, at its origin. When the material is removed from the roadbed and wasted without the Engineer's permission, the Department will not measure for payment any required refill material.

The Department will not measure for payment rock refill exceeding 2 feet.

204.04.06 Landslides. The Department will measure the quantity in cubic yards as Roadway Excavation or Embankment-in-Place, as applicable. The Department will not measure for payment the removal and disposal of any landslides resulting from faulty operations.

Whenever a landslide extends beyond the right-of-way in wooded areas, and the Engineer directs trees and stumps be removed, the Department will measure for payment clearing of the additional area under Clearing and Grubbing or Removing Trees and Stumps, as provided in the original Contract.

204.04.07 Ditches. When Ditching or Ditching and Shouldering are listed as a bid item, the Department will measure this according to Subsection 209.04. When Ditching or Ditching and Shouldering are not listed as a bid item, the Department will not measure this work for payment and will consider it incidental to either Roadway Excavation or Embankment-in-Place, as applicable.

204.04.08 Roadway Excavation. The Department will measure the quantity in cubic yards based on design quantities with authorized adjustments. The Department will base the measurement of the roadway excavation quantities at locations where serrated slopes are constructed on the areas and volumes defined by the staked slope lines. The Department will not measure for payment any excavated material used for any purpose other than that the Plans specify or the Engineer approves.

When the Contract provides for payment based on field measurements of the material excavated, the Department will measure the roadway excavation in its original position by taking cross sections before the work starts and after it is entirely completed. The Department will compute the volume by the average end-area method. The Department will include in its measurement all unavoidable slides and authorized excavation of any material below the subgrade.

Where material has been excavated beyond the slope line and wasted, without being authorized, the Department will measure the wasted material and deduct it from the excavated quantities.

In determining the amount of waste material to be deducted as the result of excavation beyond the slope lines set by the Engineer, and wasted, the Department will consider only that portion outside of one foot additional width of embankment on each side, widened uniformly. The Department will measure the volume and deduct it from the excavation quantities without regard to swell or shrinkage factors.

204.04.09 Waste. The Department will consider acquiring a waste site, disposing of waste, and providing erosion control for the site and haul roads incidental to either Roadway Excavation or Embankment-in-Place, as applicable. If the waste material is due to authorized adjustments, the Department will make provisions for a waste site and measure erosion control work for payment according to Subsection 212.04.

204.04.10 Overhaul. The Department will measure the quantity only for excavation added due to authorized adjustments. For all other excavation quantities, the Department will not measure this work for payment and will consider it incidental to either Roadway Excavation or Embankment-in-Place, as applicable.

The Department will measure the quantity by the Cubic Yard Station. A Cubic Yard Station is the product of the volume of material hauled in cubic yards and the distance that the material is hauled, in excess of the 2,000 feet of free haul, in stations of 100 feet, as determined by the Mass Diagram Method or by analytical methods.

204.04.11 Channel Lining, Class IV. The Department will measure the quantity in cubic yards as Roadway Excavation, Borrow Excavation, or Embankment-in-Place, as applicable.

204.04.12 Water. The Department will not measure for payment water used to provide sufficient moisture for compaction of the roadbed in cut sections.

204.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2200	Roadway Excavation	Cubic Yard
----	Overhaul	CubicYard Station
2488	Channel Lining, Class IV	Cubic Yard
----	Spreading Stockpiled Topsoil	Cubic Yard

The Department will pay for Overhaul at 2 percent of the Contract unit price for Roadway Excavation or Embankment-In-Place for each Cubic Yard Station.

The Department will consider payment as full compensation for all work required under this section.

SECTION 205 ¾ BORROW EXCAVATION

205.01 DESCRIPTION. Remove and place all acceptable material taken from pits off the right-of-way and isolated from the finished cross section of the roadway and use in refill, backfill, shoulder, and embankment construction, or other portions of the work.

205.02 MATERIALS AND EQUIPMENT. Reserved.

205.03 CONSTRUCTION. Use soil borrow materials with a minimum dry weight equal to or greater than the usable soils within the project limits as determined according to KM 64-511, and compact the materials to an in-place density according to Subsection 206.03.03. Furnish and place special borrow materials according to the Contract.

Submit for approval drawings of proposed borrow areas, showing the configuration of the original ground and the anticipated configuration of the area upon completion of the borrow operations; provisions for drainage of the borrow area after completing borrow operations; and any other necessary information. The Department will not allow excavation of borrow pits adjacent to the toe of any embankment.

Furnish copies of a written agreement with the property owner, approval of the owner(s) of utilities of any nature existing within the proposed borrow area, and approvals from all applicable regulatory agencies including the Natural Resources and Environmental Protection Cabinet, US Forest Service, US Coast Guard, Planning and Zoning Commissions.

Seed and protect all areas of noncommercial borrow pits, including haul roads, except areas of solid rock and areas to be under water in a pond, according to Section 212. The variety of seed may be altered upon written request from the property owner.

Cut all borrow pits to uniform lines to allow accurate measurement.

205.03.01 Historic Preservation. Protect cultural resources on borrow sites pursuant to the Historical Preservation Act of 1966.

Before using any site for borrow material, certify to the Department that a professional archaeologist has performed an archaeological reconnaissance survey on the site and has completed a report confirming the presence, on the site, of any known cultural resources affected that are eligible for, or on, the national register of historic places. Additionally, certify to the Department that the state historic preservation officer has reviewed the professional archaeologist's survey report of the site, and concurs with his findings. If any applicable cultural resources are present, mitigate according to Section 106 of the Historical Preservation act of 1966 and certify that the adverse effects upon the resources have been palliated before using the site for borrow material.

For borrow sites designated by the Department, the Department is responsible for assurances relative to cultural resources pursuant to the Historical Preservation Act of 1966.

If, during the course of borrow operations, any archaeological materials are encountered, cease work in the immediate area and notify the Engineer. Provide a professional archaeologist to conduct the necessary investigations to determine the significance of the cultural resources. Avoid the area of discovery until the investigation is complete. Should the resources prove to be significant (eligible for the National Register of Historic Places), fulfill the requirements of Section 106 of the Historic Preservation Act before proceeding.

When operations on the project are suspended due to the unanticipated finding of archaeological materials in a previously approved borrow site, the Department will adjust the Contract time according to Subsection 108.07.

205.04 MEASUREMENT. The Department will measure the quantity in cubic yards. The Department will measure the volume of material moved in the original position by the cross section, average end-area method. The Department will take the original

cross sections after sod or other material in the pit area that will not be used in the roadway has been stripped or removed, and before beginning of actual borrow operations. The Department will not measure any material excavated before taking the original cross sections. The Department will deduct as waste material in excess of that required to construct the embankment within the limits of the typical cross section or within the limits approved by the Engineer from the volume of the borrow pits, except as specified in Subsection 204.03.10. The Department will take final cross sections of borrow pits as soon as practical after removal of the material has been completed, and the Department will, in no case, delay the final cross sectioning of borrow pits until the pit has eroded or filled. When it becomes necessary to reopen a borrow pit, the Department will take another cross section of the surface before any material is removed.

The Department will not include in the measured quantity material taken from widened roadbed, widened cuts, ditches, enlarged ditches, or from other sources within the right-of-way.

The Department will consider excavated material used to complete embankments, refill, or backfill and obtained from beyond the limits of the roadway section, but within the right-of-way limits specified in the Plans, as balance excavation and will pay for it as Roadway Excavation.

The Department will consider obtaining the sites for borrow pits and the professional archaeologist or any other work required for its historic preservation and conducting erosion control incidental to Borrow Excavation.

The Department will not measure overhaul of borrow material.

When the earthwork bid item in the Contract is Embankment-in-Place, then the Department will not measure necessary borrow excavation.

205.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2210	Borrow Excavation	Cubic Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 206 ¾ EMBANKMENT

206.01 DESCRIPTION. Form embankments with materials from sources specified in the Plans or from other approved sources.

206.02 MATERIALS AND EQUIPMENT. Use water conforming to Section 803.

206.03 CONSTRUCTION.

206.03.01 Embankment Foundations. Remove sod from all embankment areas to a depth of approximately 3 inches. The Engineer will not require the removal of sod when constructing embankments over marshy areas.

Remove unsuitable material, including frozen material, encountered in embankment areas before placing any embankment material thereon.

When the height of the embankment, at subgrade elevation, is to be greater than 3 feet above existing concrete pavement, either break the pavement until no fragments have a dimension greater than 3 feet or remove the pavement. When the height of the embankment, at subgrade elevation, is to be 3 feet or less above existing concrete pavement, remove the pavement.

When placing embankment above existing asphalt pavement, break up to destroy all cleavage planes or remove as the Engineer directs.

Cut benches with horizontal and vertical faces into the original ground of embankment foundations as required. When practical, benches should be into rock. Compact the horizontal face. Provide subsurface drainage as specified in the Plans or as the Engineer directs.

206.03.02 Embankment. Excavate special ditches and channel changes before constructing adjacent embankment areas. Complete all embankment for any roadway, including ramps, frontage roads within the tolerances specified in Subsection 204.03.10.

Use only acceptable materials from sources permitted in the Contract. Do not place frozen material, stumps, logs, roots, sod, or other perishable materials in any embankment. Do not place any stone or masonry fragment greater than 4 inches in any dimension within one foot of the finished subgrade elevation, unless rock roadbed is specified as provided in Subsection 204.03.10.

The Department may allow concrete rubble, without protruding reinforcement, to be placed in embankment provided that no fragment is larger than one foot in any dimension-or is placed within 2 feet of the subgrade.

When crossing marshy or otherwise unstable areas, the Department may allow the first lift to exceed one-foot loose depth. Use rock or granular material in the first lift, when available, and construct by placing material behind the leading edge of the layer and blading into place to avoid unnecessary disturbance to the original ground.

Drain, clean out, and fill ponds lying within the staked construction limits.

Construct the upper one foot of the embankment with selected material placed in lifts not exceeding one foot loose thickness and compacted according to Subsection 206.03.03.

When rock roadbed is specified, construct the upper 2 feet of the embankment according to Subsection 204.03.09 B).

A) Embankments of Earth, Friable Sandstone, Weathered Rock, Waste Crushed Aggregate, Bank Gravel, Creek Gravel, or Similar Materials. Construct in lifts not exceeding one foot in thickness, loose depth, to the full width of the cross section, and compact the material. Shape the upper surface of the embankment to provide complete drainage of surface water at all times. Do not form ruts.

B) Embankments Principally of Unweathered Limestone, Durable Shale (SDI equal to or greater than 95 according to KM 64-513), or Durable Sandstone.

Construct in lifts not exceeding 3 feet. Ensure that the maximum dimensions of boulders or large rocks placed in the embankment do not exceed 3 feet vertically and 4.5 feet horizontally. Place rocks having any dimension greater than 2 feet at least 2 feet below subgrade elevation. Do not dump rock into final position. Distribute the rock to minimize voids, pockets, and bridging. The Engineer will not require rolling in the construction of rock embankment. Do not construct the rock embankment to an elevation higher than one foot below subgrade elevation.

C) Embankment of Rock/Shale/Soil Combination. Construct in lifts not exceeding one foot in thickness; however, when the thickness of the rock exceeds one foot, the Department may allow the thickness of the embankment lifts to increase, as necessary due to the nature of the material, up to 3 feet. Do not dump the mixture into final position. Distribute the mixture in a manner that minimizes voids, pockets, and bridging.

D) Embankments Principally of Non-Durable Shale (SDI less than 95 according to KM 64-513). Remove or break down rock fragments or limestone slabs having thickness greater than 4 inches or having any dimension greater than 1 1/2 feet before incorporating them into the lift. Construct in loose lifts not exceeding 8 inches in thickness. Apply water to accelerate slaking. Uniformly incorporate the water throughout the lift using a multiple gang disk with a minimum disk diameter of 2 feet. Compact with 30-ton static tamping foot rollers in conjunction with vibratory tamping foot rollers that produce a minimum compactive effort of 27 tons.

206.03.03 Compaction. Compact the embankment foundations and embankment to a density of at least 95 percent of maximum density as determined according to KM 64-511. The Engineer will check density according to KM 64-412.

During compaction, maintain the moisture content of embankment or subgrade material within ± 2 percent of the optimum moisture content as determined according to KM 64-511.

Compact each lift as required before depositing material for the next lift. Provide equipment that will satisfy the density requirements at all times. Run the hauling equipment, as much as possible, along the full width of the cross section.

206.03.04 Embankment Adjacent to Structures. Construct according to Subsection 603.03.04 for backfill.

206.03.05 Embankment-in-Place. When the Contract designates original material as unsuitable for the embankment foundation, the Department will designate areas of Special Excavation and/or treatment and will give instructions about the removal and disposal of unsuitable foundation material in the Plans.

When a bid item of special excavation has not been included in the Contract and the original ground is specified in the Plans as suitable to serve as the embankment foundation but the Engineer subsequently determines the material is unsuitable to remain in its original position, excavate and dispose of the unsuitable foundation material as directed. Incorporate the excavated material into embankments when manipulations such as spreading thin layers or drying the material make it acceptable for use as embankment-in-place. When excavated material cannot be used in embankments, waste the material.

206.04 MEASUREMENT. The Department will measure excavation of benches as Roadway Excavation or Embankment-in-Place, as applicable.

The Department will measure the removal of unsuitable materials from embankment areas as Roadway Excavation or Special Excavation.

The Department will consider removing sod 3 inches or less in depth; removing and/or scarifying of existing pavements in embankment areas; and the addition of water to aid compaction incidental to the earthwork bid items.

The Department will measure the quantity of unanticipated waste resulting from landslides or authorized slope changes in place before excavation. The Department

will include the quantity of unanticipated waste under Embankment-in-Place. The Department will measure a second presplitting for payment according to Subsection 204.04.04.

206.04.01 Embankment-in-Place. The Department will measure the quantity in cubic yards as the design quantity shown within the neat lines of the cross sections on the Plans, increased or decreased by authorized adjustments according to Subsection 204.04.02.

Regardless of whether the excavated material is used as Embankment-in-Place or is wasted, the Department will measure and pay for the volume of the unsuitable foundation material that is excavated as Embankment-in-Place. When the Engineer directs that the excavated material be wasted, then the Department will measure the material used to replace the wasted material as the same as the excavated volume, and will pay for the material as Embankment-in-Place. When the excavated material is used in embankment, the Department will make no separate payment for the material necessary to replace the excavated material.

For embankment material obtained outside the right-of-way limits, conform to Section 205.

The Department will not measure excavation included in the original Plans that is wasted for payment and will consider it incidental to Embankment-in-Place.

The Department will not measure overhaul of material for payment and will consider it incidental to Embankment-in-Place.

When payment is made for Embankment-in-Place, the Department will make payment for all embankment constructed on the project, including roadway embankment, refill in cuts, embankment placed in embankment benches, and the volume of trench above the pipe for bedding. The Department will not measure materials from authorized Roadway and Drainage Excavation for payment and will consider them incidental to the construction of Embankment-in-Place. The Department will include under authorized Roadway and Drainage Excavation, mainline excavation, embankment benches, special ditches, channel changes, tail ditches, surface ditches, interceptor ditches, entrances, and undercuts in rock cuts. The Department will not measure borrow excavation used to construct the embankment for payment and will consider it incidental to the construction of Embankment-in-Place.

206.04.02 Special Excavation. The Department will measure the quantity in cubic yards as the design quantity shown within the neat lines of the cross sections on the Plans, increased or decreased by authorized adjustments as specified in Subsections 204.04.01 and 204.04.02.

The Department will not measure overhaul of material and will consider it incidental to Special Excavation.

206.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2230	Embankment-in-Place	Cubic Yard
2204	Special Excavation	Cubic Yard
2200	Roadway Excavation	See Section 204.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 207 ¾ SUBGRADE

207.01 DESCRIPTION. Grade, shape, and compact the subgrade to the required density.

207.02 MATERIALS AND EQUIPMENT. Use water conforming to Section 803.

207.03 CONSTRUCTION. Prepare a smooth subgrade without indentations to the full width of the widest course of the pavement system plus one foot additional width beyond each edge.

Shape the subgrade to conform to the lines, grades, and cross sections specified in the Contract or as directed. Remove all high areas of the roadbed and fill all low areas with approved material and compact.

Compact the subgrade to a uniform density throughout according to the density and moisture control requirements of Section 206.03.03. Should the subgrade subsequently lose its density due to exposure to severe weather conditions, after having been previously compacted to the required density during the construction of the grade, recompact it to the required density.

Excavate and backfill areas of yielding or unstable material with approved material as the Engineer directs.

When excess dust is present on the subgrade, either wet the material or completely remove and replace it with suitable material before any aggregate is placed thereon, at no additional expense to the Department.

Prepare all subgrades before the base course or pavement construction to allow the required testing and checking of the subgrade before placing any aggregate. Furnish templates and labor required for checking the subgrade.

207.03.01 Reshaping and Compacting. Scarify the existing road surface to a depth not exceeding 6 inches, and uniformly distribute the material so loosened over the surface of the road. Compact the subgrade according to Section 206.

207.03.02 Construction Tolerances. On grade and drain projects, complete the subgrade to the tolerance specified in Subsection 204.03.10.

When reshaping and compacting is not a bid item, the Engineer may allow minor adjustments in plan grades as he deems necessary.

Before placing base or surface courses on rock subgrade constructed with a 0.2 foot tolerance, level it to meet the specified 1/2 inch tolerance for base or surface course preparation with materials from the pavement quantities.

207.03.03 Protection and Maintenance. Complete all ditches and drains in order to drain the roadbed. Protect the subgrade. Repair all damage, and restore the subgrade to the required template.

When hauling materials over the completed subgrade, use equipment with pneumatic tires. Do not operate equipment of such weight as to cause rutting on the subgrade.

Do not allow the compaction equipment to cross any bridge deck within the limits of the project without permission of the Engineer.

Do not store or stockpile materials on a completed subgrade.

207.04 MEASUREMENT. The Department will not measure preparation of the subgrade when the construction of the grade is a part of the Contract.

The Department will not measure the repair of yielding or unstable areas for payment when construction of the base course or pavement is included in the same contract as construction of the grade. When the base and grade are in separate contracts, the Department will measure the removal and disposal of such material as Roadway Excavation and measure the backfill material as either Roadway Excavation or Borrow Excavation, as applicable. When the earthwork bid item is Embankment-in-Place, the Department will measure removal and replacement of yielding or unstable

material in cut areas as Special Excavation.

The Department will not measure protection and repair of the subgrade for payment and will consider it incidental to the earthwork bid items.

The Department will not measure water used for maintaining moisture for subgrade compaction and water used for conditioning the subgrade immediately in advance of base or pavement construction and will consider it incidental to the earthwork bid items.

207.04.01 Reshaping and Compacting. When included as a bid item, the Department will measure the quantity horizontally along the centerline of the roadway in linear feet, exclusive of ramps, road approaches, cross roads, and frontage roads. When the project is a multiple-lane, divided highway, the Department will measure the quantity along the centerline of each roadway. When moisture and density control requirements, as provided in Subsection 206.03.03, have been waived, the Department will measure only the portion, or portions, of the project on which the work is actually done.

Where it is necessary to excavate to a depth of more than 6 inches in reshaping the existing road surface or where it is necessary to pick up the material so loosened and move it longitudinally, the Department will measure the entire work as roadway excavation.

207.04.02 Roadway Excavation. The Department will measure the quantity according to Subsection 204.04.

207.04.03 Borrow Excavation. The Department will measure the quantity according to Subsection 205.04.

207.04.04 Embankment-in-Place. The Department will measure the quantity according to Subsection 206.04.

207.04.05 Dense Grade Aggregate and Crushed Stone Base. The Department will measure quantities used to level rock subgrade constructed from a 02 foot tolerance to a 1/2 inch tolerance as pavement quantities according to Subsection 302.04.

207.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2241	Reshaping and Compacting	Linear Foot
2200	Roadway Excavation	See Subsection 204.05
2210	Borrow Excavation	See Subsection 205.05
2230	Embankment-in-Place	See Subsection 206.05
2204	Special Excavation	See Subsection 206.05
0001, 0002	DGA	See Subsection 302.05
0003	Crushed Stone Base	See Subsection 302.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 208 ¾ CHEMICALLY STABILIZED ROADBED

208.01 DESCRIPTION. Construct roadbed stabilization by uniformly mixing the specified chemical stabilizer, cement or lime, with the roadbed material, and moistening and compacting the resulting mixture.

208.02 MATERIALS AND EQUIPMENT.

208.02.01 Cement. Select any type conforming to Section 801 except Type IV. Use the same type cement throughout the work.

208.02.02 Lime. Select from the Department's List of Approved of Materials for Lime (Hydrated and Quicklime).

208.02.03 Asphalt Curing Seal. Conform to Section 806. Use RS-1, AE-60, SS-1, SS-1h, CRS-1, CSS-1, CSS-1h, or Primer L.

208.02.04 Water. Conform to Subsection 803.

208.02.05 Sand. Use natural, crushed, or conglomerate conforming to Section 804.

208.03 CONSTRUCTION.

208.03.01 Temperature and Weather Limitations. Only apply stabilizer when the ambient air temperature is at least 40 °F in the shade and rising. Do not mix stabilizer with frozen soils or with soil containing frost.

208.03.02 Preparation of Existing Roadway. Before proceeding with other construction operations, grade and shape the roadway to the grades, lines, and cross-section required for the completed roadway. Remove any organic material, such as roots, and any rocks larger than 4 inches from the material to be stabilized. Ensure that the elevation of the subgrade before stabilization is according to Subsection 204.03.10. When using lime, scarify to the depth required for the stabilization before application. Carefully control the depth of stabilization so the surface of the roadbed below the scarified material remains undisturbed and conforms to the established cross section.

208.03.03 Application of Chemical. Apply the quantity of stabilizer and mix to the depth the Contract specifies or as the Engineer directs. The Department reserves the right to increase or decrease the quantity of stabilizer used and depth of treatment as deemed necessary by the Engineer.

The Department will not accept any stabilizer that has been exposed to the open air for a period of 4 hours or more for payment. Replace any quantity lost due to rain or wind.

Only allow traffic and equipment required for spreading, watering, or mixing on the spread stabilizer.

Prepare, transport, and distribute stabilizer on the roadbed, and mix it with the soil in a manner that will not cause injury, damage, discomfort, or inconvenience to individuals or property. Do not apply stabilizer when wind conditions, as determined by the Engineer, are such that blowing stabilizer becomes hazardous to traffic, workmen, adjacent property, or results in adverse impact upon the public. Do not apply dry chemicals pneumatically.

A) Cement. Spread the specified quantity of cement required for the full depth of treatment uniformly over the surface in one application.

Only apply cement to an area of such size that all operations, dry mixing through cutting final grade, are completed within 6 hours. Perform all operations in a continuous manner and complete all operations during

daylight hours.

B) Lime. Only apply lime to an area of such size that all primary mixing operations are completed within the same day. Perform all primary mixing operations during daylight hours. Spread the lime by any of the following methods:

1) Slurry made with hydrated lime. Mix with water in agitating equipment and apply on the scarified area through distributing equipment. Use a distributor equipped to provide continuous agitation to ensure a uniform mixture from the mixing site until applied to the roadbed.
2) Slurry made by slaking quicklime at or near the project site. Gain approval of all equipment and procedures before beginning work.
3) Dry hydrated or quicklime when specified or when approved in writing by the Engineer. Use only when saturated soil conditions exist and the slurry method would worsen the situation. Uniformly spread the lime without excessive loss. The Engineer will not require scarifying of the roadbed before placing dry hydrated or quicklime.

208.03.04 Mixing.

A) Cement.

1) Dry Mixing. Immediately after distributing, mix the cement with the soil for the full depth of treatment. Take care to avoid mixing cement below the specified depth. Continue mixing until the cement has been sufficiently blended with the soil to prevent forming cement balls when applying water.
2) Moist Mixing. Immediately after the soil and cement have been dry mixed, uniformly apply and incorporate water into the mixture. Apply the water uniformly using pressure-distributing equipment. The Department will allow application of water during dry mixing when introduced through the mixing machine.

   Immediately after mixing, the Engineer will determine the moisture content of the soil cement mixture. When directed by the Engineer, uniformly apply additional water. Avoid concentration near the surface when incorporating water into the soil and cement mixture. After adding the last increment of water, continue mixing until 100 percent of the soil passes a one inch sieve and at least 80 percent of the soil passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves.

   After completing the water application and mixing, ensure that the moisture content of the mixture is not below the specified optimum moisture or more than 2 percent above the specified optimum moisture, and is less than the quantity that causes the roadbed to become unstable during compaction and finishing. Do not allow any mixture of soil and cement that has not been compacted and finished to remain undisturbed for more than 30 minutes. When the soil-cement mixture is wetted by rain to the extent that the moisture content exceeds the tolerance specified herein, reconstruct the entire section.

B) Lime. During the period after the application of lime until completion of preliminary curing, add water to maintain the moisture content of the material at or above its specified optimum at all times. Because water is needed to sustain chemical reactions occurring after applying the lime, a continual application of water during mixing may be necessary even when the material is at optimum moisture when mixing begins.

1) Primary Mixing. Immediately after spreading the specified quantity, thoroughly mix the lime into the soil for the full depth of treatment. Complete the primary mixing operation within 4 hours after applying lime.

At this time, the result shall be a homogeneous, friable mixture of soil and lime, free from clods or lumps exceeding 2 inches in size.

After primary mixing, shape the lime treated layer to the approximate cross section and lightly compact to minimize evaporation loss. Crown the surface to provide surface drainage.

2) Preliminary Curing (mellowing). Following primary mixing, allow 48 hours for the roadbed to cure (mellow). The Department will allow remixing after 24 hours if the gradation requirement is obtained. The characteristics of the soil, temperature, and rainfall may influence the mellowing period necessary. During the mellowing period, keep the surface of the material moist to prevent drying and cracking.
3) Final Mixing and Pulverizing. Within 72 hours after the preliminary curing, completely mix and pulverize the roadbed to the full depth of stabilization. Continue final mixing until 100 percent of the soil, exclusive of rock particles, pass the one inch sieve and at least 50 percent pass a No. 4 sieve.

208.03.05 Compaction and Surface Finish. Compact the mixture uniformly for its full depth, to at least 95 percent of the maximum density determined according to KM 64-511. The Engineer will determine the density. Compact continuously until completing the final compacted surface.

After curing of the roadbed is completed, correct any stabilized roadbed that does not conform to the surface tolerances of Subsection 204.03.10 by leveling approved by the Engineer. Only remove material to level in small, isolated spots. Discard any material removed from the cured roadbed.

208.03.06 Curing and Protection. After finishing the roadbed, protect it against drying by applying an asphalt curing seal.

Apply the curing seal as soon as possible, but no later than 24 hours after completion of finishing operations. Keep the finished roadbed moist, by continuous sprinkling if necessary, until applying the curing seal. Only apply the asphalt material to a roadbed surface that is dense, free from loose extraneous material, and that contains sufficient moisture to prevent penetration of the asphalt material.

Provide a curing seal consisting of the asphalt material specified and uniformly apply the curing seal at the rate of approximately 2.0 pounds per square yard. The Engineer will determine the actual rate and application temperature of asphalt material. Apply the curing seal in sufficient quantity to provide a continuous membrane over the roadbed. To avoid excessive runoff, apply the seal in 2 or more applications when directed or allowed, making each application as soon as possible after the previous application.

Do not allow any traffic or equipment on the finished surface until 7 days above 40 ºF curing is completed or the roadbed cores meet the strength requirements of the Contract. The Department will only require cores when the Contractor requests a shortened curing time. When a shortened curing time is requested, furnish cores to the treated depth of the roadbed at 500 feet intervals for each lane. The Department will test the cores using an unconfined compression test.

If any damage occurs before curing is complete, immediately reseal the damaged area.

If the asphalt material is tacky or sticky, apply a sand blotter material at a rate of approximately 5 pounds per square yard, when the Engineer directs, to avoid damage to the seal or to avoid tracking material onto other facilities.

After the curing period, protect any finished portion of the roadbed that equipment travels on from being marred or damaged.

Repair any damage caused by freezing.

Make every reasonable effort to completely cover the stabilized roadbed with the specified pavement courses before suspending work for the winter months. If the stabilized roadbed is not completely covered by the specified pavement courses, determine and perform any further work necessary to protect and maintain the uncompleted work during the winter months. Perform any work necessary to

acceptably repair or restore the uncompleted work before the beginning of spring paving operations. The Department may require cores to be taken to verify that the stabilized roadbed was not unreasonably damaged from unprotected winter cycles. Perform all work necessary to protect, maintain, or repair the stabilized roadbed subject to the Engineer's approval.

208.03.07 Maintenance. Maintain the entire roadway within the limits of the Contract, for the duration of the Contract. Keep the roadway continuously intact by immediately repairing any defects that may occur either before or after completing the stabilized roadbed, at no expense to the Department. When making repairs, completely restore the uniformity of the surface and durability of the repaired portion.

208.04 MEASUREMENT. The Department will not measure extra materials, methods, or work for payment when used to protect, maintain, or repair uncompleted work.

208.04.01 Cement. The Department will measure the quantity in tons. The Department will not measure cement for payment when exposed to the open air for a period of 4 hours; lost due to rain or wind; or used for corrective or reconstructive work.

208.04.02 Lime. The Department will measure the quantity in tons. The Department will not measure lime for payment when exposed to the open air for a period of 4 hours; lost due to rain or wind; or used for corrective or reconstructive work.

When quicklime is furnished for slurry application, the Department will measure the quantity in tons at 1.25 times the actual quantity.

208.04.03 Cement Stabilized Roadbed. The Department will measure the quantity in square yards. The Department will not measure corrective or reconstructed work for payment. The Department will not measure hot-mixed asphalt for payment when used for corrective leveling. The Department will not measure water for payment and will consider it incidental to this item of work.

208.04.04 Lime Stabilized Roadbed. The Department will measure the quantity in square yards. The Department will not measure corrective or reconstructed work for payment. The Department will not measure hot-mixed asphalt for payment when used for corrective leveling. The Department will not measure water for payment and will consider it incidental to this item of work.

208.04.05 Asphalt Curing Seal. The Department will measure the quantity in tons. The Department will not measure corrective work for payment.

208.04.06 Concrete Sand for Blotter. The Department will measure the quantity in tons.

208.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2542	Cement	Ton
0014	Lime	Ton
0008	Cement Stabilized Roadbed[1]	Square Yard
0013	Lime Stabilized Roadbed[1]	Square Yard
0358	Asphalt Curing Seal	Ton
2702	Sand for Blotter	Ton

[1] *When the Engineer increases the depth of treatment, the Department will increase the quantity for that portion of the work as follows:*

4 inches additional, multiply by 1.33
8 inches additional, multiply by 1.50

The Department will consider payment as full compensation for all work required under this section.

SECTION 209 ¾ DITCHING AND SHOULDERING

209.01 DESCRIPTION. For ditching, perform all work necessary to provide complete drainage of all side ditches, including those on road approaches within the limits of the right-of-way, and dispose of materials removed. Additionally, repair eroded areas on embankment slopes.

For shoulders, reshape existing or construct full depth earth shoulders, stabilized shoulders, or paved shoulders, and foundations for stabilized or paved shoulders, according to the Contract.

209.02 MATERIALS AND EQUIPMENT. Construct shoulders, or foundations for stabilized or paved shoulders, using materials conforming to Section 206 or 302 as specified in the Contract. When rock roadbed construction is specified, conform to Subsection 204.03.09 A) for shoulders.

209.03 CONSTRUCTION REQUIREMENTS.

209.03.01 Ditching. Remove all vegetation, including bushes and trees less than one foot in diameter, and all debris from within the limits of ditching and shouldering operations. Dispose of the materials removed by clearing in a manner approved by the Engineer. Shape the ditches to the approximate dimensions of the typical section specified in the Contract or as the Engineer directs. When the width of an existing roadbed exceeds that in the typical section, the Engineer will not require reduction of that width. In the absence of a specified typical section, use a section typical of the existing roadway. When no specific typical section is called for, use a minimum vertical depth of side ditches of one to 2 feet below the finished shoulder elevation. Do not excavate below the elevation of the solid rock. Where the roadway width allows, shape all ditches to have a slope no steeper than 3:1 from the edge of the shoulder to the bottom of the ditch. Do not perform work beyond the ditch lines except where the back slopes are disturbed by the ditching operations. Shape the disturbed areas of the back slopes to conform to the adjoining areas. Where machine operations are limited by obstructions, provide all handwork necessary to provide satisfactory drainage.

Use or dispose of the material removed from the ditches as approved by the Engineer. Submit written permission from the property owner to the Engineer before wasting material outside the right-of-way on private property.

Reshape the ends of metal entrance pipe that may be deformed to original form. Remove deposits of soil and other debris from all existing entrance pipe.

When proper drainage of an entrance pipe cannot be accomplished, the Engineer will consider cleaning complete when all soil and debris have been removed to an elevation at or below the grade of the finished ditch.

When entrance pipe has so deteriorated as to become unsuitable for further service, as determined by the Engineer, remove and replace according to Section 701 with a pipe of similar size, material, and strength.

A) Protection. Grade existing floater material on traffic-bound surfaces to the center or to the opposite side of the road before beginning ditching operations to prevent mixing floater material with material removed from the ditches, unless otherwise directed by the Engineer. Do not allow excess material to drift across the surfaced roadbed. Do not loosen or damage any portion of an existing surfaced area. Preserve delineators, mailboxes, mileposts, and similar installations. When their removal is necessary for the proper execution of the work, remove and replace them.

Do not disturb private and public entrances except when it is necessary to remove an existing entrance pipe. Repair or replace any entrance pipe damaged during the work.

When ditching and shouldering or ditching is included in a surfacing or resurfacing contract, complete ditching operations and as much of the

shoulder operations as is practical before beginning surfacing operations.

Preserve mailboxes as specified in Subsection 107.12.02.

B) Cleaning Cross Drainage Structures. When the proposal includes either the bid item of ditching and shouldering or ditching, clean all cross drainage structures, except box culverts and structures defined as bridges of all sediment, drift, and other debris.

209.03.02 Shouldering. On projects constructed as grade and drain only, or as grade and drain and traffic bound surface, construct the shoulders to the same requirements as specified for the subgrade. When shoulder material is of earth, compact a portion of the adjacent shoulder with each course of granular base. Before compaction of each course of granular base, place shoulder material against the base course to a minimum width of 18 inches and in sufficient quantity so that, after compaction, the height of the partial shoulder conforms to the height of the compacted base course.

Compact earth shoulders and foundations for paved or stabilized shoulders according to Subsection 206.03.03.

Construct stabilized, aggregate, and paved shoulders as specified in the Contract.

When reshaping existing shoulders, uniformly shape to a slope at least one inch per foot away from the edge of the existing surface. On projects not subject to the requirements of a typical section, shape the shoulder to at least 2 feet of width or a reduced width when deemed necessary by the Engineer. Furnish material from approved sources on or off the right-of-way at no additional expense to the Department.

A) Drainage. Before construction of permanent lateral drains, provide drainage for the subgrade as directed. Construct permanent lateral drains through the full width of the earth shoulders at the locations as directed for shoulders greater than 2 feet in width. On tangents, construct the drains on each side of the road at intervals not exceeding 100 feet, and stagger these drains on alternate sides of the roadway to provide a drain at intervals of approximately 50 feet. The Engineer may require the drains at shorter intervals, provided the increase in the number of drains does not exceed 10 percent. Cut the trenches to a width of 18 inches and to a depth of 2 inches below subgrade, and slope the trenches away from the subgrade. In cut sections, the Engineer will not require lateral drains in areas where the flowline of the ditch is at or above the subgrade elevation. Skew the lateral drains downgrade a maximum of 45 degrees. Backfill the trenches to a depth of 6 inches or more with aggregate conforming to Subsection 704.02. When coarse aggregate is used for backfilling lateral drains, completely wrap the coarse aggregate in geotextile fabric conforming to the Department's current requirements for fabric for subsurface drainage. Do not obstruct drainage through the lateral drains during final dressing or other operations. Do not construct any permanent lateral drains until completing all of the earthwork portion of the shoulder construction.

B) Mailbox Turnouts. Protect the edge of the mainline pavement according to Standard Drawing RPM☼110 when quantities are included in the Contract.

C) Shoulder Completion. Due to the safety and protection of the traveling public, complete the shoulders on the project at the earliest practical time. When shoulder construction is part of this Contract and the pavement is open to public traffic, conform to signing requirements for low shoulders according to Section 112 until the shoulders are completed.

209.04 MEASUREMENT.

209.04.01 Aggregate for Shoulders, Entrances, and Mailbox Turnouts. When listed as a bid item, the Department will measure the quantity in tons weighed according to Section 109.

209.04.02 Entrance Pipe. The Department will measure the quantity according to Subsection 701.04.

209.04.03 Granular Base. When the pavement design includes granular base material, the Department will measure granular material used in backfilling lateral drains in the same manner as the specified granular base material. The Department will not measure excavation for lateral drains, disposal of surplus materials, or furnishing and placing geotextile fabric for payment and will consider this work incidental to the granular base. However, when the pavement design does not include granular base material, the Department will consider furnishing aggregate, furnishing geotextile fabric, and constructing lateral drains incidental to shoulder construction.

209.04.04 Ditching. The Department will measure the quantity horizontally as the gross length of the ditches cleaned in linear feet along the edge of the shoulder adjacent to the front slope of the ditch. The Department will not measure disposal of the materials removed by clearing and ditching for payment and will consider it incidental to Ditching.

The Department will not measure cleaning out pipe structures 36 inches or less in diameter; reshaping any deformed ends on metal entrance pipe; and disposing of unsuitable entrance pipe for payment and will consider them incidental to Ditching.

209.04.05 Shouldering. The Department will measure the quantity in linear feet along the centerline of the roadway, which measurement will include the shoulder construction on both sides of the roadway. The Department will not measure disposal of the materials removed by clearing and will consider it incidental to Shouldering.

209.04.06 Ditching and Shouldering. The Department will measure the quantity as the gross length of the project measured in linear feet along the centerline of the roadway. The Department will include in the quantity all work required on the road approaches within the limits of the right-of-way.

The Department will not measure cleaning pipe structures 36 inches or less in diameter; reshaping any deformed ends on metal entrance pipe; and disposing of unsuitable entrance pipe and will consider them incidental to Ditching and Shouldering.

The Department will not measure disposal of the materials removed by clearing and ditching and will consider it incidental to Ditching and Shouldering.

209.04.07 Shoulder Surfacing. The Department will measure according to the applicable surfacing section. The Department will not measure the final roadway surface course for payment until the shoulders are completed. The Department will make partial payments for the final surface course for the portions of the project that the shoulders are substantially completed.

209.04.08 Clean Pipe Structure. When cross drains and entrance pipe that exceed 36 inches in diameter require cleaning, the Department will measure the quantity by each individual unit.

209.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2237	Ditching	Linear Foot
2714	Shouldering	Linear Foot
2575	Ditching and Shouldering	Linear Foot
0067	Aggregate for Shoulders	Ton
0068	Aggregate for Entrances	Ton
0077	Aggregate for Mailbox Turnouts	Ton
0003	Crushed Stone Base	See Subsection 302.05

0439-0454	Entrance Pipe, Size	See Subsection 701.05
3262	Clean Pipe Structure	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 210 ¾ EMBANKMENT DRAINAGE BLANKETS

210.01 DESCRIPTION. Construct embankment drainage blankets for embankment stabilization.

210.02 MATERIALS.

210.02.01 Coarse Aggregate (Rock Drainage Blanket). Conform to Section 805.

210.02.02 Natural Sand (Sand Drainage Blanket). Conform to Section 804.

210.03 CONSTRUCTION. Construct either a rock drainage blanket or sand drainage blanket according to the Plans or as the Engineer directs. When geotextile fabric is required, construct the drainage blanket according to Subsection 214.03.06.

210.04 MEASUREMENT. The Department will measure the quantity in cubic yards based on the design quantity.

210.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0021	Drainage Blanket, Embankment	Cubic Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 211 ¾ FINAL DRESSING

211.01 DESCRIPTION. Perform Final Dressing, Class A on all grade and drain projects and grade, drain, and surface projects. Perform Final Dressing, Class B on surfacing projects and resurfacing projects when listed in the proposal as a separate Contract item.

211.02 MATERIALS AND EQUIPMENT. Reserved.

211.03 CONSTRUCTION. Perform final dressing to produce a uniform finish to all parts of the roadway.

Do not disturb slopes having satisfactory vegetative covering without the Engineer's approval.

211.03.01 Final Dressing, Class A. Perform the following:

1) Clear the right-of-way of all weeds, briers, bushes, and trees, except those trees designated by the Engineer to remain, when clearing and grubbing is a Contract item.
2) Remove all sediment, drift, and other debris from all entrance structures and cross drainage structures.
3) Dispose of the materials so removed.
4) Shape areas designated by the Engineer to receive seeding and protection.
5) Shape and dress shoulders, ditches, and slopes to the lines, grades, and cross sections specified in the Contract.
6) Shape the slopes of ditches, channels, and borrow pits.
7) Fill with suitable material, all holes and depressions resulting from the removal of structures, grubbing operations, or other construction operations.

211.03.02 Final Dressing, Class B. Perform according to Final Dressing, Class A, except perform work from ditch line to ditch line.

When solid rock is encountered in ditches, the Engineer will not require excavation below the elevation of the solid rock.

211.04 MEASUREMENT.

211.04.01 Final Dressing, Class A. The Department will not measure Final Dressing, Class A for payment and will consider it incidental to the earthwork items bid.

211.04.02 Final Dressing, Class B. The Department will measure Final Dressing, Class B as the net length of surfacing or resurfacing in linear feet. When the project is a multi-lane, divided highway and a portion is constructed as separate roadways, the Department will measure the actual length of the section or sections so constructed as the actual length of the right hand roadway as defined by the direction of the stationing. The Department will measure the quantity in feet along the centerline of the roadway. The Department will include in the quantity all final dressing within the lateral limits defined for Final Dressing, Class B, as specified in the Contract, and all necessary final dressing of borrow pits, waterways, ramps, cross roads, service roads, frontage roads, multi-level roadways, and approaches, and other areas falling outside the limits of the right-of-way but being appurtenant to the Contract.

When the material removed as directed exceeds 12 inches in average depth, measured perpendicularly to the existing cross section lines, the Department will measure the additional material as Roadway Excavation.

211.04.03 Roadway Excavation. The Department will measure the quantity according to Subsection 204.04.

211.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2601	Final Dressing, Class B	Linear Foot
2200	Roadway Excavation	See Subsection 204.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 212 ¾ EROSION CONTROL

212.01 DESCRIPTION. Construct brush barriers, prepare the soil for seeding, apply materials, and mulch areas seeded or sodded.

212.02 MATERIALS. Conform to Section 827.

212.03 CONSTRUCTION. Progressively incorporate erosion control measures with the grading operations throughout the duration of the project according to Section 213.

212.03.01 Brush Barriers. Construct barriers that are dense, 2 to 5 feet in height and 4 to 10 feet wide. Do not locate barriers where diverted drainage will create erosion problems.

Do not use brush barriers at sites where the adjacent private property has been residentially or commercially developed. Do not construct the barriers at sites easily and routinely seen that will detract from the appearance of either the adjacent property or the completed highway.

212.03.02 Topsoil. When included in the Contract as a bid item, either furnish and place topsoil or place stockpiled topsoil.

A) Furnish and Place Topsoil. When the bid item is furnish and place topsoil, obtain topsoil conforming to Section 827 from source outside the right-of-way limits. Avoid injury to existing planted growths, structures, and paved surfaces during topsoil operations.

Provide equipment and methods of operation that prevent the loading of subsoil or other unsuitable material with the topsoil. During hauling operations, keep pavement surfaces clean. Promptly and completely remove any topsoil or other substances dropped on the surfaces before it is compacted by traffic.

Prepare areas designated to receive topsoil. Then place and spread topsoil to a sufficient loose depth so that after natural settlement and rolling, the completed work conforms to the required line, grades, and elevations. Compact the topsoil and prepare the area for seeding according to Subsection 212.03.03.

B) Spreading Stockpiled Topsoil. When the bid item is spreading stockpiled topsoil, obtain the material from existing stockpile on or near the project.

Do not spread topsoil until grading and shaping of the area to receive the topsoil has been completed and seeding and protection operations are ready to begin. Spread and lightly compact the topsoil to a uniform depth of approximately 6 inches over areas specified in the Plans or as the Engineer directs. Do not place topsoil on slopes steeper than 3:1.

Prepare the area for seeding according to Subsection 212.03.03.

212.03.03 Permanent Seeding and Protection. Grade exposed earth and any other erodible areas to a uniform cross section or slope as soon as practical in the judgment of the Engineer and then perform permanent seeding and protection at the earliest practical time.

Prepare all areas within the construction limits and right of way limits that can be expected to sustain plant growth and are not covered by satisfactory vegetation for permanent seeding. The Engineer will designate areas to be seeded.

A) Seed Mixtures for Permanent Seeding. Use seed Mixture No. I or Mixture No. II as the Contract specifies.

Mixture No. I:	65% Kentucky 31 Fescue (Festuca arundinacea) 10% Creeping Red Fescue (Festuca rubra) 10% Red Top (Agrostis alba) 5% White Dutch Clover (Trifolium repens) 10% Ryegrass, perennial (Lolium perenne)
Mixture No. II:	50% Kentucky Bluegrass (Poa pratensis) 25% Creeping Red Fescue (Festuca rubra) 10% Red Top (Agrostis alba) 5% White Dutch Clover (Trifolium repens) 10% Ryegrass, perennial (Lolium perenne)

B) Procedures for Permanent Seeding. Include a seeding plan in the Best Management Practices plan (BMP) according to Section 213. Prepare a seedbed and incorporate fertilizer and agricultural limestone as needed. Do not apply dry agricultural limestone when it may generate a traffic hazard. Seed and mulch to produce a uniform vegetation cover of at least 1,350 live seedlings per square yard. At least 75 percent of the 1,350 seedlings are to be permanent grasses or clover with no more than 25 percent being perennial grasses. Use straw with tackifier for mulch. The Department will allow the option of using hydromulch in lieu of straw from March 1 through May 15 and from September 1 through November 1. Use sufficient quantities of mulch and tackifier to promote germination and control erosion until vegetation is established.

C) Crown Vetch. Sow crown vetch seed on all areas having a slope steeper than 3:1 and consisting of soil or mixtures of broken rock and soil. Also, sow crown vetch on soil seams and crevices within or adjacent to rock cuts and flat areas of benched slopes. Sow crown vetch seed uniformly at a rate that will provide 9 live seedlings per square yard.

D) Top Dressing. When quantities for 20-10-10 fertilizer are included in the Contract, apply a top dressing of 20-10-10 fertilizer to all seeding and sodded areas on the project at a rate of 11.5 pounds per 1,000 square feet. Use dry fertilizer delivered to the project in bags or bulk. Apply top dressing to all areas within the right of way limits where satisfactory vegetation has been established or preserved. Apply top dressing at the time the Contract or Engineer designates; however, do not apply top dressing during the months of December and January. Do not apply top dressing until a satisfactory stand of vegetation exists. The Engineer will not require incorporation of these materials into the soil. Reapply fertilizer to any top dressed areas that later exhibit streaked or missed areas. Re-establish any vegetation severely damaged or destroyed because of an excessive application of fertilizer.

When seeding performed during the latter part of the project has not had time to attain significant growth before completing all other Contract items, the Engineer will declare the project complete without regard to top dressing work. Perform top dressing at a later time approved by the Engineer. The Engineer will not include the time necessary to complete top dressing work in the Contract item and will assess no liquidated damages provided the work is completed within the time limits according to Subsection 108.09.

E) Erosion Control Blanket. Install erosion control blankets on normal roadway, surface and special ditches that do not have any other form of erosion control to a flow depth of 1 1/2 feet. Install erosion control blankets on slopes that are 4:1 or steeper that have a 1/4 acre drainage area per 100 linear feet. Prepare the bed by loosening the soil to a depth of 2 to 3 inches. Apply fertilizer, limestone, and seed at the permanent seeding rate. Cover with the erosion control blanket. Roll out the blanket in the direction of the anticipated run-off flow. Anchor the blanket at the top and toe of slopes and at the top, toe, and edges of channels and ditches as the "Anchoring Edges

and Ends" figure shows. Secure the blanket by stapling as the "Stapling Pattern" figure shows. At seams, overlap the blanket as the "Seam Overlaps"

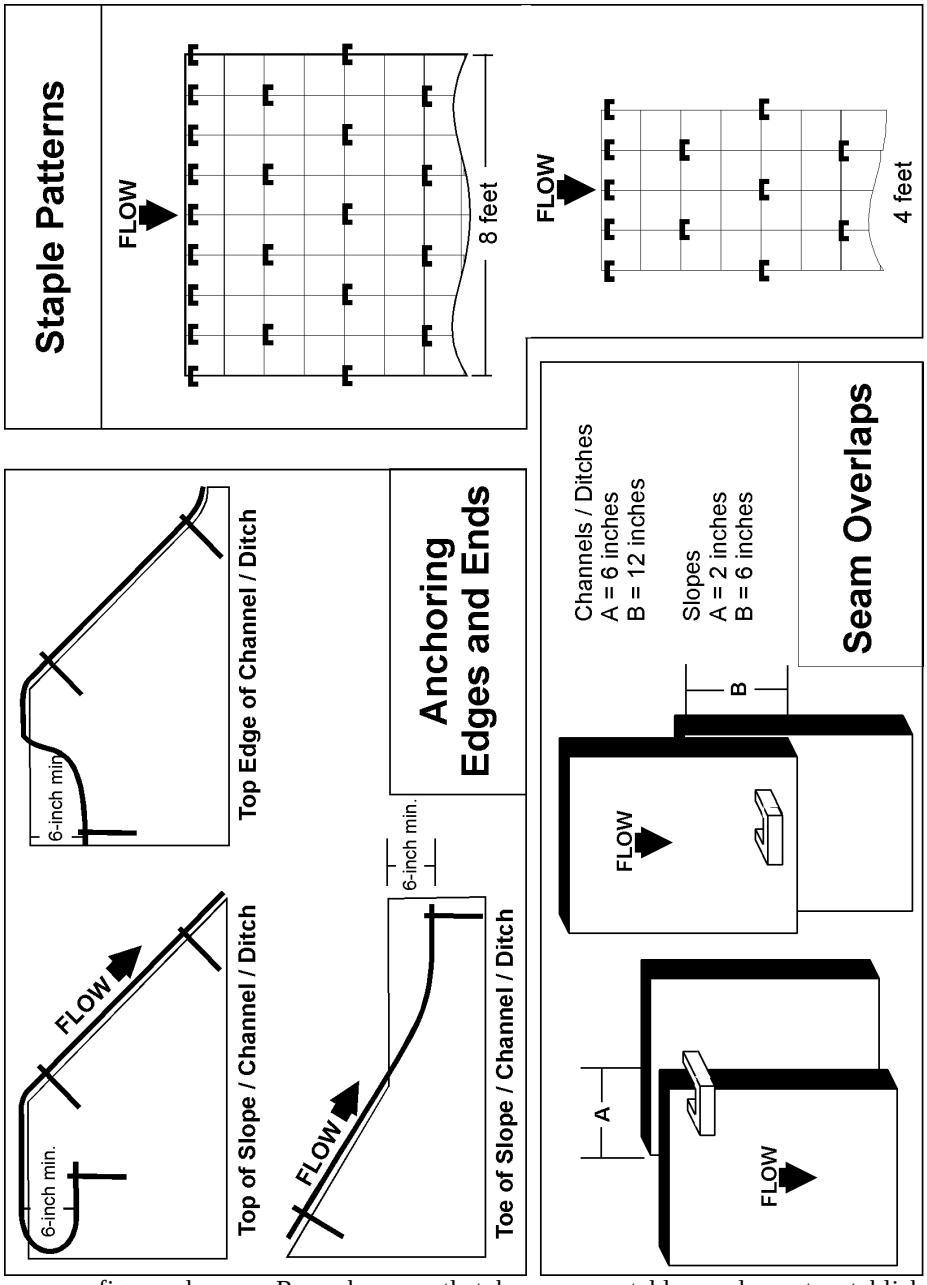


figure shows. Rework areas that become unstable or do not establish vegetation.

F) Maintenance of Seeded Areas. From the time seeding and protection work begins until the date the project is declared complete, keep all seeded areas in good condition at all times. Promptly repair any damage to seeded areas or to

mulch materials as directed. Mow when the Engineer directs.

G) **Acceptance of Seeding.** The Engineer will make an inspection to determine the acceptability of the seeding between 3 and 6 months after completion of the project. The Engineer may delay the inspection when conditions are such that the acceptability of the seeding cannot be determined at the end of the 6-month period. Ensure that at least 90 percent of each seeded area has a minimum of 1,350 live seedlings per square yard at the time of inspection, representative of the specified seed mixture with no vacant areas larger than 25 square yards. Also, ensure that all applicable areas have a minimum of 9 live area seedlings per square yard of crown vetch. Conform to this requirement for all permanent seeding performed in conjunction with the project regardless of the type of protection used or the season in which the seeding is performed.

When seeding does not conform to the live seedling requirements at the time of inspection, submit a corrective work plan to the Engineer for approval and perform the additional work necessary to conform to the original requirements. The Department reserves the right to specify application rates for agricultural lime, fertilizer, seed, and mulch for corrective seeding.

212.03.04 Sodding. At locations specified in the Contract or by the Engineer, prepare the sod bed, incorporate fertilizer and agricultural limestone as needed and place sod flush with any adjacent seeded or turfed area, pavement, curb, or other structures.

The Engineer will make an inspection to determine the acceptability of the sod between 3 and 6 months after completion of the project. Ensure that at least 90 percent is alive with no area of dead sod larger than one square yard.

212.04 MEASUREMENT.

212.04.01 Brush Barriers. The Department will not measure the quantity of brush barriers for payment and will consider construction of brush barriers incidental to Clearing and Grubbing.

212.04.02 Topsoil Furnished and Placed. The Department will measure the quantity in cubic yards in the vehicle at the point of delivery.

212.04.03 Spreading Stockpiled Topsoil. The Department will measure the quantity in cubic yards by taking cross sections of stockpiles immediately before spreading operations, and taking final cross sections of the stockpile area after spreading has been completed and the area neatly dressed.

When electing to place the topsoil directly without stockpiling, according to Subsection 204.03.07 B), then the Engineer will not separately measure the topsoil not stockpiled.

212.04.04 Agricultural Limestone. The Department will not measure the quantity of agricultural limestone for payment and will consider it incidental to Seeding and Protection and Sodding.

212.04.05 Fertilizer. The Department will not measure the fertilizer used in the seeding or sodding operations for payment and will consider it incidental to these items of work.

The Engineer will measure the fertilizer used for top dressing in tons. The Engineer will weigh top dressing according to Section 109.

212.04.06 Seeding and Protection. The Department will measure the quantity in square yards.

The Department will include in the quantity any seeding and protection necessary due to catastrophic events that are beyond the control of the Contractor.

The Department will not measure any corrective work required to conform to

Subsection 212.03.03 F).

The Department will not measure seeding and protection of areas unnecessarily disturbed or disturbed areas outside the limits of construction.

212.04.07 Erosion Control Blanket. The Department will measure the quantity of Erosion Control Blanket by the square yard of surface covered. The Department will not measure seeding for payment and will consider it incidental to the Erosion Control Blanket. The Department will not measure any reworking of slopes, channels, or ditches for payment as it is considered corrective work and incidental to the Erosion Control Blanket.

212.04.08 Sodding. The Department will measure the quantity in square yards. The Department will not measure any additional sod necessary to restore areas that fail to conform to the original requirements.

212.04.09 Crown Vetch. The Department will measure the quantity in square yards.

212.04.10 Mowing. When mowing is required, the Department will measure and pay for the quantities under a supplemental agreement.

212.05 PAYMENT. The Department will pay for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
5997	Topsoil Furnished and Placed	Cubic Yard
5998	Spreading Stockpiled Topsoil	Cubic Yard
5966	Topdressing Fertilizer	Ton
5985	Seeding and Protection	Square Yard
5950	Erosion Control Blanket	Square Yard
5989	Special Seeding Crown Vetch	Square Yard
5990	Sodding	Square Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 213 ¾ WATER POLLUTION CONTROL

213.01 DESCRIPTION. Control water pollution through use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. Coordinate these measures with the permanent erosion control features specified in Section 212 and the Contract to the extent practical to ensure effective and continuous erosion control throughout the construction and post construction period.

213.02 MATERIALS. Conform to Section 827.

213.03 CONSTRUCTION. Conform to the applicable provisions of KRS Chapters 220 and 224 of the State Water Pollution Control Laws and other applicable statutes relating to the prevention or abatement of water pollution. Conform to the requirements of all Federal and State agencies having jurisdictional control over the land the project is constructed through. Secure all necessary permits from the appropriate agencies for any temporary stream crossings and for waste area sites in flood plains, when the crossings and sites are not designated on the Plans.

Exercise every reasonable precaution to prevent the pollution of streams, lakes, and reservoirs. Construct all permanent drainage structures, ditch checks, and paved ditches as soon as practical. Conduct and schedule operations to avoid the muddying or siltation of streams, lakes, and reservoirs and to avoid damage to fish habitats. While work on an item is suspended, do not leave the partially completed item in a manner that will contribute to erosion.

Construct water pollution controls in stream channels only in areas where channel changes or channel clearings are specified in the Plans or where necessary for temporary or permanent structures. Do not divert water through channel changes until the specified channel lining has been constructed or placed, unless there is no alternative in the judgment of the Engineer.

Do not place material removed from the roadway or channel changes in streams, stream channels, other areas subject to flooding, or other locations where it may be washed away by high stream flows or fast runoff. Do not place harmful materials where they may be carried into a stream or into underground water at any time.

Provide temporary bridges or structures for hauling materials across streams. Do not operate mechanized equipment in streams except as required for the construction of structures and channel changes, or for clearing channels.

Keep clearing of stream side trees to the absolute minimum necessary for the construction of the project.

When materials known to produce pollutants are encountered, excavate, place, cover, or otherwise deter the material as a potential pollutant according to the Contract and as the Engineer directs.

Do not disturb lands and waters outside the limits of the construction. Before final acceptance of the work, reshape all such disturbed areas, including abandoned haul roads, storage areas, and plant sites, to conform to the adjacent ground.

213.03.01 Best Management Practices (BMP). Prepare the BMP jointly with the Engineer before the Preconstruction Conference. Include erosion control for all off right of way work. Plan to trap at least 80 percent of the sediment generated by the construction activities. Ensure that the BMP provides one-inch of ponding per 2 1/2 acres of soil disturbance. Achieve this ponding with silt checks, silt traps, and sedimentation basins. Reduce the ponding requirement by appropriately timing construction of sodded and aggregate lined ditches, silt fences, and other provisions used to slow the water down or by performing progressive seeding, mulch covering, or other provisions used to reduce the soil exposure.

Ensure that the BMP is available for public inspection throughout the life of the project.

213.03.02 Progress Requirements. Coordinate the progress of both permanent

and temporary erosion control measures with the clearing, grubbing, and grading operations throughout the duration of the project, and according to the BMP.

The Engineer will limit the area of excavation, borrow, and embankment operations commensurate with the Contractor's capability of maintaining the finish grading, seeding, and other such permanent pollution control measures according to the accepted schedule. For areas greater than 750,000 square feet submit a written request for approval to the Engineer. Keep the duration of the exposure of the uncompleted construction as short as practical.

After exposing areas of erodible material, make every effort to stabilize and protect the areas as quickly as possible. Upon failure to coordinate the erosion control measures with the grading operations in a manner to effectively control erosion and to prevent water pollution, the Engineer may suspend the grading operations and withhold monies due on current estimates until all aspects of the work are coordinated in an acceptable manner. Additionally, the Department will apply liquidated damages when all aspects of the work are not coordinated in an acceptable manner within 5 days after written notification.

In case of repeated failures to control erosion, pollution, or siltation, the Engineer reserves the right to employ outside assistance or use his own forces to provide the necessary corrective measures. The Department will charge such incurred direct costs plus project engineering costs to the Contractor and make appropriate deductions from the pay estimate.

213.03.03 Inspection and Maintenance. Investigate all erosion control devices weekly and after each 1/2-inch rainfall event. Remove all accumulated silt when the devices are 50 percent full.

The Engineer will monitor the in-place erosion control for the project once every 7 calendar days and within 24 hours following a 1/2-inch or greater rainfall. The Engineer will furnish the documentation of this monitoring and any proposed changes due to this monitoring to the Contractor. This documentation and any proposed changes are to be included with the Erosion Control Schedule.

213.03.04 Construction Activities Affecting Streams. When in-stream work is unavoidable, perform it in a manner and duration to minimize re-suspension of sediments and disturbance to substrates and bank or riparian vegetation. To the maximum extent practical, perform all work during low flow conditions. Investigate for water in-takes or other activities immediately downstream affected by increased turbidity resulting from the work. Before beginning any work in the stream, give sufficient notice to allow the downstream water users to prepare for any temporary change in water quality.

Use fill or riprap that will not adversely affect the biological, chemical or physical properties of the receiving waters or cause violations of water quality standards. When riprap or channel lining is installed, use a weight and size that will not create bank stress or slump conditions.

On channel slopes not riprapped or otherwise stabilized, re-vegetate stream banks and riparian zones concurrently with Project progression to restore beneficial wildlife habitat. When specified in the Contract, randomly place, in offset rows, trees and shrubs as specified in the Plans; on either one side or both sides of the channel bank; and upstream and downstream of a proposed bridge within the disturbed area as specified in the Plans. Limit each species to 20 percent of the total. The Contract will specify the seeds, shrubs, and trees and include a quantity to be selected from each category. The Plans will include the rate of seeding. The Department may allow an adjustment in the plant species and quantities based on field conditions.

Do not dump spoil materials from the watercourse or on-shore operations, including sludge deposits, into the watercourse according to Section 404 guidelines of the Clean Water Act. Provide areas of deposit of dredged materials with temporary dikes or bulkheads for separation and retention of settleable solids.

When specified in the Plans, place soil excavated from an existing channel at designated locations along the new channel. This, and any stockpiling or double handling necessary is considered incidental to the earthwork bid items on the project.

Carry out the fill created by the discharge and any disposition of dredged or excavated materials on-shore, and all earthwork operations to control and minimize sediment run off and soil erosion to the watercourse.

Place all permanent structures in the stream to allow fish movement through the site. When specified in the Plans, construct artificial riffle structures, flow deflectors, boulders, or other types of structures to replace in stream aquatic habitat.

213.03.05 Temporary Control Measures. Provide and maintain immediate permanent or temporary pollution control measures to prevent contamination of adjacent property, watercourses, lakes, ponds, or other areas of water impoundment.

Incorporate all permanent erosion control features into the project at the earliest practical time as outlined in the accepted schedule. Provide inlet and outlet protection at existing drainage structures. Install temporary controls as needed through the duration of the project. Coordinate the temporary pollution control measures with the permanent erosion control features to the extent deemed practical by the Engineer to ensure effective and continuous erosion control throughout the construction and post-construction periods.

Temporary pollution controls may include construction work outside the right-of-way where such work is necessary as a result of roadway construction such as borrow pit operations, haul roads, and equipment storage sites.

A) Sedimentation Basins. As the first grading operation in the drainage area, construct an earth, or rock and earth, dam with designated spillways according to the Plans. When a sedimentation basin is to be used and plans are not included in the Contract, submit plans to the Engineer for approval before construction.

Either clean out and dress or remove the sedimentation basin, as the Engineer directs, upon completion of the project.

B) Silt Checks. Use one of the following types:

1) Silt Check Type I - Straw bales, staked to remain in place.
2) Silt Check Type II - Crushed stone such as cyclopean stone riprap, quarry run stone, or other size material approved by the Engineer, dumped in place and shaped to the configuration required.
3) Silt Check Type III - Blasted or broken rock dumped in place and shaped to the configuration required.

Remove and properly dispose of sediment deposited at silt checks as necessary. When no longer needed, remove the silt checks and dispose of surplus materials as excavated materials according to Section 204. Seed and protect the entire area disturbed, as directed. Do not leave silt checks in place after completion of the project unless allowed by the Engineer or specified in the Plans.

C) Silt Traps. Construct silt traps by excavating basins in natural or excavated channels. Use one of the following types:

1) Type A - Excavated pits, from 2 to 3 feet in depth, 20 to 30 feet in length, and 5 to 10 feet in width.
2) Type B - Excavated pits with the addition of a dike. Construct according to the Plans and Standard Drawings

Remove sediment deposited in silt traps. When no longer needed, remove the silt traps and dispose of surplus materials according to Subsection 204.03.08. Seed and protect, or sod, the entire area disturbed, as the Engineer directs. Do not leave silt traps in place after completion of the project unless allowed by the Engineer or specified in the Plans.

D) Temporary Silt Fence. Furnish, install, maintain, and remove temporary silt fence. The temporary silt fence works as a water permeable filter to remove

suspended particles from the water passing through it.

Construct as shown in the Contract continuous and transverse to the flow. Limit the equivalent runoff area to 1,000 square feet per 10 feet of temporary silt fence.

Maintain the temporary silt fence after installation. Remove silt accumulations by tapping the dry fabric from the downstream side and dispose of it as excavated materials. Replace the geotextile fabric when clogging, damage, or deterioration prevents it from functioning properly.

When no longer needed, remove and dispose of the fence off the right-of-way. Dispose of the accumulated silt or dress in place, and seed and protect the area. When intact, the Department will allow the reuse of the fence at other locations.

E) Temporary Silt Ditch. Construct a special temporary ditch adjacent and parallel to the right-of-way in relatively rolling areas where, in the judgment of the Engineer, adjacent property may be damaged from sheet-type soil erosion. This special ditch is not intended to carry large volumes of water but to catch sediment from runoff. Construct silt checks within the ditch or at the outlet. Construct the special ditch according to the Plans and Standard Drawings at the locations designated by the Engineer.

F) Temporary Seeding and Protection. Obtain the Engineer's approval for the seed before use.

Promptly perform the work of temporary seeding and protection to prevent visible erosion. Protect all seeded areas with a mulch that precludes siltation.

Perform temporary seeding and protection under the following conditions:

1) When it is impractical to bring an area to final line, grade, and finish so that permanent seeding and protection work can be performed without subsequent serious disturbance by additional grading.
2) When soil erosion occurs, or is considered to be a potential problem, on areas where construction operations are temporarily suspended.
3) When an immediate cover would be desirable to minimize erosion, siltation, or pollution.
4) On temporary roadways that are expected to remain in place for longer than 30 days and that are constructed of erodible materials.

G) Temporary Mulch. Obtain the Engineer's approval for the mulch before use.

When Temporary Seeding and Protection would be required, but the time of exposure is 30 days or less, perform the work of temporary mulching to prevent visible erosion. Place temporary mulch to an approximate 2-inch loose depth and apply tackifier.

H) Temporary Drainageways. As erodible areas are exposed, construct temporary drainageways where needed to divert runoff from erosive soil areas to the silt traps or checks or silt ditches. Construct interceptor ditches or silt fences at the top of cut slopes when beginning excavation. Construct surface ditches, roadside ditches, and flumes to carry runoff from the roadway at the earliest possible time during the grading work.

When needed, use pipe as liners for these temporary drainageways. The Engineer will approve the type and location of the drainageways as well as the need for a liner. Install the pipe liner according to the Plans and Standard Drawings. Use pipe of any substantial type or material for overflow pipe in the construction of temporary silt basins and for flumes.

When fill slopes have been constructed to such a stage that protection of the face of the slope from roadway runoff is necessary, construct a temporary earth mound ditch or silt fence at the outer edge of the shoulder along the top of the embankment as directed by the Engineer. Construct the ditch to form an earth mound on the embankment side of the ditch and carry runoff from the roadway along the shoulder to the flumes and roadside

ditches. Use temporary berm ditches at the top of fill slopes after completing the permanent seeding and protection work and until beginning the surfacing operations. Stabilize the ditch and mound by spraying with asphaltic material when deemed necessary.

213.04 MEASUREMENT. The Department will consider the various materials and labor used to construct, maintain, and, when no longer needed, remove the erosion control devices incidental to the initial construction.

The Department will not measure maintenance or corrective work for payment when it is due to a failure in following the BMP.

213.04.01 Roadway Excavation. The Department will measure the quantity according to Subsection 204.04.

213.04.02 Borrow Excavation. The Department will measure the quantity according to Subsection 205.04.

213.04.03 Embankment-in-Place. The Department will measure the quantity according to Subsection 206.04.

213.04.04 Temporary Seeding and Protection. The Department will measure the quantity in square yards. The Department will not measure temporary erosion and pollution control measures required due to negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled. When construction of a temporary roadway is required by the Contract, the Department will measure the associated temporary seeding and protection. The Department will not measure temporary seeding and protection of temporary roadways constructed for the convenience of the Contractor.

213.04.05 Temporary Mulch. The Department will measure the quantity in square yards. The Department will not measure temporary erosion and pollution control measures required due to negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled. When construction of a temporary roadway is required by the Contract, the Department will measure the associated temporary mulch. The Department will not measure temporary mulch for temporary roadways constructed for the convenience of the Contractor.

213.04.06 Pipe for Flumes. The Department will measure the quantity in linear feet.

213.04.07 Sedimentation Basin. The Department will measure the quantity in cubic yards. The Department will not measure filter pipe, drain pipe, and spillway paving on sedimentation basins for payment and will consider them incidental to this item of work.

213.04.08 Clean Sedimentation Basin. The Department will measure the quantity of sediment removed in cubic yards.

213.04.09 Silt Trap, Type. The Department will measure the quantity by each individual unit.

213.04.10 Clean Silt Trap, Type. The Department will measure the quantity by each individual unit.

213.04.11 Silt Check. The Department will measure the quantity by each individual unit.

213.04.12 Clean Silt Check. The Department will measure the quantity by each individual unit.

213.04.13 Temporary Silt Fence. The Department will measure the quantity in linear feet from end post to end post of each installation.

213.04.14 Clean Temporary Silt Fence. The Department will measure quantity in linear feet along the fence.

213.04.15 Temporary Silt Ditch. The Department will measure the quantity as roadway excavation.

213.04.16 Temporary Drainageways. The Department will measure the quantity as roadway excavation.

213.04.17 Channel Lining, Classes IA, II, III, and IV. The Department will measure the quantity according to Subsection 703.04.

213.04.18 Plants, Trees, Vines, and Shrubs. The Department will measure the quantity by each individual unit.

213.04.19 Deflector, Gabion. The Department will measure the quantity by each individual unit.

213.04.20 Deflector, Dumped Stone. The Department will measure the quantity by each individual unit.

213.04.21 Riffle Structure, Dumped Stone. The Department will measure the quantity by each individual unit.

213.04.22 Riffle Structure, Gabion. The Department will measure the quantity by each individual unit.

213.04.23 Boulder. The Department will measure the quantity by each individual unit.

213.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
5985	Seeding and Protection	See Subsection 212.05
2200	Roadway Excavation	See Subsection 204.05
2210	Borrow Excavation	See Subsection 205.05
2230	Embankment-in-Place	See Subsection 206.05
5953	Temporary Seeding and Protection	Square Yard
5952	Temporary Mulch	Square Yard
----	Pipe for Flumes	Linear Foot
2711	Sedimentation Basin	Cubic Yard
2712	Clean Sedimentation Basin	Cubic Yard
2703, 2704	Silt Trap, Type	Each
2706, 2707	Clean Silt Trap, Type	Each
2705	Silt Check	Each
2708	Clean Silt Check	Each
2701	Temporary Silt Fence	Linear Foot
2709	Clean Temporary Silt Fence	Linear Foot
2482-2484, 2488	Channel Lining, Classes IA, II, III, and IV	See Subsection 703.05
----	Plants, Vines, and Shrubs	See Subsection 724.05
----	Trees	See Subsection 724.05
2618	Deflector, Gabion	Each
2617	Deflector, Dumped Stone	Each
2738	Riffle Structure, Dumped Stone	Each

2622	Riffle Structure, Gabion	Each
2713	Boulder	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 214 ¾ GEOTEXTILE CONSTRUCTION

214.01 DESCRIPTION. Install geotextile fabric, when required in the Contract, for slope protection and channel lining, underdrains and drainage blankets, and subgrade or embankment foundation stabilization.

214.02 MATERIALS.

214.02.01 Geotextile Fabric. Conform to Section 843.

214.02.02 Steel Pins. Conform to Section 843.

214.03 CONSTRUCTION. The Engineer will reject the fabric if it has defects, rips, holes, flaws, deterioration, or damage.

Prepare the surface to receive the fabric to a smooth condition, free of obstructions, debris, or sharp objects that may puncture the fabric. Place the fabric smooth and free of tension, stress, folds, wrinkles, or creases. Do not operate equipment directly on the fabric. Protect the fabric at all times from contamination. Remove and replace any contaminated fabric with uncontaminated fabric.

Repair or replace any fabric damaged. Repair individual isolated cuts, tears, or punctures by placing a patch of geotextile fabric that extends at least 3 feet beyond the damage in all directions or by field splicing the patch.

Cover the fabric with a layer of the specified material within 14 calendar days. Remove and replace fabric not covered within the 14 days.

214.03.01 Laps. When more than one strip is necessary, place an overlap of at least 18 inches. Place transverse laps so the upstream strip laps over the downstream strip. Place horizontal laps so the upper strip laps over the lower strip.

Install fastener pins through both strips of overlapped fabric at no less than 5-foot intervals along a line through the midpoint of the overlap, and at any other locations as necessary to prevent any slippage of the fabric.

The Department will allow field splices in place of laps.

214.03.02 Field Splices. Sew the full length of the boundary between adjacent sheets of fabric. Ensure that the seam strength conforms to the requirements of Section 843.

214.03.03 Slope Protection and Channel Lining. Place Type I fabric with the long dimension parallel to the channel or toe of slope.

Protect the fabric from damage due to the placement of the slope protection or channel lining either by limiting the height of drop of the material to no greater than 3 feet or by placing a cushioning layer of sand on top of the fabric before dumping the material. Demonstrate to the Engineer that the placement technique prevents damage to the fabric. Begin placement of material at the toe and proceed up the slope.

214.03.04 Underdrains. Place and shape Type II fabric to the sides and bottom of the trench without stretching the fabric. Place filter aggregate so as not to damage, displace, or dislodge the fabric according to Subsection 704.03. Fold the fabric over the backfilled trench and secured it with steel pins at intervals of 5 feet to produce a double thickness of fabric over the top of the trench.

214.03.05 Subgrade or Embankment Foundation Stabilization. Place Type III fabric with the long dimension parallel to the long dimension of the area to be covered. Leave surface vegetation in place.

During back dumping and spreading, do not allow the wheels of trucks, dozer blades, and other equipment to come into direct contact with the fabric. Spread the material in the direction of the fabric overlap. If large fabric wrinkles develop during spreading operations, fold and flatten the wrinkles in the direction of spreading.

Avoid large folds which reduce the fabric overlap width.

214.03.06 Drainage Blankets. Place Type IV fabric with the long dimension parallel to the long dimension of the area to be covered.

Place the drainage blanket material to present a reasonably even surface free from mounds or depressions. After the material is placed, fold the fabric over the ends and sides of the material, and place additional fabric over the material so that the material is completely encased within the fabric. Install additional pins, regardless of the location, as necessary to prevent any slippage of the fabric. Place the fabric so that laps do not occur at the edges or ends of the drainage blanket. Place embankment in a manner to avoid damage or displacement of the completed drainage blanket.

214.04 MEASUREMENT. The Department will measure the quantity in square yards. The Department will not measure fabric when the Contract indicates the fabric is incidental to the work, when the specifications for another item requires incidental installation of geotextile fabric, or when no separate bid item for fabric is listed in the proposal.

The Department will not measure material in laps or seams.

When fabric is used for underdrains, either to wrap perforated pipe or to wrap aggregate, the Department will measure the quantity according to Subsection 704.04.

When the fabric is used to completely enclose an aggregate drainage blanket, the Department will measure the quantity as the sum of (1) the area of the lower surface of the aggregate layer, (2) the area of the upper surface of the aggregate layer, and (3) the area of the sides and ends of the aggregate layer; using the dimensions specified in the Plans.

The Department will not measure for payment the repair or replacement of damaged fabric or replacement of fabric not covered within 14 days.

214.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2596-2599	Fabric-Geotextile, Type	Square Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 215 ¾ TREATMENT OF OPEN SINKHOLES

215.01 DESCRIPTION. Clean and fill open sinkholes and cap open sinkholes not used for drainage.

215.02 MATERIALS.

215.02.01 Geotextile Fabric. Conform to Section 843, Type IV.

215.02.02 Concrete. Use Class B concrete conforming to Subsection 601.02 and 601.03.

215.02.03 Steel Reinforcement. Conform to Section 811.

215.03 CONSTRUCTION. Locate and flag all open sinkholes before starting clearing and grubbing operations. Clear the sinkhole area according to Section 202. Remove the soil overburden, organic material, and debris from the sinkhole as specified in the Plans or as directed by the Engineer.

Place geotextile fabric between any soil and the Granular Embankment Refill. Refill the sinkhole with Granular Embankment, and compact it as the Engineer directs. Furnish Granular Embankment refill conforming to the following requirements:

A) Roadway Excavation. When obtaining granular embankment from roadway excavation, the Engineer will accept it by visual inspection. Use granular embankment that is free of shale or other deleterious materials.

B) Off-Site Materials. Use granular embankment having no more than 10 percent passing the No. 200 sieve when tested according to KM 64-606. The Engineer will inspect the quality of all granular embankments. The Engineer will accept the processed material by visual inspection when the material includes a significant amount of fragments greater than 1 1/2 inches. Do not use natural sand and other fine aggregates. The Engineer will approve the size and type of refill.

C) Clay. For clay soil cap, use an impervious clay the Engineer approves. Compact according to Section 206.03.03.

D) Concrete. Use a cap of reinforced concrete, precast or cast-in-place, with a minimum thickness of one foot as specified in the Contract or as the Engineer directs. Use Class B concrete according to Subsection 601.03. Furnish precast concrete according to Section 605. Reinforce the concrete with No. 8 bars placed on one-foot centers in both directions, and located 3 inches from the bottom surface of the concrete. Interlock the concrete cap with bedrock.

215.04 MEASUREMENT.

215.04.01 Granular Embankment. The Department will measure roadway excavation used for rock refill or for the clay soil cap in cubic yards according to Section 204 or 206, as applicable. Otherwise, the Department will measure by the cubic yard as Granular Embankment.

215.04.02 Geotextile Fabric. The Department will measure the quantity according to Subsection 214.04.

215.04.03 Concrete, Class B. The Department will measure the quantity according to Subsection 601.04.

215.04.04 Cleaning Sinkhole. The Department will measure the quantity by each individual unit cleaned.

215.04.05 Steel Reinforcement. The Department will measure the quantity

according to Subsection 602.04.

215.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2223	Granular Embankment	Cubic Yard
2596-2599	Geotextile Fabric, Type	See Subsection 214.05
2555	Concrete, Class B	See Subsection 601.05
2469	Clean Sinkhole	Each
8150	Steel Reinforcement	See Section 602.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 216 ¾ SETTLEMENT PLATFORMS

216.01 DESCRIPTION. Furnish all materials, construction, installation, and maintenance of settlement platforms as the Engineer directs.

216.02 MATERIALS.

216.02.01 Miscellaneous Metals. Conform to Section 813.

216.02.02 Fine Aggregate. Conform to Section 804.

216.02.03 Steel Pipe. The Engineer will visually inspect for acceptance.

216.03 CONSTRUCTION. Fabricate from the materials and to the dimensions specified in the Plans or Standard Drawing for settlement platforms.

Level the ground surface to an elevation 2 inches below the desired elevation of the base plate of the settlement platform. Level over a sufficient area to accommodate the bottom plate and at the location shown or directed. Place, lightly tamp, and level a 2-inch layer of fine aggregate at the proposed location of the bottom plate. Set and level the bottom plate on the fine aggregate. Place loose soil to an elevation corresponding to that of the top plate of the settlement platform. Ensure that the loose soil does not disturb the platform and that it extends laterally from the perimeter of the top plate to a slope of 1:1 or flatter. After placing and leveling the top plate, complete the embankment as specified for the project, and ensure that the settlement platform is not damaged or disturbed.

The Engineer will measure and record settlement, to the nearest 0.01 foot, and elevation of the embankment at weekly intervals or more frequently in order that no more than 10 percent of the expected settlement occurs between readings. The Engineer will submit the data to the Division of Materials weekly.

Stop work at any location where settlement platforms are disturbed or damaged, and make necessary repairs or replacement. As the embankment is constructed, add sections of 2 1/2-inch and 4-inch pipe to the assembly (tighten each new section of 2 1/2-inch pipe with a pipe wrench before taking a reading to ensure that the next added section does not affect future readings). Keep the top of the outer pipe closed as work progresses with a 4-inch standard cap. When work is complete, secure the cap to the final outer pipe section.

216.04 MEASUREMENT.

216.04.01 Settlement Platforms. The Department will measure the quantity by each individual unit.

216.04.02 Steel Pipe. The Department will measure each size in linear feet.

216.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2692	Settlement Platform	Each
3340	Steel Pipe, 2 1/2-inch	Linear Foot
3343	Steel Pipe, 4-inch	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

DIVISION 300

AGGREGATE BASE COURSES

SECTION 301 ¾ TRAFFIC-BOUND BASE

301.01 DESCRIPTION. Construct traffic-bound base courses with one or more courses of coarse aggregate on a prepared subgrade.

When the Contract provides for traffic-bound surfacing of road approaches, private entrances, and turnouts in conjunction with other highway surfacing or paving operations, perform such work according to Section 112.

301.02 MATERIALS. Furnish aggregate conforming to Section 805.

301.03 CONSTRUCTION.

301.03.01 Preparation of Subgrade. Prepare and maintain the subgrade according to Section 207.

301.03.02 Placing Aggregates. Spread the aggregate in the number of courses and at the rate of application indicated in the Contract to the width and depth specified. Place additional aggregate to strengthen weakened areas as the Engineer directs.

When practical, route hauling equipment uniformly over all portions of the previously laid courses of the base. The Department will not require any additional compaction. Obtain the Engineer's permission prior to revising this procedure for distribution of aggregate.

301.04 MEASUREMENT. The Department will measure the quantity in tons according to Section 109.

301.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0020	Traffic-Bound Base	Ton

The Department will consider payment as full compensation for all work required under this section.

SECTION 302 — DENSE GRADED AGGREGATE BASE (DGA) AND CRUSHED STONE BASE (CSB)

302.01 DESCRIPTION. Construct the base on a prepared subgrade.

302.02 MATERIALS.

302.02.01 Aggregate. Conform to Section 805.

302.02.02 Water. Conform to Section 803.

302.03 CONSTRUCTION. Prepare the subgrade according to Section 207, and keep it free from irregularities.

When reshaping and compacting or scarifying and reshaping is not specified for existing traffic-bound surfaces, grade and shape to the grade and cross section required.

Construct shoulders according to Section 209.

302.03.01 Mixing. Thoroughly mix the aggregate and water in a pugmill type mixer, unless another type mixer is approved. Add water as needed to compact to the specified in-place density.

302.03.02 Transporting. Transport the plant-mixed material to the project without loss or segregation. Cover each truck load with a heavy canvas sheet to reduce the loss of moisture during transit when the time between loading the truck and spreading the mixture exceeds 30 minutes.

302.03.03 Placing and Spreading. Place and shape the mixture by power equipment, to the specified lines, grades, cross sections, and depths, without segregation.

Place, spread, shape, and compact in a manner that is as continuous as practical during each day's run. Wet the base as directed during shaping and compaction operations to maintain the moisture content at the level necessary to ensure proper compaction.

When the required thickness of base is no more than 8 inches for CSB and 6 1/2 inches for DGA and the Engineer is satisfied that acceptable compaction can be achieved throughout the full depth, place the material in one layer. Otherwise, place the material in 2 or more layers of no less than 3 inches.

Wet the subgrade or previous base layer as directed before placing the base material.

302.03.04 Compacting.

A) Control Strips. Before constructing the base, complete a control strip to determine the level of compaction necessary to achieve the target density for the remaining base course. Construct additional control strips whenever a change is made in the source, gradation, type of subgrade, type of base aggregate, layer thickness, or as the Engineer requires.

Compact with an effort greater than or equal to that produced by a 16-ton pneumatic roller, or a 8-ton steel-wheel vibratory roller. Operate vibratory rollers according to the manufacturer's instructions.

Leave each control strip in place to become part of the project. Complete at least one control strip for each layer of base material. Unless the Engineer approves otherwise, construct the control strip to a minimum length of 500 feet and to the full width of the aggregate base course. Use the same equipment and procedures intended for the construction of the remainder of the base course. After 2 passes of the compaction equipment the Department

will mark and take 3 density measurements at randomly selected sites, at least 2 feet from the edge of the base. The Department will take density measurements at the same 3 locations after subsequent passes of the compaction equipment. Compact the control strip until no further increase in density can be obtained from additional passes.

The Engineer will visually inspect the base material after each pass to determine if the aggregate is being crushed into fine material. If the aggregate is being crushed, cracked, shoved, or shows other signs of distress, cease compaction efforts. If compaction of the base is not satisfactory, use other methods to achieve satisfactory results.

Regardless of lift thickness, the Department will require a control strip to establish a roller pattern.

B) Target Density. After completing compaction of the control strip, the Engineer will conduct 10 field density measurements at random locations in the control strip and average the 10 measurements to obtain the target density for the compaction of the base.

C) Field Density Measurement. When the total compacted thickness is more than 4 inches, the Engineer will determine the field density with nuclear gauges. When the total compacted thickness is 4 inches or less, the Engineer will determine compaction by nuclear gauge or make acceptance by visual inspection.

D) Test Sections. The Engineer will divide the remaining length of the project into test sections of approximately 2,500 square yards with a depth equal to that of the control strip; divide each test section into 5 equal segments; take density measurements at a random location within each segment; and require the test sections average density to be 98 percent of the target density or greater with no individual measurement less than 95 percent of the target density.

When the average density of a test section does not meet the density required above, cease laydown operations, and either provide additional compaction effort or rework the entire test section to obtain the required average density. When an individual density measurement does not meet the required density, provide additional compaction efforts or rework the area represented by that measurement to meet the required density.

E) General. Maintain the initial layers of base to a uniform grade and cross section during compaction. Shape the final layer with additional material when necessary.

When trimming the final layer to the final grade with an automatic grading machine, provide a layer approximately 1/2 to one inch above grade for continuous cutting. After making the final pass with the grading machine, wet and roll the base with a static roller. The Engineer will recheck density to ensure the material still conforms to the density requirements. Reuse excess material removed by the grading machine in shoulders, islands, or other areas where aggregate stone base is specified, but not under roadway pavement.

Use manually operated mechanical tampers in areas inaccessible to power equipment.

Do not add fines to meet target density.

302.03.05 Maintenance and Protection. Restrict traffic on the completed base to the minimum necessary to complete the work, and maintain public traffic. Moisten areas subjected to traffic, as directed, to avoid the loss of fine materials. If desired, use a dilute emulsified asphalt for dust control.

Before constructing succeeding courses, check for damage, such as raveling and lost density, and recheck the grade and cross section. Make corrections as necessary.

Make every reasonable effort to completely cover the aggregate base course with the specified pavement courses before suspending work for the winter months. When the base course is not completely covered with the specified pavement courses, determine and perform all work necessary to protect and maintain the uncompleted work during the winter months. Perform all work necessary to acceptably repair or

restore the uncompleted work before the beginning of spring paving operations. Obtain the Engineer's approval for all work necessary to protect, maintain, and repair the base.

302.03.06 Surface Tolerances. Ensure that the surface of the top course of the base is smooth and uniform. When performing final grading, trim the base to within ± 1/2 inch of the specified cross section and ± 3/8 inch in 10 feet from the specified longitudinal grade at any location or to an accuracy allowing the succeeding courses to meet their specified surface and thickness tolerances, whichever is stricter.

Furnish all devices and labor necessary to check the surface.

302.04 MEASUREMENT. The Department will not measure water used to moisten the subgrade, for mixing the base material, and to maintain moisture during compaction and maintenance of the base for payment.

The Department will measure the quantity of plant-mixed materials according to Section 109. The Department will not make deductions for water in the mixture.

The Department will not measure construction of control strips, any necessary reworking of control strips, or test sections for additional payment.

The Department will not measure dust control for payment.

The Department will not measure for payment any extra materials, methods, or construction techniques, the Engineer determines not to be a part of the specified construction, to protect, maintain, or repair any portion of the uncompleted work during the winter months.

The Department will measure and deduct material wasted from trimming the final grade.

302.04.01 Dense Aggregate Base. The Department will measure the quantity in tons.

302.04.02 Crushed Stone Base. The Department will measure the quantity in tons.

302.05 PAYMENT. The Department will pay for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0001	DGA Base	Ton
0003	Crushed Stone Base	Ton

The Department will consider payment as full compensation for all work required under this section.

SECTION 303 ¾ PAVEMENT DRAINAGE BLANKET

303.01 DESCRIPTION. This section covers pavement drainage blankets. For PCC pavements, construct either an untreated, asphalt-treated, or cement-treated drainage blanket. For asphalt pavements, construct an untreated, asphalt-treated, or cement-treated drainage blanket as the Contract specifies.

303.02 MATERIALS.

303.02.01 Aggregate. Use crushed stone conforming to Sections 804 and 805.

302.02.02 Asphalt Binder. Conform to Section 806, PG 64-22.

303.02.03 Cement. Conform to Section 801, Type I or III.

303.02.04 Water-Reducing Admixture. Conform to Subsection 802.01, Type A, D, F, or G.

303.02.05 Water. Conform to Section 803.

303.02.06 Curing Compound. Conform to Subsection 823.02.

303.03 CONSTRUCTION.

303.03.01 Composition.

A) Untreated. Provide Size No. 57 aggregate. Obtain the Engineer's approval for any adjustments to the gradation when increased stability of the drainage blanket is deemed necessary.

B) Asphalt-Treated Drainage Blanket (ATDB). Use a gradation within the master range in the following table:

Sieve Size	Percent Passing
1 1/2 inch	100
3/4 inch	85-100
1/2 inch	35-65
No. 4	0-20
No. 8	0-10
No. 200	0-4

Test gradation according to KM 64-407, KM 64-433, or KM 64-620.

For asphalt pavements, use an asphalt binder content of 1.5 to 2.5 percent by weight of the mixture. For PCC pavements, use an asphalt binder content of 2.5 percent or less by weight of the mixture. When using a porous aggregate, increase the asphalt binder content as needed to compensate for asphalt absorption by the aggregate. Submit aggregate samples and a proposed JMF for approval according to KM 64-421. Maintain the JMF asphalt binder content within ± 0.5 percentage points as determined according to KM 64-405, KM 64-436, or AASHTO T 308.

Asphalt binder content will be based on visual inspection of the extent the aggregate is coated. The Department will not adjust payment due to adjustment of the asphalt binder content.

Request adjustments in the JMF gradation if deemed necessary to increase stability of the drainage blanket, providing the revised JMF gradation and asphalt binder content are maintained within the specified limits.

C) Cement Treated Mixture. Provide Size No. 57 aggregate. Submit aggregate

samples and a proposed cement content, and the Engineer will perform testing as necessary to determine if the proposed mix design is acceptable.

For asphalt pavements, ensure the mix design conforms to the following:

1) Minimum compressive strength of 400 psi shall be attained in 72 hours ± 6 hours. Determine the compressive strength according to KM 64-305, except the specimen shall remain in the mold until the time of the test.
2) Minimum cement content of 250 pounds per cubic yard.
3) Maximum water/cement ratio of 0.37.
4) Use a water-reducing admixture.

303.03.02 Placement of Drainage Blanket.

A) Untreated Drainage Blanket. Place with self-propelled equipment to produce a smooth, uniform layer of material ready for compaction. Compact with a smooth-wheel roller to a smooth and uniform surface. Do not use vibrating rollers. Place the drainage blanket on the shoulders with an offset spreader to avoid damaging or displacing the underdrain pipe. Immediately replace any pipe that is damaged by construction or hauling equipment.

B) ATDB. All requirements of Section 403 for asphalt mixtures apply, except as follows:

1) Maintain the temperatures of the materials and the mixture, in degrees Fahrenheit, within the following ranges:

	Minimum	Maximum
Aggregate	200	260
Asphalt Binder	200	260
Mixture at Plant	200	260
Mixture When Placed	180	260

2) Avoid excess drainage of the asphalt binder while being stored.
3) Compact the ATDB using a smooth-wheel roller. Do not use vibrating rollers. Avoid over rolling to the extent that aggregate particles are broken.
4) The surface of the ATDB shall be smooth and uniform, and shall reasonably conform to the specified lines, grades, and typical section. The completed ATDB shall meet the surface tolerances specified in Subsection 403.03.11 for base courses. Perform any corrective work necessary using asphalt mixtures the Engineer approves. The Department will not allow procedures or mixtures that might produce fine material that would tend to clog or reduce drainage.
5) Allow the ATDB to cure at least 10 hours, or as the Engineer directs, before placing subsequent courses.

C) Cement-Treated Drainage Blanket.

1) Plant, Mixing, and Hauling. Conform to the applicable batch plant, mixing procedures, and hauling equipment requirements of Section 501 for PCC pavement.
2) Placing and Spreading. Use spreading, consolidation, and finishing equipment that conforms to the requirements of Section 501, or is approved by the Engineer upon demonstration of satisfactory performance on a test strip of approximately 3,000 square yards.
3) Compaction. Compact the material with a steel-wheeled, tandem roller weighing approximately 10 tons, unless the drainage blanket is placed by a slip-form paver and the Engineer determines consolidation is acceptable without rolling. Compact within 30 minutes after spreading by completing at least 2 complete coverages of the drainage blanket with

the roller. Provide sufficient equipment and rollers to ensure that no more than 1.25 hours elapse between the time that water is added to the combined aggregate and cement and the time the final compaction is completed.

4) Curing. Cure by one of the following methods immediately after spreading and compacting the drainage blanket:

   a) Cover the entire surface and exposed edges of the drainage blanket with transparent or white plastic of at least 4 mils thickness. For asphalt pavements, hold the plastic in place with aggregate or other acceptable means for at least 3 days. Immediately repair any damage occurring to the plastic during the curing period.
   b) Membrane-cure according to Subsection 601.03.17 B). For PCC pavements, the Department will waive the curing time requirements.

5) Surface Finish. The surface of the drainage blanket shall be smooth and uniform, and shall reasonably conform to the specified lines, grades, and cross section. Ensure the completed drainage blanket does not show a deviation greater than 1/4 inch from a 10-foot straightedge, and the cross slope does not deviate more than 1/4 inch in 5 feet from the specified cross slope.
6) Perform any corrective work necessary using mixtures the Engineer approves. The Department will not allow procedures or mixtures that might produce fine material that would tend to clog or reduce drainage.
7) Weather Limitations and Protection. Mix and place the cement treated material when the air temperature in the shade, away from artificial heat, is 45 °F and rising. Unless otherwise authorized in writing by the Engineer, discontinue mixing and placing the cement-treated material when a descending air temperature in the shade, and away from artificial heat, reaches 50 °F.

303.03.03 Maintenance and Protection. Limit traffic over the drainage blanket to the minimum necessary for succeeding or adjacent work. Prevent contamination of the drainage blanket by dust, dirt, or mud. Remove and replace portions of the blanket that is contaminated to the extent that the drainage is clogged or reduced at no additional cost to the Department.

Preserve the integrity of the subgrade, base courses, perforated pipe, pavement drainage blanket, and the subsequent paving courses. Control the gross weights and types of hauling vehicles so no component is damaged by hauling for construction of the next component.

Do not operate trucks or other equipment longitudinally directly over the perforated pipe.

Repair damage to any of the various items, except damage caused by public traffic, at no cost to the Department.

303.03.04 Overlaying of Drainage Blankets. Exercise extreme caution when placing asphalt mixtures near or over underdrains to avoid displacing or damaging the drain.

A) Untreated Drainage Blanket.

1) Asphalt Mixture Overlay. Operate one or more rollers on the drainage blanket ahead of the paver to repair and recompact any portion of the drainage blanket displaced by hauling equipment. Grade when necessary. Place the first course using a paver mounted on tracks to minimize displacement of the drainage blanket.

   Compact the first course of asphalt base placed on an untreated drainage blanket to the greatest extent possible without damage in the judgment of the Engineer. The Department will waive density

requirements for this course. The Department will apply density requirements to all subsequent courses of asphalt mixture.

Contrary to Section 403, use the rate of application to control thickness of the asphalt base. Place the mixture at the weight per square yard designated in the plans or proposal, or by the Engineer. Do not exceed the designated rate of application by more than 5 percent. The Department will not pay for any material placed in excess of this 5 percent tolerance.

Allow the first course of base 7 days to cure before placing the succeeding course, unless the Engineer shortens the required time due to rainy and/or cool weather. In all cases, provide at least 3 days curing.

2) PCC Overlay. When PCC pavement is constructed on an untreated drainage blanket, place by the slip form process. Use offset equipment to construct PCC shoulders.

B) Treated Drainage Blanket.

1) Asphalt Mixture Overlay. When asphalt pavement is constructed on a treated drainage blanket, place the first course using a paver mounted on tracks if rubber-tired pavers cause displacement of the drainage blanket.

Compact asphalt base according to Subsection 403.03.10.

Allow the first course of asphalt mixture to cure overnight before placing the succeeding course.

Place the thickness of asphalt base on treated drainage blankets according to Subsection 403.03.06.

2) PCC Pavement Overlay. Place without damaging the drainage blanket or underdrain system. Use anchor hooks of sufficient length to extend through the drainage blanket and hold the load-transfer assemblies securely in place.

303.04 MEASUREMENT.

303.04.01 Drainage Blanket-Type I (Untreated). The Department will measure the quantity in tons according to Section 109.

303.04.02 Drainage Blanket-Type II (ATDB). The Department will measure the quantity in tons according to Subsection 402.04. Asphalt mixtures used for leveling the surface of the completed drainage blanket will be measured in tons as drainage blanket.

303.04.03 Drainage Blanket-Type III (Cement-Treated). The Department will measure the quantity in tons according to Section 109.

303.04.04 PCC Pavement Drainage Blanket. The Department will measure the quantity in tons according to Section 109.

303.05 PAYMENT. The Department will pay for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0015	Drainage Blanket-Type I - Untreated	Ton
0018	Drainage Blanket-Type II - ATDB	Ton
0019	Drainage Blanket-Type III - Cement Treated	Ton
0022	PCC Pavement Drainage Blanket	Ton

The Department will make payment for Drainage Blanket-Type II (ATDB) according to the Lot Pay Adjustment Schedule for Specialty Mixtures in Section 404.

The Department will consider payment as full compensation for all work required under this section.

DIVISION 400

ASPHALT PAVEMENTS

SECTION 401 ¾ ASPHALT PLANT REQUIREMENTS

401.01 DESCRIPTION. Provide and maintain a plant and all equipment necessary to produce and test asphalt mixtures.

401.02 EQUIPMENT.

401.02.01 All Asphalt Mixing Plants. Ensure that all asphalt mixing plants are inspected and approved by the Department before initial use and a minimum of once annually thereafter. For initial approval, submit a "Contractor's Master Certification of Asphalt Mixing Plant and Related Equipment" form for each plant to the Engineer. For previously approved plants, submit an "Annual Renewal Certification for Previously Approved Plants and Related Equipment" form to the Engineer before beginning each season. When significant changes are made in the plant equipment or in the method of operation at an approved plant, reapply for approval.

Ensure the manufacturer's plate, listing the maximum capacity of the plant, is attached to the plant. Do not operate the plant at a production rate greater than the operational capacity of any plant component. The Engineer reserves the right to reduce the size of the batch or rate of production when, in his judgment, the mixer will not operate effectively at the rated capacity. Operate the plant so that it produces a mixture within the specified properties, gradation tolerances, and asphalt binder tolerances.

When plants are in operation, the Department will require the following minimum computer equipment for submission of test data: one computer on the site of operations installed with, and capable of running, the following:

1) Microsoft Windows 95; and
2) Microsoft Excel, Version 7.0 or greater.

Additionally, the Department will require that each Company provide at least one Internet access site for sending and receiving electronic mail.

A) Field Laboratory. Furnish and maintain a field laboratory facility according to Subsection 106.03.02. A field laboratory may be a building, trailer, or space within a building, provided the space is completely closed to the remainder of the building. Provide means for visually monitoring mixing plant operations. Do not use laboratories for storage.

Provide a laboratory conforming to the following minimum requirements:

1) a floor space of 250 square feet with a minimum width of 7 feet;
2) provisions for heating and cooling within the range of 65 to 80 °F;
3) adequate lighting; and
4) a sufficient number of electric wall outlets (110-120v) to accommodate all equipment.

The Engineer will accept a laboratory with a floor space less than 250 square feet if it was previously approved and is determined to be of adequate size.

In addition to the equipment required to perform testing according to the applicable Kentucky Methods (KM), equip each laboratory with the following minimum furnishings and equipment, conforming to the applicable specifications, as required for the type of construction specified in the Contract:

1) the KM Manual;
2) the Standard Specifications book;

3) one workbench, at least 2 1/2 feet wide by 6 feet long;
4) one desk or table and 2 chairs;
5) a fire extinguisher located near the door;
6) a first-aid kit;
7) one Superpave Gyratory Compactor (SGC) from the Department's List of Approved Materials;
8) all items necessary for calibration or verification of the SGC; and
9) four 150-mm molds for the particular SGC.

When solvent extractions are used for acceptance purposes, provide all additionally needed equipment, according to the applicable KM. Ensure that the extractor stand is fully enclosed and equipped with fans capable of exhausting at least 1,450 cubic feet per minute. Build duct-work across the entire backside of the workbench with an access port into an enclosed cabinet, so as to direct any fumes or dust from the top of the workbench into the enclosed cabinet. The Engineer will furnish a sketch of an acceptable exhaust system upon request. The Engineer will approve other configurations if he determines that they meet the intended purpose. Mount all control switches outside the cabinet.

When using solvent extractions for asphalt binder content determination, provide equipment and solvent for either the centrifuge (Method A) or the vacuum extractor (Method B) according to KM 64-405.

B) Aggregate Storage. Provide sufficient storage for separate stockpiles, bins, or stalls for each size of aggregate; or otherwise provide a direct feed from the aggregate production. Keep different sizes separated until delivery through the cold feed proportioning devices. Maintain the storage area in an orderly condition with walkways between stockpiles not separated by bins or stalls. Provide adequate provisions for sampling aggregates from the stockpiles or the direct feed from the aggregate production.

C) Equipment for Handling Asphalt Binders. Provide tanks for storage of asphalt binders equipped for heating the material to the temperature required in Subsection 401.03.01. Heat the tank without letting the flames contact it.

Provide a circulating system for the asphalt binder of a capacity that ensures continuous circulation between the storage tank and proportioning unit during the entire operating period.

Place the discharge end of the asphalt binder circulating pipe at the opposite end of the circulating pump, near the bottom of the storage tank.

Heat and insulate all pipelines and fittings to prevent heat loss.

Provide a storage tank with a capacity that ensures continuous plant operation and uniform temperature of the asphalt binder when it is introduced into the pugmill. Provide means for accurately measuring the volume of asphalt binder in the storage tank at any time. Provide separate storage for each type and grade of asphalt binder stored at each plant site.

Provide a sampling outlet that is readily accessible and free from obstruction in each storage tank or in the asphalt binder feed lines connecting the plant storage tanks to the asphalt plant. When the sampling valve is located in the feed line, provide it between the pump and the return line discharge in a location that is readily accessible and free from obstruction. Provide a drainage receptacle for flushing the outlet before sampling.

D) Feeder for Drier. Provide a mechanical feeder that is an apron, belt, reciprocating plate, or vibrating type with accurate and separate adjustments for total and proportional feed. Install total and proportional feed adjustments that are continuously variable and capable of being fixed in any position.

E) Drier. Provide a drier capable of drying and heating the aggregate to the moisture content and temperature requirements set forth in the applicable mixture specifications without leaving any visible unburned residue on the aggregate when discharged from the drier.

F) Screens. Provide plant screens to prevent oversized material and to separate all aggregates so they may be recombined consistently within the specification limits for the asphalt mixture being produced.

G) Bins. Provide the plant, except for drum-mix plants, with a hot-bin storage of a sufficient capacity to ensure uniform and continuous operation.

Use bins that are divided into at least 3 compartments and arranged to ensure storage of appropriate fractions of the aggregates. Use bins that are designed such that samples of dry, screened aggregates may be readily sampled from each compartment.

Provide each compartment with an overflow pipe that prevents material from backing up into other bins or into contact with the screen.

Provide dry storage for mineral filler and provisions for accurate proportioning.

Equip each compartment with an audible alarm to indicate when there is a low supply of material. Equip batch plants with an actuating device that prevents material from being drawn from other compartments when material is low in the compartment being used. Equip continuous plants with an actuating device that prevents material from being drawn from all compartments when material is low in any one compartment.

H) Asphalt Binder Control Unit. Provide a means, either by weighing or metering, to obtain the proper quantity of asphalt binder. Ensure that metering devices are accurate to within ± 1.0 percent when tested for accuracy. Use asphalt binder scales that conform to Subsection 401.02.02 B).

When metering the quantity of asphalt binder, check the delivery of the meter by actual weight.

For drum and continuous mixing plants, calibrate the asphalt binder delivery system and metering device before starting production at the beginning of each construction season, each time the plant is relocated, after making significant changes in the plant equipment, after revising the method of operation, and whenever the Engineer deems it necessary.

Maintain the specified temperatures of asphalt binder in the pipelines, meters, buckets, spray bars, and other containers or flow lines.

I) Thermometers. Provide a recording and a non-recording thermometer in the asphalt binder feed line between the storage tank and the charging valve. When a non-recording thermometer is installed in the asphalt binder storage tank(s), the Department will not require a non-recording thermometer in the feed line.

Provide a recording and a non-recording thermometer near the discharge of the aggregate bin, unless the aggregate dryer is equipped with an automatic burner control system capable of heating the aggregate and consistently maintaining the temperature of the asphalt mixture within ± 15 °F.

Maintain a file for each project of all daily temperature charts for asphalt binder for a period of 3 years for review by the Engineer.

J) Control of Mixing Time. Use a plant equipped with means for governing mixing time.

K) Dust Collectors. Equip the plant with an effective dust collector capable of either wasting the collected dust or using it in the mixture.

L) Power Sprayer. Furnish a power sprayer to apply a fine uniform spray or mist of approved material in truck beds to prevent the adherence of asphalt mixtures during hauling.

M) Signs. Place a sign on or near the plant visible to all asphalt mixture haulers prior to loading, stating "TRUCKS HAULING STATE MATERIAL WILL NOT BE LOADED WHEN BEDS CONTAIN CONTAMINATING MATERIAL AND MUST BE TARPED PRIOR TO LEAVING PLANT."

N) Other Requirements. Provide adequate and safe stairways to the mixer platform and guarded ladders for other plant units at all locations necessary to provide access to all plant operations. Provide a sturdy platform of sufficient height to inspect and sample the mixture after discharge into the haul units.

O) Safety Requirements. Ensure that all plants and plant sites conform to the safety, health, and sanitation requirements of Subsection 107.01.01.

401.02.02 Special Requirements for Batch Plants.

A) Weigh Box or Hopper. Provide equipment that weighs each bin size of aggregate into a weigh box or hopper that is suspended on scales and holds a full batch size of aggregate. Provide gates that prevent leakage when closed.

B) Scales. Provide springless, dial type, or anther approved types of scales for any weigh box or hopper, and for weighing asphalt material. Provide scales of standard make and design having tolerances on overregistration and underregistration not exceeding 0.5 percent of the indicated weight when tested for accuracy.

Ensure that the change in load required to noticeably alter the position of rest of the indicating element(s) of a non-automatic indicating scale is not greater than 0.1 percent of the nominal scale capacity.

Ensure that graduation intervals for scales are less than 0.1 percent of the nominal scale capacity and are plainly visible.

On dial scales, reduce parallax effects to the practical minimum with clearance between the indicator index and scale graduations not exceeding 0.06 inches.

Provide scales equipped with adjustable set points or pointers for marking the weight of each material to be weighed into the batch.

Have the component batching scales inspected and certified as specified in Subsection 109.01.02.

Provide no fewer than 10 test weights, each of at least 50 pounds nominal weight and stamped with its actual weight, for the purpose of testing and calibrating the scales. For each scale, provide a suitable cradle or platform for applying test loads. Keep test weights clean and conveniently located for calibration of the scale or provide means for testing and calibrating the scales by a commercial scale company when the Engineer requests.

The Department will allow batch plants to operate with no screens, other than a scalper screen, provided:

1) The plant is equipped with an aggregate weighing device (belt scales) that provide positive weight control;
2) The system controls aggregate flow from each bin;
3) The system controls the proportion from each bin in relation to the total aggregate flow;
4) The system provides the plant operator with a continuous digital display of the flow rate from each bin and the total aggregate flow rate; and
5) The system provides an alarm or automatic shut-off on the aggregate feed that operates when the flow from any individual feeder is interrupted.

Calibrate each cold feeder, along with the aggregate weighing devices, according to Subsection 401.02.05 A) and B).

C) Bins. For batch plants equipped with aggregate weighing devices Subsection 401.02.02 B) specifies, the Department will not require 3 separate hot aggregate bin compartments.

D) Asphalt Materials Bucket. If using a bucket, provide one large enough to handle a batch in a single weighing.

Provide a filling system that prevents asphalt binder material from overflowing, splashing, or spilling outside the bucket during filling and weighing.

Use a steam or oil-jacketed bucket or a bucket with properly insulated electric heating units. Arrange the bucket so it delivers the asphalt binder in a thin uniform sheet or in multiple sprays over the full length of the mixer.

E) Mixer Unit for Batch Method. Include at the plant a batch mixer of an approved twin pugmill type. Ensure that the mixer does not leak or cause segregation during discharge.

Provide a blade clearance from all fixed and moving parts that does not exceed 1 1/2 inches.

Provide a mixer with an accurate time lock. Control the operation of a complete mixer cycle by locking the weigh-box gate after charging the mixer until closing of the mixer gates at the completion of the cycle. Ensure that the asphalt materials bucket remains locked throughout the dry-mixing period and that the mixer gates remain locked throughout the dry and wet mixing periods. (The dry-mixing period is the interval of time between the opening of the weigh-box gate and the application of asphalt binder. The wet-mixing period is the interval of time between the start of the application of asphalt binder and the opening of the mixer gate.)

401.02.03 Special Requirements for Automatic Batching. Provide the systems with equipment for accurately proportioning batches of the various components of the mixture by weight in the proper sequence and for controlling the sequence and timing of mixing operations. Equip the plant with adjustable timing devices and other time-delay circuits that integrate the individual components of batching and mixing operations with the auxiliary interlock cut-off circuits necessary to interrupt and stop the automatic cycling of the batching operations whenever the quantity of any ingredient falls outside the tolerance specified below:

BATCH TOLERANCES

Material	Percent of Total Batch Weights
Batch Aggregate Component	± 1.5
Mineral Filler	± 0.5
Asphalt Binder	± 0.1
Zero Return (Aggregate)	± 0.5
Zero Return (Asphalt Binder)	± 0.1

Ensure that the accumulated weight of the batches is within 2.0 percent of the total batch weight. Record batch quantities according to AASHTO M 156.

When the automatic proportioning system becomes inoperative, the Engineer may allow the plant to operate semi-automatically until repairs can reasonably be expected to be made, provided the asphalt mixtures produced conform to specifications. The Department will not allow the plant to operate in this manner for more than 3 working days.

401.02.04 Special Requirements for Continuous Plants.

A) Gradation Control Unit. Provide a means to check the proportioning of each bin size of aggregate by weight.

Mount interlocked feeders under the bin compartments. Equip the interlocked feeders with a dust-proof revolution counter with maximum graduations of 0.1 of a revolution. Set the bin proportions based on pounds of each aggregate size per revolution.

Provide each bin with a feeder mechanism capable of controlling the rate of flow of aggregate from each bin. If a gate orifice feeder is used, ensure that it has at least one adjustable dimension. Provide calibrated gages with graduations of no more than 0.1 inch for each gate to establish the gate openings.

When using mineral filler, furnish a separate bin and feeder with its drive interlocked with the aggregate feeders.

B) Weight Calibration of Asphalt Binder and Aggregate Feed. Calibrate the gate openings and asphalt materials flow by means of test samples in pounds per revolution.

Use individual orifices to bypass the aggregate feed out of the bins into suitable test boxes. Confine each individual material in individual test receptacles or compartments.

Supply accessories so the aggregate in each compartment may be weighed separately.

C) Synchronization of Aggregate and Asphalt Binder Feed. Provide positive interlocking or mechanical control between the flow of aggregate through the gates and the flow of asphalt binder through the proportioning device. Check the rate of flow of the asphalt binder by the scale weight per revolution.

D) Mixer Unit for Continuous Method. Provide a continuous mixer of an approved twin pugmill type.

Provide paddles that are adjustable for angular position on the shafts and reversible to retard the flow of the mix.

Equip the hopper with dump gates that allow rapid and complete discharge of the asphalt mixture.

401.02.05 Special Requirements for Dryer Drum Plants.

A) Aggregate Weighing Device. Provide an aggregate weighing device that includes a compensating adjustment for aggregate weight changes due to such factors as moisture content, wasting collected fines, and adding mineral filler. Provide a device that is capable of being set to the nearest 0.1 percent. Ensure the metering devices are accurate to within $\pm$ 0.5 percent.

B) Feeder for Drier. Provide a scalping screen of appropriate size in advance of the weighing device.

Control aggregate flow from each bin. Control the proportion from each bin in relation to the total aggregate flow. Provide the plant operator with a continuous digital display of the flow rate from each bin and the total aggregate flow rate. When devices other than belt scales are used to control individual aggregate proportions or when belt scales do not have the capability to control the proportioning from each bin in relation to the total aggregate flow, provide an alarm that operates when the sum of the individual cold feeds differs by more than 3 percent from the measured weight of the total aggregate feed.

Provide an aggregate feed system with belt scales or other devices to provide positive weight control of the total aggregate feed. Ensure that the total aggregate flow is automatically coupled with the asphalt binder proportioning device.

Provide an alarm or automatic shut-off on the total aggregate feed that operates when the flow from any individual feeder or the flow of asphalt binder to the drum is interrupted.

Provide means for obtaining representative samples of individual and combined aggregate from belts or feeders before their introduction into the dryer.

Calibrate each cold feeder, along with the aggregate weigh bridge(s), before starting production at the beginning of each construction season, each time the plant is relocated, after making significant changes in the plant equipment, after revising the method of operation, and whenever the Engineer deems necessary.

C) Drier. Use a dryer drum mixer capable of simultaneously heating, mixing, and thoroughly coating the aggregate with a controlled amount of asphalt binder in a rotating cylindrical drum. The Department may allow coating of the aggregate with asphalt binder in a separate chamber with an approved

design.

Equip the dryer drum plant with approved thermometric instruments at the discharge chute of the drum mixer. Equip the system with automatic burner controls regulated by approved temperature-sensing devices.

D) Surge and/or Storage Bin. Provide a surge and/or storage bin conforming to Subsection 401.03.02 D).

E) Dust Collector. Use a dust collector capable of proportioning collected dust in the vicinity of the asphalt injection device.

F) Production Quality Control. Stop mixing operations immediately if, at any time, there is a failure of the automatic electronic weighing system of the aggregate feed or the asphalt binder feed control occurs. Do not manually operate the proportioning controls.

401.03 CONSTRUCTION.

401.03.01 Preparation of Mixtures. Deposit the coarse and fine aggregates in the cold elevator(s) at a rate to ensure correct and uniform temperature control of the heating and drying operations.

If the supplier heats the asphalt binder outside the specified range, let it reach a temperature within the specified range before mixing it with the aggregates. The Engineer may retest or reject asphalt mixture, in storage at the plant, that has been heated by the Contractor outside the specified range. Do not use asphalt binder while it is foaming.

Maintain the temperature of the component materials and the asphalt mixture within the ranges listed in the following table:

MIXING AND LAYING TEMPERATURES (°F)

Material		Minimum	Maximum
Aggregates		240	330
Aggregates used with Recycled Asphalt Pavement (RAP)		240	—
Asphalt Binders	PG 58-22 and PG 64-22	230	330
	PG 70-22	285	350
	PG 76-22	285	350
Asphalt Mixture at Plant (Measured in Truck)	PG 58-22 and PG 64-22	250	330
	PG 70-22	300	350
	PG 76-22	310	350
Asphalt Mixture at Project (Measured in Truck When Discharging)	PG 58-22 and PG 64-22	230	330
	PG 70-22	275	350
	PG 76-22	300	350

Maintain the temperature of the mixture at the plant to within ± 15 °F of the approved mixing temperature. The Engineer may accept batches outside this tolerance if they are within the temperature requirements listed in the above table.

401.03.02 Mixing and Holding. Measure each size of aggregate and the asphalt binder separately. Regulate the proportion for each component to produce a mixture within the limits of the job-mix formula (JMF) and having all particles coated with asphalt binder.

Thoroughly mix the hot aggregates at the temperatures specified and proportion them by weight.

The Engineer may establish maximum mixing times when deemed necessary.

A) Batch Plants. Use the following mixing times, unless the Engineer determines that longer times are necessary, to produce acceptable mixtures:

1) Three seconds minimum for mixing the dry aggregates, beginning at the time of the opening of the aggregate weigh hopper discharge gate;
2) Fifteen seconds maximum for introducing asphalt binder in an even distribution throughout the full length of the mixer, beginning at the end of the dry-mixing interval;
3) Twenty-five seconds minimum for mixing the aggregates and asphalt binder, beginning with the start of flow of the asphalt binder to the mixer;
4) When the time for introducing the asphalt binder exceeds 10 seconds, mix the asphalt binder and aggregates, after all asphalt binder has been introduced, a minimum of 15 seconds; and
5) Thirty seconds minimum for the total mixing time from the time of the opening of the aggregate weigh hopper discharge gate until the time of the opening of the mixer discharge gate.

When the Engineer extends either the time for dry-mixing or the time for introducing the asphalt binder into the mixer, or both, extend the minimum total mixing time to the same lengths of time as the dry-mixing time and asphalt binder introduction time.

B) Continuous Plants. Mix the aggregates and asphalt binder to produce a well coated mixture.

C) Dryer Drum. For a dryer drum mixing plant, the Engineer will not establish the mixing time. However, maintain production at the rate required to obtain a satisfactory aggregate coating and a uniform mixture conforming to the mixture specifications.

D) Surge or Storage Systems. Provided each system has prior approval, the Department will allow surge or storage systems for hot asphalt mixtures. The Engineer will approve the surge or storage system if tests indicate the system is capable of conveying, retaining, and delivering the asphalt mixture without balling or hardening, appreciable loss of mixture temperature, segregation of the aggregates, or excessive oxidation of the asphalt binder. Add a silicone additive to the asphalt binder for mixtures to be stored beyond the day of mixing. The Engineer may withdraw approval of a surge or storage system when tests or inspections indicate the system is having a detrimental effect on the asphalt mixture.

Insulate bins intended for storage, and seal the top and bottom of the bins to prevent infiltration of outside air. When using bins for storage, maintain near full to provide a non-oxidizing condition. Maintain mixture temperatures to within those specified for Asphalt Mixtures at Plant according to Subsection 401.03 or 404.03 as applicable.

Completely empty surge bins by the end of each working day. When the bins cannot be emptied, store the asphalt mixtures overnight in a manner that prevents damage. Obtain the Engineer's approval for storage longer than overnight, up to 72 hours.

The Engineer will reject any asphalt mixture damaged in any way by use of a surge or storage system.

401.04 MEASUREMENT. Reserved.

401.05 PAYMENT. Reserved.

SECTION 402 ¾ CONTROL AND ACCEPTANCE OF ASPHALT MIXTURES

402.01 DESCRIPTION. Provide the process control and acceptance testing of all classes and types of asphalt mixtures.

402.02 MATERIALS AND EQUIPMENT.

402.02.01 Personnel. Provide a qualified Superpave Mix Design Technologist (SMDT) to be responsible for the submission and adjustment of the mix designs. Provide a qualified Superpave Plant Technologist (SPT) to be present during production and to perform the daily inspection, process-control, and acceptance testing at the plant site.

The Department will use a qualified SMDT for approval of all mix designs and a qualified SPT for verification testing.

402.03 CONSTRUCTION.

402.03.01 Responsibilities.

A) Composition of Mixtures. A JMF is defined as a single percentage for each specified sieve size for aggregate gradations and a specified asphalt binder content (AC) expressed to the nearest 0.1 percent. The Department will require an approved JMF within the specified gradation requirements for each mixture required on the project. Submit the JMF for the Engineer's approval according to KM 64-421.

B) Setup. Notify the Engineer of the intent to start a minimum of 36 hours before beginning production of each type of mixture. Furnish the facilities, equipment, personnel and all other resources needed to comply with KM 64-435 and KM 64-426. Provide a Quality Control Plan (QCP) and complete the setup duties of KM 64-421. Upon completing setup, prepare 2 duplicate maximum specific gravity (MSG) samples according to KM 64-411, and furnish them to the Engineer before the start of the second day of production. Complete the process control operations of KM 64-426. When the Engineer directs, obtain samples for Department use.

402.03.02 Acceptance.

A) General. The Department will accept asphalt mixtures from the plant on a lot basis. A lot is 4,000 tons. A sublot is 1,000 tons. Monitor and evaluate the AC, air voids (AV), voids-in-mineral aggregate (VMA), density, and gradation.

B) Sampling. Obtain all samples from the truck bed. Excluding the first sublot of production, obtain all samples according to the random sampling procedures of KM 64-113. Randomly determine when to obtain the acceptance samples, and take one sample for each sublot. At the beginning of each production day, do not take any acceptance samples before the production of 50 tons. If the random number falls within the first 50 tons, take the sample from the first loaded truck following the truck containing the 50th ton produced.

C) Setup. The setup period is the first sublot of production. Within the first 4 hours of project production or by the end of the first sublot, test to document that the mixture meets a 0.90 minimum pay value for AC, AV, and VMA. The Department will monitor the setup duties and testing and may test to confirm the setup results. When any of the mixture properties do not meet the minimum pay value, cease all shipments to the project and adjust procedures or mixture properties until they are acceptable. Provide the Engineer with a copy of the random number chart established for the entire tonnages for the mixture specified. Develop the rolling pattern during the first sublot. When

necessary during setup, adjust the AC up to ± 0.3 percent provided all other properties stay within their specified acceptance limits. Obtain the Engineer's approval to make this adjustment on all Specialty Mixtures.

D) Testing Responsibilities. Beginning with the second sublot, complete the following tests:

1) AC. Perform one evaluation corresponding to each AV/VMA analysis per sublot. Test according to KM 64-405, KM 64-436, KM 64-437, KM 64-438, or AASHTO T 308.
2) AV. Prepare and analyze one set of 2 specimens per sublot. Test according to KM 64-435.
3) VMA. Prepare and analyze one set of 2 specimens per sublot. Test according to KM 64-435.
4) Density. The Contract will state the compaction option to be used.

   Option A. Furnish 4 cores per sublot to the Engineer. Core the finished course at locations randomly selected by the Engineer according to KM 64-113. For random locations falling near the pavement driving lane joints, obtain the core as close to the location as possible without having any part of the core circumference coming closer than 3 inches to the pavement edge or joint. Obtain cores by the end of the following work day. Replace all cores the Engineer deems damaged. When directed by the Engineer, saw cores to the thickness actually placed. Promptly fill each core hole with compacted asphalt mixture or non-shrink grout. The Department will determine the density from the furnished cores according to KM 64-442. The Department will base values on the percent of solid density for that sublot's MSG's. The Department will evaluate values regularly exceeding 95 percent to determine if the MSG's or target density values are invalid.

   Option B. The Department will not require any cores.
5) Gradation. Control according to KM 64-407, KM 64-433, or KM 64-620 as needed.

   Use the same field sample for tests 1) through 3). Use the same specimens for tests 2) and 3). Retain the AV/VMA specimens and one additional corresponding MSG sample for 5 working days for verification testing by the Department. For Specialty Mixtures, retain a mixture sample for 5 working days for verification testing by the Department.

E) Shoulder Mixtures. The Department will accept shoulder mixtures as follows:

1) Placed Monolithically With the Mainline. Perform tests 1), 2), and 3) of Part D) above as part of the mainline mixture. Do not take cores from the shoulder for acceptance testing.
2) Placed Separately. Perform tests 1), 2), and 3) of Part D) above.

F) Specialty Mixtures. The Department will accept Open-Graded Friction Course (OGFC), Asphalt-Treated Drainage Blanket (ATDB), Asphalt Mixture for Pavement Wedge, Leveling and Wedging, Scratch Course, and asphalt mixtures for Base Failure Repair as follows. Perform one AC and one gradation determination per sublot. Determine the gradation from samples corresponding to the same production time period as the AC determination. Obtain and test the gradation samples according to KM 64-407, KM 64-433, or KM 64-620.

G) Mixtures With RAP. Furnish the grade of asphalt binder determined according to KM 64-427. Furnish a RAP sample and a minimum of 3 representative extracted gradation and determinations with the mixture design submittal. Perform one AC determination during setup. After setup, perform and document an AC determination and gradation for every 2 lots of mixture supplied.

H) Unsatisfactory Work.

1) Based on Lab Data. When the Contractor or Department determines any individual sublot pay value would be below 0.90 for AC, AV, or VMA in any QC or QA test, make adjustments and immediately run tests again. If the second round of tests determines any individual sublot pay value would have been below 0.90 for AC, AV, or VMA, cease all shipments to the project and adjust procedures or mixture composition until they are acceptable. Document acceptable materials and work before restarting operations. When the Engineer determines that safety concerns or other considerations prohibit an immediate shutdown, continue work and the Department will make an evaluation of acceptability according to Subsection 402.03.04.
2) Based on Field Review. If the Department determines that a portion of in-place material is unsatisfactory, the Department may require that the location be cored. The Department will then test the material for AC and Density. The Department will consider the work unsatisfactory and require corrective work to the affected area when a property met or exceeded a 1.00 pay value in the sublot acceptance test and the core shows the property having a pay value of below 0.90. Additionally, the Department will consider the work unsatisfactory and require corrective work to the affected area when any property of the core is within the following thresholds, regardless of the sublot acceptance test results:

PROPERTY	THRESHOLD
AC	$\geq \pm$ 0.9% deviation from JMF
Density	$\leq$ 89.0% or $\geq$ 97.5%

402.03.03 Verification. For volumetric properties, the Department will perform a minimum of one verification test for AC, AV, and VMA for each lot. For specialty mixtures, the Department will perform one AC and one gradation determination per lot. The Department will obtain an independent sample at the same time the Contractor is obtaining the random sample. The Department may perform the verification test on the Contractor's equipment or on the Department's equipment. Provided the differences are within the tolerances listed below and the results compare favorably with the other sublots' results, the Department will use the Contractor's test values to compute the appropriate lot pay value.

When differences between test results are not within the tolerances listed below, the Department will retest the Contractor's retained samples for the sublots. The Department's results will be used in the computation of the appropriate Lot Pay Adjustment. In the event that the Contractor's retained samples are not available, the Contractor shall provide additional samples, at his expense, as directed by the Engineer, to determine the acceptability of the lot in question.

COMPARISON OF DEPARTMENT AND CONTRACTOR TESTING	
Test	Tolerance (%)
AC	± 0.5
AV and VMA	± 1.0 (same equipment) ± 1.5 (different equipment)
1/2 inch and larger	± 5
3/8 inch, No. 4, No. 8, and No. 16	± 4
No. 30, No. 50, and No. 100	± 3
No. 200	± 2

The Department will monitor the test results of the acceptance testing for each sublot to identify patterns within the data. When patterns indicate substantial differences between the verified and non-verified sublots, the Department will perform further comparative testing according to Subsection 402.03.04.

The Department will perform independent-assurance testing (IAST) at the frequency prescribed by the Department's Manual of Field Sampling and Testing Practices.

402.03.04 Dispute Resolution. When differences between the Department and Contractor continue to exist and impact acceptability or payment, resolve the dispute according to Subsection 113.07.

402.04 MEASUREMENT. The Department will measure asphalt mixtures by the ton. On initial treatment and resurfacing jobs, the Department will not measure material placed in excess of the 5-percent tolerance specified in Subsection 403.03.06.

The Department will not measure for payment any extra materials, methods, or construction techniques, determined by the Engineer not to be a part of the specified construction, used to protect, maintain, or repair any portion of the uncompleted work during the winter months.

The Department will not measure the filling of core sample holes of asphalt mixtures for payment and will consider them incidental to the asphalt mixture.

When Reshape and Compact is not listed as a bid item, the Department will not measure the preparation of the foundation for the mixture courses.

The Department will not measure anti-strip additive for payment and will consider it incidental to the asphalt mixture.

For initial treatment, the Department will not measure excavation at bridge ends and related disposal of materials for payment and will consider it incidental to the asphalt mixture.

The Department will not measure construction of indented rumble strips for payment and will consider it incidental to the asphalt mixture.

402.04.01 Weight. The Department will weigh asphalt mixtures according to Section 109. The actual weight equals the pay weight except when the aggregates used have a combined bulk specific gravity in excess of 2.75. When the combined bulk specific gravity is greater than 2.75, the Department will determine the pay weight according to the following formula:

$$T = W\,[\%AC + \%MF + (\%Aggregate \times 2.75)/G] / 100$$

Where:
T = Pay weight.
W = Actual weight.
%AC = Percent, by weight, of asphalt binder in the total mixture.
%Aggregate = Percent, by weight of total mixture, of mineral aggregates excluding mineral filler.

G = Calculated combined, bulk, oven-dry, specific gravity of aggregates used in the mixture, excluding mineral filler.
%MF = Percent, by weight, of mineral filler.

The Department will determine the bulk, oven-dry specific gravity for the fine and coarse aggregates according to AASHTO T 84 and AASHTO T 85, respectively. The Department will determine the frequency of testing for specific gravity of the actual project aggregates to determine the pay weight.

402.04.02 Thickness on New Construction. When the core thickness exceeds the compacted plan thickness by more than 1/2 inch, the Department will deduct the thickness exceeding the 1/2-inch tolerance. When calculating the deduction for excess thickness, the Department will not include in the thickness measurements any leveling course placed at the Contractor's expense or any materials placed on top of the completed base at the direction of the Engineer.

When the Engineer determines the asphalt base is deficient in thickness by more than 1/2 inch from the compacted plan thickness, the Department will measure material required according to Subsection 403.03.06 B) for the overlay as asphalt base. The Department will only measure the calculated quantity necessary to bring the deficient area to the plan thickness. The Department will not measure material placed in excess of the plan thickness to achieve smooth transitions or to match grades.

If the Engineer deems it necessary to check the thickness of the overlaid area by coring, the Department will deduct the cost of this additional coring from monies due, or to become due, the Contractor when deficient thickness is found.

When the Engineer waives the overlaying requirement, he will make a reduction in payment for the theoretical quantity of asphalt base as determined deficient.

402.04.03 Quality Control (QC). The Department will measure the quantity according to Subsection 113.08.

402.05 PAYMENT.

402.05.01 Specialty Mixtures. The Department will calculate pay for OGFC, ATDB, Asphalt Mixture for Pavement Wedge, Leveling and Wedging, Scratch Course, and asphalt mixtures for Base Failure Repair according to the Lot Pay Adjustment Schedule for Specialty Mixtures in Section 404. The Department will assign a pay value for AC and gradation within each sublot and average the sublot pay values to determine the pay value for each lot.

402.05.02 Asphalt Mixtures and Mixtures With RAP. The Department will pay for the mixture at the Contract unit bid price and apply a Lot Pay Adjustment for each lot placed based on the degree of compliance with the specified tolerances. Using the Lot Pay Adjustment Schedule, the Department will assign a pay value for AC, AV, VMA, and Density within each sublot and average the sublot pay values to determine the pay value for a given property for each lot.

A) First Sublot (Setup). When the Engineer determines the first sublot's individual pay values are 0.90 or greater, the Department will use 1.00 pay values for all properties in the sublot. When the Engineer determines any of the first sublot's individual pay values are less than 0.90, the Department will apply a pay value of 0.85 or less for that property and may require corrective work.

B) After the First Sublot (Setup). The Department will use the Contractor's test results for each sublot to determine the pay values for AC, AV, VMA, and gradation (when applicable) provided the mixture's values are acceptable according to Subsection 402.03.03. When the Contract specifies compaction Option A, the Department will use the Department's test results for each sublot to determine the pay value for Density. When the Contract specifies compaction Option B, the Department will use 1.00 for the pay value for

Density.

When the randomly determined samples for AC, AV, VMA, and gradation (when applicable) fall outside the final sublot, the Department will calculate payment for these properties using the test results from the previous sublot.

When the final sublot contains a tonnage amount resulting in less than 4 randomly selected cores, the Department will calculate payment for Density using the available test results for the final sublot.

C) Conventional and RAP Mixtures Placed on Shoulders.

1) Placed Monolithically With The Mainline – The Department will pay as mainline mixture but use 1.00 for the Density Pay Value for shoulder quantities.
2) Placed Separately. The Department will use 1.00 for the Density Pay Value.

D) Conventional and RAP Mixtures Placed Monolithically as Asphalt Pavement Wedge. The Department will pay as mainline mixture but use 1.00 for the Density Pay Value for Asphalt Pavement Wedge quantities. Additionally, for Asphalt Pavement Wedge quantities, no pay value may exceed 1.00.

E) Asphalt Mixtures for Temporary Pavement. When the Engineer determines the individual pay values are 0.90 or greater, the Department will use a 1.00 pay value for all properties. When the Engineer determines any of the individual pay values are less than 0.90, the Department will apply a pay value of 0.85 or less for that property and may require corrective work.

402.05.03 Quality Control (QC). When listed as a bid item, the Department will pay for the quantity according to Subsection 113.09.

LOT PAY ADJUSTMENT SCHEDULE

Lot Pay Adjustment = (Unit Price) (Quantity) [{0.1(AC Pay Value) + 0.25(AV Pay Value) + 0.25(VMA Pay Value) + 0.4(Density Pay Value)} - 1.00]

WEIGHTED VALUES				
	AC	AV	VMA	Density
Weight (%)	10	25	25	40

AC	
Pay Value	Deviation From JMF (%)
1.00	≤ ± 0.5
0.95	± 0.6
0.90	± 0.7
(1)	≥ ± 0.8

VMA	
Pay Value	Deviation From Minimum
1.00	≥ min. VMA
0.95	0.1-0.5 below min.
0.90	0.6-1.0 below min.
(1)	> 1.0 below min.

AV	
Pay Value	Test Result (%)
1.05	3.5-4.5
1.00	3.0-5.0
0.95	2.5-5.5
0.90	2.0-6.0
(1)	< 2.0 or > 6.0

DENSITY	
Pay Value	Test Result (%)
1.05	94.0-96.0
1.00	92.0-93.9
0.95	91.0-91.9 or 96.1-96.5
0.90	90.0-90.9 or 96.6-97.0
(1)	< 90.0 or ≥ 97.0

(1) *The Department will evaluate the acceptability of the work. When the Department allows the Contractor to leave the work in place, the Department will pay 85 percent or less, although the Department may require the Contractor to perform corrective action to the work.*

SECTION 403 ¾ PRODUCTION AND PLACEMENT OF ASPHALT MIXTURES

403.01 DESCRIPTION. This section includes general requirements that are applicable to all types of asphalt mixtures. Deviations from these general requirements are indicated in the specific requirements for each type.

Construct one or more courses of asphalt mixture on the prepared foundation according to these Specifications and the specific requirements of the type specified in the Contract.

403.02 MATERIALS AND EQUIPMENT.

403.02.01 Fine Aggregate. Conform to Section 804.

403.02.02 Coarse Aggregate. Conform to Section 805.

403.02.03 Asphalt Binder. Conform to Section 806.

403.02.04 Self-Leveling Silicone Rubber Sealant. Conform to Section 807.

403.02.05 Release Agent. Select from the Department's List of Approved Materials.

403.02.06 Transport Equipment. Provide trucks for transporting asphalt mixtures that have tight, clean, and smooth metal beds that have been sprayed with a minimum amount of release agent. Equip all trucks with covers made of heavy canvas, or similar material suitable for protecting the mixture from the weather, that completely cover the loaded material.

403.02.07 Asphalt Pavers. Use asphalt pavers that are self-propelled and capable of spreading and finishing all courses to the indicated widths and depths, line, grade, and cross section, with a smooth finish, uniform in density and texture, without requiring an undue amount of back-dressing for correcting irregularities. Equip the paver with the following:

1) a screed or strike-off assembly that easily adjusts to the required crown and will place the asphalt mixture in variable widths;
2) an auger and vibrator that operates along the full width of the screed;
3) a level that is attached to the screed and in full view of the operator;
4) automatic screed controls, with sensors for both sides of the paver, capable of sensing grade from an outside reference, sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain the desired grade and transverse slope;
5) a transverse slope controller that is capable of maintaining the screed at the desired slope within $\pm$ 0.1 percent; and
6) automatic feeder controls that properly adjust to maintain a uniform depth of material ahead of the screed.

403.02.08 Rollers. Provide self-propelled rollers that are capable of reversing smoothly. Equip steel-wheel rollers with adjustable scrapers to keep the wheels clean at all times.

403.02.09 Small Tools and Portable Equipment. Provide all necessary small tools and portable equipment required for satisfactory execution of the work and devices necessary for routine checks of finishing requirements.

Provide standard 10-foot long straightedges. Have straightedges available on the project before the work is started and all times thereafter until completion of the work.

403.03 CONSTRUCTION.

403.03.01 Seasonal and Weather Limitations. Do not place asphalt mixtures on any wet surface, when the ambient air and existing surface temperatures on the project are less than those specified in the table below, or when weather conditions otherwise prevent the proper handling or finishing of the asphalt mixtures.

Between November 15 and April 1, do not place asphalt mixture courses that will become a permanent part of the work without obtaining the Engineer's written permission. Additionally, make every effort to have all asphalt base and binder courses covered before November 15.

If all asphalt mixture courses are not completed before November 15, perform all further work necessary to protect and maintain the uncompleted work during the winter months. Perform any work necessary to repair or restore the uncompleted work before the beginning of spring paving operations. Perform all work necessary to protect, maintain, or repair the base subject to the Engineer's approval.

TEMPERATURE LIMITATIONS

Minimum Ambient Air Temperature and Minimum Temperature of the Existing Surface for Placing Asphalt Mixtures (°F)

Open-Graded Friction Course (OGFC)	60
Asphalt Mixture, Surface (one inch thick or less)	45
Asphalt Mixture, Surface (thicker than one inch)	40
Asphalt Mixture, Base and Binder	35
Leveling and Wedging	45
Asphalt Mixture for Pavement Wedge	40
Asphalt-Treated Drainage Blanket	35

403.03.02 Preparation of Base. Prepare the foundation before placing the asphalt mixture courses. The preparation may include fine grading and recompaction of earth or blasted rock subgrades, or crushed or natural aggregate bases.

Maintain prepared subgrades and/or granular bases until placing the initial course of asphalt mixture to ensure that the foundation is true to the required grade and cross section.

Grade and shape existing traffic bound base to the required grade and cross section before applying any asphalt mixture course. Wet and roll any salvable floater material into the existing traffic bound base.

When required, apply curing seal, prime, or tack coat, or a combination, according to Section 406.

When applying the initial asphalt mixture surfacing on the traffic bound base, excavate as necessary at both ends of all bridges within the limits of the project. Excavate deep enough to apply the total thickness of the asphalt mixture courses being constructed. The excavation should be wide enough to accommodate the width of the course, or wider when directed, and as long as necessary, up to 100 feet, for smooth transitions from the top surface course to the bridge deck.

Sweep existing or previously placed asphalt mixture or concrete courses clean of all foreign material. Apply tack coat according to Section 406.

Remove existing markers installed in grooves, and fill the recess with the compacted asphalt mixture. The Department will not require filling of the grooves when milling of the existing pavement is included in the Contract and the milling operation removes the grooves.

Remove existing Type V markers, and fill the recess and any additional damaged area with compacted asphalt mixture. Fill the damaged areas, even when the Contract includes milling, unless the Engineer determines the damaged areas are not hazardous to public traffic. The Department will retain ownership of the castings. Deliver the removed markers to the Department of Highways' Maintenance lot nearest the project.

Adjust small drainage structures such as catch basins as required to match the finished pavement, or to provide proper drainage, according to Subsection 710.05.

Only when the Engineer directs, adjust manholes according to Section 710.

Return manhole adjusting rings that are removed and not reused to the utility owner.

403.03.03 Preparation of Mixture.

A) Mixture Composition. Provide the appropriate mixture composition for the specified asphalt mixture, or substitute a higher type. Conform to the gradation requirements of AASHTO MP2 for the Superpave mixture type the Contract specifies. Unless the Engineer authorizes otherwise in writing, use the same type and source of ingredient aggregates and asphalt binder throughout the entire project for each type of mixture. For asphalt surface courses requiring polish-resistant coarse aggregate, limit the portion of non-polish-resistant fine aggregate retained on a No. 4 sieve to 5 percent of the total combined aggregates. Sands from polish-resistant aggregate sources included in the Department's List of Approved Materials are exempt from this requirement.

When using a porous aggregate, increase the asphalt binder content (AC) as needed for asphalt binder absorption by the aggregate.

The following aggregate requirements are listed in order of the highest, Type A, to the lowest, Type E:

1) Type A. 100 percent of the coarse aggregate shall be from the Department's List of Class A Polish-Resistant Aggregate Sources. Ensure that 20 percent of the total combined aggregate is polish-resistant fine aggregate.
2) Type B. Provide one of the following:

   a) 100 percent of the coarse aggregate shall be from the Department's List of Class B Polish-Resistant Aggregate Sources; or
   b) the coarse aggregate shall be a minimum of 50 percent from the Department's List of Class A Polish-Resistant Aggregate Sources, which may exclude some limestones, dolomites, and gravels.

   For Option a) or b) above, ensure that 20 percent or more of the total combined aggregate is polish-resistant fine aggregate.

3) Type C. Ensure that 40 percent or more of the total combined aggregate is polish-resistant; unrestricted Class A coarse, fine, or combination.
4) Type D. Ensure that 20 percent or more of the total combined aggregate is polish-resistant; unrestricted Class A coarse, fine, or combination.
5) Type E. No restriction on aggregate type.

B) Moisture Content of Mix. Determine the moisture content of the coated mixture according to KM 64-434. When moisture contents are greater than 0.25 percent, take corrective action to lower the moisture content. When moisture contents are greater than 0.10 percent, adjust the AC determination made on plant-produced mixture to reflect the actual AC as the Engineer directs. The Engineer will determine the frequency of moisture content testing.

C) Mix Design Criteria. Conform to the gradation requirements and restricted zone of AASHTO MP2 for the Superpave mixture.

1) Preliminary Mix Design. Submit a preliminary mix design, completed using a Superpave gyratory compactor (SGC). Perform the volumetric mix design according to AASHTO PP28 and conforming to AASHTO MP2. Complete the volumetric mix design at the appropriate number of gyrations as given in AASHTO PP28 for the number of ESAL's. The Department will define the relationship between ESAL classes, as given in the bid items for Superpave mixtures, and ESAL ranges as follows:

Class	ESAL's (millions)
1	< 0.3
2	0.3 to < 3.0
3	3.0 to < 30.0
4	≥ 30.0

2) Selection of Optimum AC. Normally, the Department will approve the AC at an air-void content of 4.0 percent. The Engineer may assign an AC corresponding to other air-void levels as deemed appropriate.
3) Tensile Strength Ratio (TSR). Analyze the mixture for TSR according to ASTM D 4867 with one freeze/thaw cycle, 150-mm specimens compacted with a SGC, and a target degree of saturation of the conditioned specimens of 65 ± 5 percent.

403.03.04 Transporting Material. Securely fasten all covers in place on the truck before leaving the plant. During cool weather, or when an unexpected delay occurs, keep the loads covered until just before unloading. Insulate truck beds, when necessary, to maintain the specified temperature to the point of delivery. Do not use any truck that causes excessive segregation of mixture or that leaks.

403.03.05 Spreading and Finishing. Prevent segregation of the fine and coarse aggregates during all phases of construction. Spread the mixtures with a paver. Heat the screed uniformly throughout its length. Do not allow flames to directly contact the mixture. Adjust the paver speed to provide the best results for the mixture being used and to coordinate with the rate of delivery of the mixture to the paver to provide a uniform placement rate without intermittent operation. Operate the screed or strike-off assembly without tearing, shoving, or gouging the mixture when laying the mixture. Operate vibrating screeds or other compacting features of the paver according to the manufacturer's recommendations during the placement of the pavement.

Use automatic screed and slope controls. However, if the Engineer determines that under certain conditions better results may be obtained without using the controls, then the Engineer may waive using either the grade control or slope control requirements, or both.

Notify the plant to stop shipment whenever the automatic screed controls break down or malfunction. Obtain the Engineer's approval to manually operate the equipment, or operate it by other methods, to place the remainder of material already in transit, provided the method of operation produces results otherwise conforming to this section.

Obtain vertical control for the outer edges of each mainline roadway from reference lines or by using a ski arrangement. The Department will allow obtaining horizontal control from the reference line. Automatically control the grade and slope for intermediate lines using reference lines, or a ski and a slope control device, or a dual ski arrangement.

Immediately after striking off and before rolling, visually inspect each course for irregularities, and correct if necessary. Keep hand raking of the mixtures to the absolute minimum. Ensure that the finished surface has a uniform appearance, free from segregated areas. Immediately remove and replace, as directed, all portions of a pavement course that are defective in mixture composition, show excessive segregation, or do not otherwise comply with the Contract.

Correct irregularities in alignment of the outside edge or edges of longitudinal joints by adding or removing material before compacting the edges.

Over uniform, narrow areas, such as widening or narrow, paved shoulders where the use of pavers would be impractical, spread by a mechanical spreader. Ensure that the material is placed to the required lines, grades, and cross section without segregation of the mixture.

Over areas where machine spreading is impractical due to irregularities or

obstructions, spread the mixture by approved methods. Place the material to avoid segregation and to reduce to a minimum the amount of patching required during compaction. Discard all coarse aggregate particles brought to the surface by raking.

Spread all surface courses with allowances made for compacting to finish approximately 3/8 inch above forms, gutters, or similar construction.

The Department may allow shoulders and Asphalt Mixture for Pavement Wedge to be paved monolithically with the mainline if it is in the best interest of the Department. Obtain the Engineer's approval before doing so.

Do not place or compact asphalt mixture when the natural light is insufficient without providing artificial lighting satisfactory to the Engineer. Unless the Contract specifies nighttime paving, do not place binder, surface, or other asphalt mixture wearing courses at night, without first obtaining the Engineer's permission. The Engineer may require daytime paving if the Engineer deems the nighttime work unsatisfactory.

403.03.06 Thickness Tolerances. Place asphalt mixtures at the lift thickness specified in the Contract. The Engineer may allow the base lifts to be adjusted to improve rideability provided the total base thickness remains the same.

Nominal-Maximum Size of Mixture	Thickness Range
1 1/2-inch	4 – 6 inches
1-inch	3 – 4.5 inches
3/4-inch	2 – 4 inches

A) Initial Treatment and Resurfacing Projects. Ensure that the total combined thickness of each class of asphalt base conforms to the Contract. Control the thickness by the rate of application. Place the mixture at the Contract specified weight per square yard. Do not exceed the rate of application by more than 5 percent.

B) New Construction. The Engineer will make thickness checks according to KM 64-420, as soon as practical after completion of all, or a major portion, of the asphalt base. When desired, supply the personnel and equipment, and core according to KM 64-420 under the Engineer's supervision. The Engineer will measure the cores. Fill all core holes either with compacted asphalt mixture or non-shrink grout. Complete all remedial overlay work before placing the final course.

When constructing an overlay, match the grades of the adjacent work such as storage lanes, approaches, entrances, etc., to the overlay section, whether these adjacent areas are deficient in thickness or not.

Ensure the total combined thickness of all layers is within ± 1/2 inch of the compacted plan thickness.

When there is an asphalt binder course, consider it as asphalt base for the purpose of determining compliance with thickness tolerances.

When the top layer of a new pavement is OGFC or sand asphalt surface, consider all asphalt mixtures beneath that course as asphalt base for the purpose of determining compliance with thickness tolerances specified hereinafter.

When the Engineer determines the asphalt base is deficient in total thickness by more than 1/2 inch from the compacted plan thickness, overlay the full width pavement to bring the pavement to the required plan thickness. When placing additional material is not feasible due to structures, drainage, or other engineering reasons, the Engineer may waive the requirement for overlaying.

403.03.07 Joints. When curbs, gutters, pavement, and other structures adjoin the new construction, coat all contact surfaces of the existing construction and joints of previously placed new construction, both longitudinal and transverse, with tack.

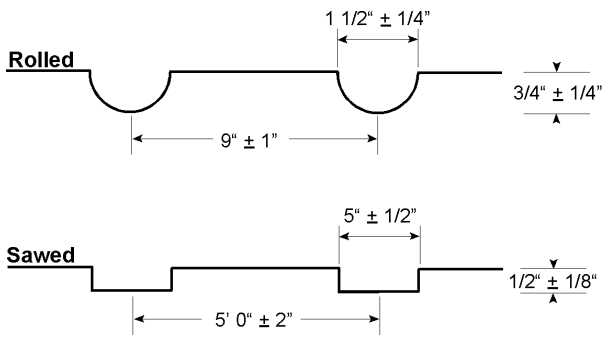
When the pavement construction consists of 2 or more courses, offset the longitudinal joint a minimum of 6 inches. Place the longitudinal joint in the final

surface course along the dividing line between the lanes. Clean adjacent surfaces of all loose materials so the joint shall receive full compaction from the rollers.

Place and spread all courses as continuously as possible, keeping the number of joints to a minimum. When a transverse joint is necessary, complete the spreading of the material by the finishing machine, and adjust the course to a straight line, square with the pavement. Before work is resumed, cut back the joint on the previous run, exposing the full depth of the course. Remove all excess material. Check the joint with a 10-foot straightedge at intervals of 2 feet or less immediately after initial rolling. Immediately correct any irregularities not conforming to Subsection 403.03.11 either by additional raking or adding hot material, or both. Discard all coarse aggregate particles brought to the surface by raking. Roll joints to compress the material and to produce as tight a joint as possible.

Avoid cold longitudinal joints when practical by either placing the full width of the course in one pass, operating pavers in echelon, or moving pavers back each day after placing sufficient tonnage in each traffic lane so the course placed will be the full width of the pavement at the end of each day. Obtain the Engineer's approval for the method of paving.

403.03.08 Rumble Strips. When using a surface mixture instead of Asphalt Mixture for Pavement Wedge, or when the Engineer deems it appropriate to pave the driving lanes and the adjacent shoulder monolithically, provide rumble strips as shown below. Construct strips on all main line shoulders. When furnishing Asphalt Mixture for Pavement Wedge, binder, or a base mixture for shoulders, the Department will not require rumble strips.



Length of strips: 2 feet

Distance from the edge of the mainline pavement to the end of the strip: 1 foot

Time the rolling operation so indentations are at the specified size and depth without causing unacceptable displacement of the asphalt mat. Correct unacceptable rolled-in rumble strips by sawing as detailed above.

If preferred, construct the rumble strips by sawing. If choosing this method, saw, size, and space the grooves as detailed above or as detailed on Standard Drawing No. RPM-145. Paint the disturbed areas of sawn rumble strips with a tack coat.

On shoulders less than 3 feet, shorten the length and distance of the strips as the Engineer directs.

403.03.09 Leveling and Wedging, and Scratch Course.

A) Leveling and Wedging. Conform to the gradation requirements for base, binder, or surface as applicable. Submit a JMF to the engineer for AC approval according to KM 64-421. The Engineer may adjust the gradation requirements of the asphalt mixture being used for leveling and wedging in order to provide smooth transitions.

Upon completing each course of asphalt mixture and before spreading the next course, check the surface of that course by a stringline for deviations from a uniform grade. Correct any such deviations from the required uniformity by applying additional material, spreading, and rolling as directed.

When construction of the previous course is included in the same contract, mill any high joints or other high areas as required in addition to leveling and wedging.

When leveling and wedging is provided for on resurfacing projects, check the existing surface by stringline for deviations from a uniform grade. Correct the courses in the same manner with an application of either a binder mixture or a surface mixture, or both.

When an asphalt mixture has been included in the proposal for leveling and wedging, perform this work at the locations designated before starting the normal paving operations. Thoroughly clean the areas to receive the corrective work and apply the same tack material as specified for the courses being constructed. Do not apply the material as a scratch course over the entire area of the existing pavement. Do not apply the material monolithically with the surface course.

Spread the asphalt mixture for leveling and wedging with a motor-patrol grader or paver. After spreading, thoroughly compact the mixture.

B) Scratch Course. When required by the Contract, place an asphalt mixture as a scratch course. Conform to the gradation requirements for base, binder, or surface as the Engineer directs. Submit a JMF to the Engineer for AC approval according to KM 64-421. Apply the mixture over the entire area of the existing pavement before constructing the final surface course; do not apply material monolithically with the surface course. Set the paver to a minimum thickness as directed to correct rutting, adverse warping, dipping, and other imperfections in the existing pavement and to provide a smooth, level surface for the final surface course.

Compact with a pneumatic-tired roller to ensure proper compaction in rutted and warped areas in the existing pavement.

When required by conditions on the project, the Engineer may adjust the gradation requirements of the specified mixture.

403.03.10 Compaction. Compact asphalt mixtures by Option A or B, as specified in the Contract. When the compaction option is not specified, compact by Option B.

Operate the rollers to eliminate all roller marks and obtain the specified compaction. Operate vibratory rollers of a design, weight, and frequency that produces the specified compaction without damaging the mat.

During the initial rolling of each course, visually inspect its surface for any irregularities that may develop. Remove and replace areas in which the material is not in compliance with the specified mixture requirements.

Move the rollers at a slow but uniform speed with the drive roll or wheels nearest the paver. Immediately correct any displacement due to reversing the direction of a roller, or from other causes, using rakes and adding fresh mixture when required. While rolling, do not displace the line and grade of the edges of the asphalt mixture.

To prevent adhesion of the material to the roller wheels, keep the wheels moistened with water, but do not use excess water. Do not use kerosene, oil, or other harmful liquids. The Department will allow a small quantity of detergent to be mixed with the water.

Compact areas adjacent to manholes, curbs, narrow widening, and other small areas inaccessible to a roller, by mechanical tampers.

A) Compaction Under Option A. Develop the rolling pattern during the first sublot.

B) Compaction Under Option B. Provide initial or breakdown rolling consisting of one complete coverage by a 3-wheel roller or tandem roller weighing at least 10 tons and having a compressive capability on the rear wheels of at least 325 pounds per linear inch of wheel width. Ensure that 3-axle, steel-

wheeled rollers weigh at least 12 tons. Ensure that 2-axle, steel-wheeled, tandem rollers weigh at least 10 tons. For initial or breakdown rolling, provide rollers that are equipped with wheels having a diameter of 40 inches or more. Perform the rolling immediately after spreading and finishing the mixture.

Provide intermediate rolling consisting of at least 3 complete coverages with a tandem roller weighing at least 10 tons. Start intermediate rolling after completing the breakdown rolling as closely as possible without causing undue displacement, cracking, or shoving of the material.

For intermediate rolling of 1 1/2-inch and 1-inch nominal size mixes, use a pneumatic-tired roller. Use pneumatic-tired rollers that weigh at least 12 tons and have 7 to 9 tires capable of inflation pressures up to 125 psi. Maintain an inflation pressure in all tires within ± 5 psi of the manufacturer's recommended pressure. Arrange the tires so that the gap between the tires of the front axle is covered by the tires of the rear axle. Mount wheels to provide equal contact pressure under each wheel. Use a tire tread that is satisfactory to the Engineer. Maintain tire size and inflation pressure such that the contact pressure is at least 80 psi.

Perform final rolling of the uppermost layer or surface course with a tandem roller. Operate the roller, at all times, parallel to the centerline. When desired, and the Engineer allows, use a pneumatic-tired roller for final rolling on base courses.

Begin rolling at the sides and progress to the center on crowned surfaces. Begin rolling at the low side and progress to the high side on superelevated sections. Operate the rollers parallel to the centerline and lap successive trips of each roller uniformly to the previous trip. During breakdown rolling, the Engineer may allow the course to be rolled without the required lap of the wheels on successive trips. End alternate trips of the rollers on transverse lines at least 3 feet apart. Regulate starting and stopping of the rollers to avoid distorting the surface. Do not allow the rollers at any time to stand on the material being placed immediately behind the paver. When rolling is temporarily suspended, stop the rollers as far behind the paver as practical.

When using a 3-wheel roller, roll as directed. Do not use a 3-wheel roller to roll over a crown or over a warped section when the center axle is in the locked position.

The Engineer may allow a different rolling pattern. Submit the alternate rolling pattern for approval. Provide any demonstration or testing the Engineer requires. Obtain written approval from the Engineer before continuing with the alternate pattern.

403.03.11 Surface Tolerances. Check the surface of each course with templates, straightedges, or stringlines. Check the surfaces of the finished courses longitudinally with a 10-foot straightedge placed parallel to the centerline over the width of the surface.

Ensure the following:

1) The finished surfaces of the base and binder courses do not deviate more than 1/4 inch from the 10-foot straightedge.
2) The finished surface of the final surface course does not deviate more than 1/8 inch from the 10-foot straightedge.
3) The cross slope of all courses does not deviate more than 1/4 inch in 5 feet from the required cross slope.
4) The asphalt surface conforms to all requirements for a final surface course when the top portion of a new pavement consists of a wearing course underlain by asphalt surface.

Correct all irregularities exceeding the allowable tolerances. Correct surface course irregularities by removing and replacing the entire lift thickness or by overlaying. Do not remove the irregular areas of the surface course by surface

grinders.

On resurfacing projects, when no provisions are made for constructing leveling and wedging courses, scratch courses, or milling, the Engineer will waive the specified requirements for surface tolerances.

403.03.12 Transverse Joints. When specified in the Contract, cut transverse joints in overlays of PCC pavement, base, and shoulders. Seal with self-leveling silicone rubber sealant.

403.03.13 Pavement Marking. Apply and maintain pavement marking as specified in Section 112.

403.04 MEASUREMENT.

403.04.01 Removing Type V Pavement Markers. The Department will measure the quantity by each individual unit. The Department will determine the quantity by dividing the length of each run of markers by the markers' average spacing, plus one. The Department will not measure delivery for payment and will consider it incidental to this item of work.

The Department will not measure other marker types for removal, disposal, or filling of their grooves for payment. The Department will consider all of this work incidental to the surfacing items in the Contract.

403.04.02 Adjust Manhole. The Department will measure the quantity by each individual unit.

403.04.03 Asphalt Mixtures. The Department will measure the quantity according to Subsection 402.

403.04.04 Leveling and Wedging. For resurfacing projects, when leveling and wedging is listed as a bid item, the Department will measure the quantity in tons according to Subsection 402.04. For reconstruction and new construction, the Department will measure the quantity of leveling and wedging placed on the first base course in tons as base material. The Department will not measure leveling and wedging used to correct irregularities in subsequent courses for payment and will consider it incidental to placing the course.

403.04.05 Asphalt Scratch Course. The Department will measure the quantity according to Section 402.04.

403.04.06 Protective and Restorative Work. The Department will not measure for payment any extra materials, methods, or construction techniques, determined by the Engineer not to be a part of the specified construction, used to protect, maintain, or repair any portion of the uncompleted work during the winter months.

403.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

403.05.01 Adjust Manhole. In the event the Engineer directs the Contractor to adjust existing manholes and the Contract does not include a bid item for this work, the Department will make payment at an agreed unit price of $250.00 for each manhole acceptably adjusted by using the adjusting ring method, or an agreed unit price of $350.00 for each manhole acceptably adjusted by removing or adding masonry.

403.05.02 Asphalt Mixtures. The Department will make payment for the completed and accepted quantities according to Section 402.

403.05.03 Leveling and Wedging. The Department will make payment for the completed and accepted quantities according to the Lot Pay Adjustment Schedule for

Specialty Mixtures in Subsection 404.05.

403.05.04 Asphalt Scratch Course. The Department will make payment for the completed and accepted quantities according to the Lot Pay Adjustment Schedule for Specialty Mixtures in Subsection 404.05.

Code	Pay Item	Pay Unit
6600	Remove Pavement Marker Type V	Each
1791	Adjust Manhole Frame to Grade	Each
202-229	Asphalt Mixtures, Base	Ton
271-280	Asphalt Mixtures, Binder	Ton
297-336	Asphalt Mixtures, Surface	Ton

The Department will consider payment as full compensation for all work required under this section.

SECTION 404 ¾ OPEN-GRADED FRICTION COURSE (OGFC)

404.01 DESCRIPTION. Construct one course of hot-mixed, hot-placed, OGFC approximately 3/4-inch thick on a foundation provided by either new or existing pavements.

404.02 MATERIALS AND EQUIPMENT.

404.02.01 Aggregates. Conform to Subsection 403.02 and the following:

A) Fine Aggregate. Limit sands from sources not included in the Polish-Resistant Aggregate Sources section of the Department's List of Approved Materials to 20 percent of the total aggregate in the mixture.

B) Coarse Aggregate. Provide 100 percent Class A polish-resistant aggregate.

404.02.02 Asphalt Binder. Provide the PG binder specified in the Contract conforming to Section 806.

404.02.03 Anti-stripping Additive. Select from the Department's List of Approved Materials.

404.02.04 Tack. Conform to Section 806.

404.03 CONSTRUCTION. Conform to Section 403, except as provided in this section and in the Contract. The OGFC is intended to provide a coarse-textured, well-draining, skid-resistant wearing surface. Construct this course at a higher elevation than adjacent gutters to provide proper lateral drainage of water through the course.

For multiple lanes in the same direction, place the material continuously in one lane each day. Protect it from traffic until it has cured overnight.

When placing OGFC on two-lane, two-way pavements, operate the paver according to Subsection 403.03.05.

404.03.01 Seasonal and Weather Limitations. In addition to the weather limitations specified in Subsection 403.03.01, do not place OGFC between September 15 and May 1, without obtaining the Engineer's written permission.

404.03.02 Leveling and Wedging. Perform the necessary leveling, wedging, and patching to repair an existing pavement before beginning construction of this surface course.

404.03.03 Tack Coat. Apply according to Section 406, except as follows. When furnishing emulsions for the tack coat, do not dilute the emulsions. Apply undiluted SS-1, SS-1h, RS-1, RS-2, CSS-1, CSS-1h, or CRS-1 at an approximate rate of 0.8 pounds (0.1 gallons) per square yard.

404.03.04 Preparation of Mixtures. Submit the JMF for OGFC for approval according to Subsection 402.03. Conform to the gradation requirements specified. The Department will perform a mix design according to KM 64-424.

Test the approved JMF of the mixture according to KM 64-433 or KM 64-620, and ensure that it conforms to the requirements shown in the table below.

During the operation of the plant, conform to the following tolerances from the approved JMF, and also maintain the master gradation ranges below at all times.

SIEVE SIZE	MASTER GRADATION RANGE (Percent Passing by Weight)	JMF TOLERANCES
1/2 inch	100	
3/8 inch	90-100	
No. 4	25-50	± 6%
No. 8	5-15	± 4%
No. 16	-	
No. 200	2.0-5.0	

Obtain the Engineer's approval for the percent by weight of asphalt binder in the mixture. Do not deviate from the established AC by more than 0.4 percent. Test the mixture according to KM 64-405, KM 64-436, KM 64-437, KM 64-438 or AASHTO T 308.

Use the anti-stripping additive at the rate of 0.5 percent by weight of asphalt binder.

Maintain temperatures of the ingredient materials and the mixture within the following ranges:

MIXING AND LAYING TEMPERATURES (°F)			
Material		Minimum	Maximum
Aggregates		240	330
Asphalt Binders	PG 64-22	230	330
	PG 70-22	285	350
	PG 76-22	285	350
Asphalt Mixtures at Plant (Measured in Truck)	PG 64-22	230	265
	PG 70-22	265	310
	PG 76-22	275	320
Asphalt Mixtures at Project (Measured in Truck When Discharging)	PG 64-22	175	265
	PG 70-22	230	310
	PG 76-22	260	320

Spread the OGFC at an approximate rate of 65 pounds per square yard to provide an approximate thickness of 3/4 inch.

Roll with a steel-wheel, tandem roller weighing between 5 and 8 tons. Begin rolling immediately after placing the course. Limit rolling to the minimum necessary for consolidating the mixture and bonding it to the underlying surface. Avoid excessive rolling and breakage of the aggregate.

404.04 MEASUREMENT. The Department will measure the quantity in tons according to Subsection 402.04. The Department will not measure asphalt tack coat and anti-strip additives for payment and will consider them incidental to this item of work.

404.05 PAYMENT. The Department will calculate payment by the Lot Pay Adjustment Schedule for Specialty Mixtures.

The Department will apply the schedule's tolerances to the average of the absolute values of deviations from the JMF.

When the deviation is on the high side of the JMF, the Engineer will evaluate each occurrence and determine if it is detrimental to the pavement performance and whether the mixture is acceptable at no deduction, at some deduction, or must be removed and replaced.

When a pay factor less than 1.00 is determined for gradation on more than one sieve, the Department will use the lowest single pay factor determined.

When a pay factor less than 1.00 is determined for both AC and gradation on one or more sieves, the Engineer will evaluate and determine if the deficiencies will have a cumulative negative influence on the mixture. If so, the Engineer will apply both the reduced pay factor for the AC and the largest deduction for the gradation failures. If not, the Engineer will apply the larger single deduction.

The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0266-0268	Asphalt Surface, Open-Graded, Grade	Ton

The Department will consider payment as full compensation for all work required under this section.

LOT PAY ADJUSTMENT SCHEDULE FOR SPECIALTY MIXTURES (AVERAGE TEST DEVIATIONS FROM JMF)							
	Pay Value	1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests
Asphalt	1.00	0.0-0.5	0.0-0.35	0.0-0.30	0.0-0.28	0.0-0.26	0.0-0.23
Binder	0.98	0.6	0.36-0.39	0.31-0.34	0.29-0.32	0.27-0.29	0.24-0.26
Content	0.95	----	0.40-0.44	0.35-0.38	0.33-0.35	0.30-0.32	0.27-0.30
	0.90	0.7	0.45-0.53	0.39-0.46	0.36-0.43	0.33-0.40	0.31-0.36
	0.85	0.8	0.54-0.64	0.47-0.55	0.44-0.52	0.41-0.48	0.37-0.43
	0.75	≥ 0.9	≥ 0.65	≥ 0.56	≥ 0.53	≥ 0.49	≥ 0.44
1 1/2 inch	1.00	0-13	0-9.5	0-8.0	0-7.1	0-6.5	0-6.0
Sieve	0.98	14	9.6-10.9	8.1-9.2	7.2-8.2	6.6-7.5	6.1-6.9
	0.95	15-16	11.0-12.4	9.3-10.4	8.3-9.2	7.6-8.4	7.0-7.8
	0.90	17-20	12.5-14.7	10.5-12.4	9.3-11.0	8.5-10.1	7.9-9.3
	0.85	21-23	14.8-17.6	12.5-14.8	11.1-13.1	10.2-12.0	9.4-11.1
	0.75	≥ 24	≥ 17.7	≥14.9	≥ 13.2	≥ 12.1	≥ 11.2
1/2 inch,	1.00	0-9	0-7.0	0-6.0	0-5.4	0-5.0	0-4.7
3/4 inch,	0.98	10	7.1-8.0	6.1-6.9	5.5-6.2	5.1-5.8	4.8-5.4
and 1 inch	0.95	11-12	8.1-9.1	7.0-7.8	6.3-7.0	5.9-6.5	5.5-6.1
Sieves	0.90	13-14	9.2-10.8	7.9-9.3	7.1-8.4	6.6-7.8	6.2-7.3
	0.85	15-16	10.9-12.9	9.4-11.1	8.5-10.0	7.9-9.3	7.4-8.7
	0.75	≥ 17	≥ 13.0	≥ 11.2	≥ 10.1	≥ 9.4	≥ 8.8
3/8 inch,	1.00	0-8	0-5.9	0-5.0	0-4.5	0-4.1	0-3.9
No. 4,	0.98	9	6.0-6.8	5.1-5.8	4.6-5.2	4.2-4.7	4.0-4.5
No. 8,	0.95	10	6.9-7.7	5.9-6.5	5.3-5.8	4.8-5.3	4.6-5.1
No. 16,	0.90	11-12	7.8-9.1	6.6-7.8	5.9-7.0	5.4-6.4	5.2-6.0
and No. 30	0.85	13-14	9.2-10.9	7.9-9.2	7.1-8.3	6.5-7.6	6.1-7.2
Sieves	0.75	≥ 15	≥ 11.0	≥ 9.3	≥ 8.4	≥ 7.7	≥ 7.3
No. 50	1.00	0-6	0-4.7	0-4.0	0-3.6	0-3.3	0-3.1
Sieve	0.98	7	4.8-5.4	4.1-4.6	3.7-4.2	3.4-3.8	3.2-3.6
	0.95	8	5.5-6.1	4.7-5.2	4.3-4.8	3.9-4.3	3.7-4.0
	0.90	9	6.2-7.3	5.3-6.2	4.9-5.6	4.4-5.1	4.1-4.8
	0.85	10	7.4-8.7	6.3-7.4	5.7-6.7	5.2-6.0	4.9-5.7
	0.75	≥ 11	≥ 8.8	≥ 7.5	≥ 6.8	≥ 6.1	≥ 5.8
No. 100	1.00	0-3	0-2.3	0-2.0	0-1.8	0-1.7	0-1.6
Sieve	0.98	----	2.4-2.6	2.1-2.3	1.9-2.1	1.8-2.0	1.7-1.8
	0.95	4	2.7-3.0	2.4-2.6	2.2-2.3	2.1-2.2	1.9-2.1
	0.90	5	3.1-3.6	2.7-3.1	2.4-2.8	2.3-2.6	2.2-2.5
	0.85	----	3.7-4.3	3.2-3.7	2.9-3.3	2.7-3.1	2.6-3.0
	0.75	≥ 6	≥ 4.4	≥ 3.8	≥ 3.4	≥ 3.2	≥ 3.1
No. 200	1.00	0.0-2.0	0.0-1.7	0.0-1.5	0.0-1.4	0.0-1.3	0.0-1.2
Sieve	0.98	2.5	1.8-2.0	1.6-1.7	1.5-1.6	1.4-1.5	1.3-1.4
	0.95	3.0	2.1-2.2	1.8-2.0	1.7-1.8	1.6-1.7	1.5-1.6
	0.90	----	2.3-2.6	2.1-2.3	1.9-2.2	1.8-2.0	1.7-1.9
	0.85	3.5	2.7-3.1	2.4-2.8	2.3-2.5	2.1-2.4	2.0-2.2
	0.75	≥ 4.0	≥ 3.2	≥ 2.9	≥ 2.6	≥ 2.5	≥ 2.3

SECTION 405 ¾ ASPHALT SEAL COAT

405.01 DESCRIPTION. Construct an asphalt seal coat consisting of one or more applications each of asphalt material and cover aggregate.

405.02 MATERIALS AND EQUIPMENT.

405.02.01 Asphalt Material. Furnish the type and grade specified in the Contract conforming to Section 806.

405.02.02 Aggregate. Conform to Section 804 or 805, as applicable.

405.02.03 Equipment. Provide, and keep on the project at all times, an accurate thermometer, hand brooms, and other small tools and equipment essential for completion of the work.

Provide equipment for heating the asphalt material and pressure distributors conforming to Subsection 406.02.04.

Provide a mechanical broom or sweeper for cleaning the existing surface and for sweeping the completed seal coat.

Provide an aggregate spreader of an approved type equipped with a mechanical feed. Ensure that the spreader is capable of depositing aggregate from the transporting vehicle directly onto the fresh asphalt material at the rate specified, in smooth, uniform layers, independent of the forward speed. Ensure that the spreader is capable of being filled and moved without discharging aggregate.

Provide a pneumatic-tired roller for roadway surfaces. On slopes, the Department will allow a steel-wheel roller.

405.03 CONSTRUCTION.

405.03.01 Weather Limitations. Do not construct any seal coat when the ambient temperature is below 45 °F, nor when the ambient temperature within the preceding 24 hours has been 35 °F or lower, except with the Engineer's written permission.

405.03.02 Preparation of Surface. Sweep the road with a mechanical sweeper and with wire hand brooms, when necessary. Clean the edges of the surface so that the full width of the roadway to be treated is uniformly clean. Where any mud or earth exists, remove it in advance of the application of the asphalt material, and allow the surface to thoroughly dry.

If cracks cannot be adequately filled by the seal coat, fill them with asphalt material and apply cover aggregate before applying the seal coat.

405.03.03 Heating and Applying Asphalt Material. Heat and maintain the asphalt material within the following temperature ranges during application:

RS-1	70 - 140 °F
RS-2, HFRS-2, CRS-1, CRS-2	125 - 175 °F

Apply asphalt material by means of a pressure distributor in a uniform, continuous spread over the section to be treated in the quantity per square yard specified in the Contract or as the Engineer directs.

Keep the nozzles of the spray bar clean at all times. Immediately make uniform any streaked areas by use of a hand hose equipped with a nozzle.

Treat areas over which it is impractical to operate a distributor by means of a hand hose equipped with a nozzle or by means of a pouring pot.

Do not apply the asphalt material farther in advance of the spreading of the aggregate than can be covered directly by the aggregate immediately available at the site of work.

When the seal coat treatment is constructed in half-widths, provide complete coverage by overlapping the 2 applications approximately 4 inches along the centerline.

Prevent spotting or discoloring curbs, headwalls, and other structures. When such discolorations occur, remove them at no expense to the Department.

Make joints utilizing an approved method.

405.03.04 Application of Cover Material. Provide the gradation specified in the Contract. Ensure that the aggregate for cover material is surface-dry when applied, unless damp aggregate is allowed or required due to the type of asphalt material being used. Spread the aggregate immediately following the application of the asphalt material. Spread the aggregate before the asphalt material breaks. Ensure that the spreading equipment does not contact the asphalt material before it is covered with aggregate. Apply the cover material at the rate designated in the Contract, with precautions taken not to exceed the designated rate by more than 5 percent. Use hand brooms to correct any irregularities.

When applied on the roadway lanes and shoulders, roll the entire surface width with pneumatic-tired rollers immediately following the spreading of the aggregate. Do not use steel-wheel rollers. Operate the rollers parallel to the centerline, and cover the entire surface with at least 3 passes of the rollers, or more when the Engineer directs.

When applied on the roadway lanes and shoulders, after rolling, mechanically sweep the completed seal coat to remove all excess cover aggregate after the asphalt material has cured sufficiently to allow sweeping without dislodging the imbedded aggregate, when deemed necessary. If an asphalt surface course is to be applied over the seal coat, do not allow traffic on the seal coat before applying the surface course unless required by the traffic control plan or the Engineer.

405.04 MEASUREMENT. When an authorized adjustment is made, the Department will measure quantities up to 5 percent in excess of the designated application rate for payment. The Department will not measure quantities exceeding the designated application rate by more than 5 percent for payment.

405.04.01 Asphalt Material for Asphalt Seal Coat. The Department will measure the quantity in tons according to Section 109.

405.04.02 Asphalt Seal Aggregate. The Department will measure the quantity in tons according to Section 109.

405.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Asphalt Material for Asphalt Seal Coat	Ton
0100	Asphalt Seal Aggregate	Ton

The Department will consider payment as full compensation for all work required under this section.

SECTION 406 ¾ ASPHALT CURING SEAL AND ASPHALT PRIME AND TACK COATS

406.01 DESCRIPTION. Prepare existing bases or surfaces, and apply liquid asphalt material before placing covering courses of asphalt mixtures or treatments.

406.02 MATERIALS AND EQUIPMENT.

406.02.01 Tack Coat. Furnish any of the following asphalt materials conforming to Section 806: SS-1, SS-1h, CSS-1, CSS-1h, AE-60, RS-1, or CRS-1.

406.02.02 Prime Coat. Furnish Primer-L conforming to Section 806 unless the Contract allows another material.

406.02.03 Curing Seal. Furnish any of the following asphalt materials conforming to Section 806: RS-1, RS-2, AE-60, SS-1, SS-1h, CRS-1, CSS-1, CSS-1h, or Primer L.

406.02.04 Water. Conform to Section 803.

406.02.05 Equipment. Provide hand brooms and other small tools and equipment essential to completing the work in addition to a mechanical broom or sweeper, asphalt heating equipment, and a pressure distributor. Provide a mechanical broom or sweeper that is adjustable to make uniform contact with the surface and that thoroughly cleans without cutting into the surface being swept.

Provide equipment for heating the asphalt material in tanks, railroad cars, trucks, and distributors that is capable of heating the material to the required temperature without introducing moisture, localized overheating, or otherwise changing the characteristics of the material.

Mount the pressure distributor on a self-propelled, motor vehicle equipped with pneumatic tires, and ensure that it has sufficient power to maintain a constant and uniform speed under all operating conditions. Use a distributor designed to apply the material uniformly at the rate required for the type of construction. Use a distributor conforming to the following requirements:

A) Tank. Use a tank with a capacity of at least 600 gallons and equipped with a removable manhole cover, an overflow pipe, and a dial gage for indicating the contents (mounted so as to be plainly visible to the operator). Carry an accurate measuring stick on the distributor at all times.

B) Heating System. Ensure that the heating system evenly heats and maintains the asphalt material within the required temperature range at all times. Provide a temperature measuring device that will quickly and accurately determine the temperature of the material.

C) Distributing System. Ensure that the pressure distributing system contains a separate power and pump unit of sufficient capacity to distribute the required quantity of asphalt material at a constant flow and uniform pressure. Mount a dial pressure gage plainly visible to the operator.

D) Spray Bar and Nozzles. Use a full-circulating spray bar that adjusts in length to conform to the width of the application being made without overlapping. Use a spray bar that swings laterally over a distance of 9 inches or more. Provide a positive and immediate cut-off and means to prevent material from dripping onto the road surface when the flow is shut off. Use individual nozzles that maintain an equal flow from all nozzles at the same time. To prevent clogging of the nozzles, provide screens for the circulating system, and keep the screens clean. Also, provide a hand spray bar and nozzle having an adequate length of flexible steel hose with packed couplings.

E) Tachometer or Synchronizer. Have a tachometer visible to the truck operator to enable him to maintain the constant speed necessary for the

application of the specified quantity of material. Furnish suitable charts showing the truck speeds necessary for the correct application.

When using a synchronizer, the tachometer may be omitted. Use a synchronizer that delivers a specified quantity of asphalt material onto the road surface independent of the truck speed.

406.03 CONSTRUCTION. For the asphalt prime coat, apply liquid asphalt material to granular-type bases.

For the asphalt tack coat, apply liquid asphalt material to the surface of concrete or brick pavements and bases, to existing asphalt surfaces and, when necessary, to newly constructed asphalt courses.

406.03.01 Weather Limitations. Conform to the temperature limitations specified for the asphalt mixture to be placed. Do not apply prime and tack coats to wet surfaces.

406.03.02 Preparation of Surface. Obtain the Engineer's approval of the prepared surface before applying the prime or tack coat.

A) Asphalt Prime Coat. Grade and shape the existing traffic bound base to the required grade and cross section before applying any asphalt material. Wet and roll salvable floater material into the existing traffic bound base.

B) Asphalt Tack Coat. Use mechanical sweepers to clean the application surfaces of all dirt and other foreign matter. Use wire hand brooms when necessary. Extend sweeping beyond the edges of the surface to ensure a thorough cleaning of the full width to be treated.

C) Asphalt Curing Seal. Ensure the roadbed surface is dense, free from loose extraneous material, and contains sufficient moisture to prevent penetration of the asphalt material.

406.03.03 Application. Provide necessary barricades, warning signs, and flaggers to prevent traffic from traveling over a freshly applied prime or tack coat. Also, provide for public convenience and safety as specified in Sections 104 and 107.

Prevent spotting or discoloring curbs, headwalls, and other structures. When discolorations occur, remove them at no expense to the Department.

Protect the exposed, treated surfaces from damage. Repair all damaged areas.

Maintain the material within the following temperature ranges during application:

Primer-L	60-120 °F
SS-1, SS-1h, CSS-1, CSS-1h	70-160 °F
RS-1, RS-2	70-140 °F
CRS-1	120-185 °F

A) Asphalt Prime Coat. Apply prime coats at the rate specified in the Contract, or as directed when conditions justify variations in the rates of application.

Apply the number of applications of the prime coat as directed. Apply the material under pressure. Do not use hand-pouring except for special conditions, and then only with the Engineer's approval.

Allow the prime coat to cure before placing the asphalt mixture course unless the Engineer approves otherwise.

B) Asphalt Tack Coat. Apply the tack coat with a spray bar that can be raised to a sufficient height so as to uniformly and completely coat the entire surface. When a uniform application, at the rate required, cannot be obtained from a spray bar, then apply the tack coat by fogging with a hand spray attachment. The Engineer will only accept complete and uniform coverage. Unless otherwise specified in the requirements for the asphalt mixture being placed, apply tack at a rate to achieve an undiluted residue of 0.4 pounds (0.05 gallons) per square yard.

When furnishing RS-1 or CRS-1 for tack, apply them undiluted.

When furnishing SS-1, SS-1h, CSS-1, or CSS-1h for tack, the Department will allow diluted or undiluted application provided uniform and complete coverage is achieved. When applying tack in a diluted form, apply it a sufficient time in advance to ensure that all water has evaporated before placing the asphalt mixture.

On newly constructed base and binder courses, adjust the application rate as the Engineer directs.

When placing asphalt material adjacent to curbs, existing pavements, or other structures, first coat the contact surface of the existing structure with tack material.

If the initial application of any tack material is not uniform, apply additional material as directed at no additional expense to the Department.

Remove asphalt material applied in excess of the requirements, or cover it with a blotter course of dry sand or stone chips as the Engineer directs.

On projects over which public traffic is being maintained, apply the tack coat over one-half of the pavement width, not to exceed one-half day's work, in advance of the construction of the asphalt cover course. Do not end the tack coat application at a location hazardous to traffic. Do not apply tack coat to a lane that requires overnight closure, unless the Engineer approves it in writing. Schedule the work so that at the end of the day's production all tack is covered with the asphalt mat or a sand blotter course. At road intersections or other traffic crossings, the Engineer may require the application of a sand blotter course over the tack coat.

When Sand for Blotter is included in the Contract as a bid item, cover the tack coat with surface-dry, natural sand in a minimum quantity sufficient to prevent the tack coat from being picked up by traffic. Apply the sand uniformly at the rate the Engineer directs but not exceeding 5 pounds per square yard. The normal rate is 2 to 3 pounds per square yard.

C) Asphalt Curing Seal. Uniformly apply the curing seal at the rate of approximately 2.0 pounds per square yard. The Engineer will determine the actual rate and application temperature of asphalt material. Apply the curing seal in sufficient quantity to provide a continuous membrane over the roadbed. To avoid excessive runoff, apply the seal in 2 or more applications when directed or allowed, making each application as soon as possible after the previous application. If any damage occurs, immediately reseal the damaged area.

If the asphalt material is sticky, apply a sand blotter material at a rate of approximately 5 pounds per square yard, when the Engineer directs, to avoid damage to the seal or to avoid tracking material onto other facilities.

406.04 MEASUREMENT. The Department will not measure for payment the removal of discolorations, maintenance, and repair of the applied coating, or removal of excess material.

406.04.01 Cutback Asphalt Emulsion Primer-L. The Department will measure the quantity according to Section 109. The Department will not measure water used to prepare dry surfaces for payment.

406.04.02 Asphalt Material for Tack. The Department will not measure tack for payment and will consider it incidental to the asphalt courses.

406.04.03 Asphalt Curing Seal. The Department will measure the quantity according to Section 109. The Department will not measure water used to prepare dry surfaces for payment.

406.04.04 Sand for Blotter. When listed as a bid item, the Department will measure the quantity in tons according to Section 109. The Department will not measure sand for payment when used to treat excessive asphalt material application.

406.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0296	Cutback Asphalt Emulsion Primer-L	Ton
0358	Asphalt Curing Seal	Ton
2702	Sand for Blotter	Ton

The Department will consider payment as full compensation for all work required under this section.

SECTION 407 ¾ ASPHALT MIXTURE FOR PAVEMENT WEDGE

407.01 DESCRIPTION. Construct a pavement wedge composed of a hot-mixed, hot-placed, asphalt mixture. Prepare the area to be covered by the mixture when necessary.

407.02 MATERIALS AND EQUIPMENT.

407.02.01 Asphalt Binder. Furnish either PG 58-22 or 64-22 conforming to Section 806.

407.02.02 Aggregate. Conform to Sections 804 and 805. Use a gradation within the requirements in the following table:

Sieve Size	Percent Passing
1 1/2 inch	100
3/4 inch	70-100
3/8 inch	45-80
No. 4	30-60
No. 8	20-45
No. 16	15-35
No. 30	5-20
No. 100	3-10

Test gradation according to KM 64-433 or KM 64-620.

Use an asphalt binder content (AC) between 4.5 and 6.0 percent by weight of the mixture. When using a porous aggregate, increase the AC as needed to compensate for asphalt absorption by the aggregate. Submit a JMF to the Engineer for AC for approval according to KM 64-421. Maintain the approved AC within ± 0.5 percentage points as determined according to KM 64-405, KM 64-436, KM 64-437, KM 64-438, or AASHTO T 308.

407.03 CONSTRUCTION. Conform to Section 403 except as specified in this section and in the Contract.

Construct the wedge to the depth, width, and slope the Contract specifies where existing conditions permit. Remove the sod or perform trench excavation only when necessary to obtain the specified depth and width. Do not remove solid rock.

Compact the mixture with a roller weighing at least one ton.

407.04 MEASUREMENT. The Department will measure the quantity according to Subsection 402.04.

The Department will not measure trench excavation or sod removal performed as specified in this section for payment and will consider them incidental to this item of work.

407.05 PAYMENT. The Department will make payment for the completed and accepted quantities according to the Lot Pay Adjustment Schedule for Specialty Mixtures in Section 404 under the following:

Code	Pay Item	Pay Unit
0263	Asphalt Mixture for Pavement Wedge	Ton

The Department will consider payment as full compensation for all work required under this section.

SECTION 408 ¾ ASPHALT PAVEMENT MILLING AND TEXTURING

408.01 DESCRIPTION. Remove existing pavement by milling and texturing.

408.02 MATERIALS AND EQUIPMENT. Provide a power-operated, self-propelled milling machine capable of:

1) removing asphalt pavement to the required depth, profile, cross slope, and surface texture;
2) accurately establishing profile grades by referencing from either the existing pavement or from an independent grade control;
3) controlling cross slope;
4) applying sufficient down-pressure to plane the milled surface; and
5) effectively removing cuttings from the pavement and preventing dust from escaping into the air.

Provide supplemental equipment as necessary to remove material adjacent to curbs, railroad crossings, and other areas that cannot be removed by the milling machine. Additionally, provide a mechanical sweeper and, when the Engineer deems necessary, a water truck to control dust.

408.03 CONSTRUCTION. The depth of cut indicated in the Contract is approximate only. The Engineer will specify the actual depth of cut.

When the Contract requires a bottom-of-rut cut, remove only the amount of material necessary to acceptably texture the bottom of the rut. Where there are no ruts, remove only the amount of material necessary to obtain an acceptable texture.

Remove the material in successive cuts of approximately 1 to 1 1/2 inches, measured at the edge of the cutting drum. Complete each cut over the entire length and width of the area. Do not begin the next cut until the Engineer examines the area and determines that additional cutting is necessary.

When maintaining public traffic is not necessary, the Department may allow deeper cuts, provided the final cut does not exceed 1 1/2 inches and satisfactory results are obtained.

Provide an average depth of 0.20 inch between the high and low points on the milled pavement. Do not allow the elevation of the longitudinal edges of adjacent cuts to differ more than 1/8 inch. When the Engineer deems necessary, apply water to control dust.

Obtain the Engineer's permission to leave vertical longitudinal faces during non-working hours in areas exposed to public traffic. When allowed, limit the vertical longitudinal faces to 1 1/2 inches in height and taper them in a manner the Engineer approves, to avoid creating a hazard for traffic.

After milling and texturing, ensure that the finished surface conforms to the required grade and cross section and provides a smooth riding surface free from gouges, ridges, oil film, and other imperfections of workmanship. Thoroughly sweep up all millings. Load and haul away all materials swept up.

Repair pavement that is gouged, torn, or otherwise damaged during milling operations, and repair damage done to any other property of any kind including utility frames, grates, and covers.

408.03.01 Surface Tolerance. Ensure that the finished surface after the final cut does not deviate more than 1/8 inch from a 10-foot straightedge and that the cross slope does not deviate more than 3/8 inch in 10 feet. Correct all irregularities exceeding these limits.

408.03.02 Approaches and Tapers. Mill approaches and tapers as required by, and to the satisfaction of, the Engineer. The Engineer will determine the length, width, and depth of cut on approaches and tapers. Match the approaches and tapers to the

finished cut on the mainline and transition them to the existing surface to within 1/8 inch.

When the Engineer deems necessary, transition private entrances to provide a smooth approach to the roadway.

408.03.03 Pavement Marking. Apply and maintain pavement markings according to Section 112.

408.03.04 Adjusting Small Drainage Structures. Adjust small drainage structures, such as catch basins, as required to match the finished pavement, or to provide proper drainage, according to Subsection 710.03.03. When existing catch basin grates are below the finished grade, the Department will require no adjustments.

Keep all small drainage structures, utility valves, etc. free of cuttings and other debris during the milling operation.

408.03.05 Adjusting Manholes. Only when the Engineer directs, adjust manholes according to Subsection 710.03.03. Return manhole adjusting rings that are removed and not reused to the utility owner.

408.04 MEASUREMENT.

408.04.01 Asphalt Pavement Milling and Texturing. The Department will measure the quantity of material removed from the areas milled and textured in tons.

When the original Contract quantity is 2,000 tons or more, weigh the material according to Section 109, except that the Department will accept commercial or portable scales, certified by the Kentucky Department of Agriculture, Division of Weights and Measures, and approved by the Engineer.

When the original Contract quantity is less than 2,000 tons, arrange for 3 trucks of each capacity to be weighed to determine the average net weight per load. The Department will calculate the total quantity using the average weight per load and the load count for each size of truck. The Engineer may require additional weighing if excessive variation in loading is apparent. The Engineer may perform check-weighing.

The Department will not measure additional milling performed to correct deficiencies in the finished grade, cross section, or texture for material removed when the deficiencies are due to unsatisfactory workmanship.

The Department will not measure work to repair damage caused by the milling operations.

The Department will not measure water used to control dust for payment and will consider it incidental to this item of work.

408.04.02 Mobilization for Asphalt Pavement Milling and Texturing. The Department will measure the quantity by the lump sum. The Department will measure Mobilization for Asphalt Pavement Milling and Texturing for payment only once per Contract and will consider any additional mobilization operations for milling and texturing incidental to this item of work.

The Department will not measure Mobilization for Asphalt Pavement Milling and Texturing for payment when milling is performed to correct deficiencies in the finished grade, cross section, or texture for material removed when the deficiencies are due to unsatisfactory workmanship.

408.04.03 Adjusting Small Drainage Structures. The Department will measure the quantity according to Subsection 710.04.

408.04.04 Adjust Manhole. The Department will measure the quantity by each individual unit.

408.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

408.05.01 Asphalt Pavement Milling and Texturing. When Asphalt Pavement Milling and Texturing is a major item, the Department will use the supplemental formulas established in Subsection 104.02.02 for determining adjusted unit prices when either an underrun or an overrun of 25 percent occurs in the quantity of milling and texturing actually performed.

408.05.02 Adjust Manhole. In the event the Engineer directs the Contractor to adjust existing manholes and the Contract does not include a bid item for this work, the Department will make payment at an agreed unit price of $250.00 for each manhole acceptably adjusted by using the adjusting ring method, or an agreed unit price of $350.00 for each manhole acceptably adjusted by removing or adding masonry.

Code	Pay Item	Pay Unit
2677	Asphalt Pavement Milling and Texturing	Ton
2676	Mobilization for Asphalt Pavement Milling and Texturing	Lump Sum
1709, 1719 1791, 1792	Adjusting Small Drainage Structures, Type, Size	See Subsection 710.05
1791	Adjust Manhole Frame to Grade	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 409 — ASPHALT MIXTURES USING RECLAIMED MATERIALS

409.01 DESCRIPTION. Use reclaimed asphalt pavement (RAP) from Department projects or other approved sources in hot asphalt mixtures, provided mixture requirements are satisfied. For other sources to be approved, satisfactorily establish to the Engineer that the quality of the material is acceptable.

409.02 MATERIALS AND EQUIPMENT. Conform to KM 64-427 for the required grade of asphalt binder which is based on the percentage of RAP in the mixture.

409.03 CONSTRUCTION. Keep RAP of different gradation, asphalt binder percentage, asphalt binder properties, and aggregate properties separate at all times, including when stockpiling and feeding. The Department may approve other methods and procedures provided that all characteristics of the material remain uniform.

409.03.01 Restrictions. Do not use reclaimed materials in open-graded friction courses.

Before using RAP in asphalt mixtures requiring polish-resistant aggregate, provide documentation to the Engineer's satisfaction that the reclaimed material consists of a given portion of polish-resistant aggregate.

409.03.02 Preparation of Mixture.

A) Mix Requirements. Conform to the Contract requirements for each mixture produced using RAP. If mixtures produced using RAP do not conform to the requirements for that mixture, complete the project using all virgin materials at no additional expense to the Department.

B) JMF. Develop the JMF, and submit it according to KM 64-421 to the Department for approval according to KM 64-427.

C) Mixing. Obtain the Engineer's approval for the method of incorporating RAP into the mixture. Thoroughly mix the new and reclaimed materials into a uniform mass. Ensure that the final mixture conforms to all requirements of the Contract. Ensure that the moisture content of the final mixture is not detrimental to the handling, hauling, placing, or compacting of the mixture.

The Engineer may require a longer mixing time for the new aggregate and reclaimed material, before and after the addition of virgin asphalt binder, than is normally specified.

409.04 MEASUREMENT. The Department will not measure RAP separately but will include it in the measured quantities of asphalt mixture produced.

409.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the appropriate pay item for the asphalt mixture being produced.

The Department will not make separate payment for incorporating RAP. The Department will not increase or decrease the Contract unit prices for any asphalt mixture on the project as a result of using, or not using, reclaimed material in the asphalt mixtures.

SECTION 410 ¾ ASPHALT PAVEMENT RIDE QUALITY

410.01 DESCRIPTION. This section covers the requirements for the ride quality of completed asphalt pavements. Included are provisions for incentive payments for outstanding work and deductions for acceptable, but lesser quality, work. Ride quality is a measurement of surface tolerance in terms of a Rideability Index (RI). The RI is an index derived from controlled measurements of the longitudinal profile in the wheel tracks and correlated with panel ratings of ride quality. The Contract will specify when ride quality requirements apply.

410.02 MATERIALS AND EQUIPMENT. The Department will measure the longitudinal profile of the surface with an ASTM E 950, Class 1 device.

410.03 CONSTRUCTION.

410.03.01 Lift Thickness. When the Engineer approves, the thickness of individual lifts of asphalt base may be adjusted to improve ride quality. Conform to Subsection 403.03.06.

410.03.02 Corrective Work. Submit corrective work procedure plans to the Engineer for approval before performing the work. Provide a final surface comparable to adjacent pavement that does not require corrective work in respect to texture, appearance, and skid resistance.

410.03.03 Ride Quality.

A) Acceptance Testing. The Department will test the ride quality of the pavement for acceptance after the Contractor:

1) makes a request at least 2 weeks in advance;
2) partially completes the paving and the Department deems it necessary; or
3) completes all mainline paving.

The Department will determine the RI by applying a linear transform, determined by correlation, to the values (average of 2 wheel paths) determined by ASTM E 1926. Thoroughly clean the surface of all dirt and other foreign matter immediately before the Department performs the testing.

The Department will divide and test each traffic lane using one-mile test sections starting at the beginning of the lane and proceeding in the direction of traffic. The Department will exclude discontinuities, such as bridges, in the pavement. When a test section at the end of a lane is less than one mile long, the Department will include that section with the adjacent section. When deemed necessary, the Department will retest the pavement after any corrective work is completed.

When the final riding surface is an open-graded friction course (OGFC), the Department will test it before the OGFC is placed and, when deemed necessary, after it is placed.

B) Requirements. Achieve a RI of 3.45 or greater for each one-mile section. When the RI is less than 3.45, perform corrective work, or remove and replace the pavement to achieve the specified RI. The Department's testing generates a computer file containing the measured longitudinal profile in terms of elevation values of each wheel track at 6-inch intervals. The Department will create a strip chart from the file showing the elevation and distance traveled when the RI is less than 3.60 or upon request for higher RI values.

410.04 MEASUREMENT. The Department will measure the ride quality in terms of

the RI according to Subsection 410.03. The Department will not measure the RI as a separate pay unit but will use the RI to calculate a Ride Quality Adjustment payment.

410.05 PAYMENT. The Department will apply a Ride Quality Adjustment for each one-mile section tested. The Department will calculate the Ride Quality Adjustments by multiplying the asphalt surface mixture payment for each one-mile test section by its appropriate ride quality pay value found in the Ride Quality Adjustment Schedule below.

When requesting tests on partially completed pavement, the Department will perform one test at no charge. The Department will perform additional requested testing and retesting for corrective work or pavement replacement at a cost of $150.00 per lane-mile. The Department will deduct charges for additional requested testing and retesting for corrective work from monies due on the Contract.

RIDE QUALITY ADJUSTMENT SCHEDULE

Rideability Index	Pay Value[1]
4.15 or higher	+0.15
4.10 to 4.14	+0.10
4.05 to 4.09	+0.05
3.70 to 4.04	0.00
3.60 to 3.69	-0.05
3.50 to 3.59	-0.10
3.45 to 3.49	-0.15
3.44 or lower	Corrective work or replacement required

[1] *The Department will not apply a positive pay value for corrective work other than removal and replacement to achieve the RI.*

SECTION 411 ¾ ASPHALT WEDGE CURBS AND MOUNTABLE MEDIANS

411.01 DESCRIPTION. Construct extruded asphalt sections of constant width with an extrusion-type machine. Construct asphalt sections of variable width by machine or hand.

411.02 MATERIALS AND EQUIPMENT.

411.02.01 Asphalt Materials. Conform to Section 806. For tack and paint coats, use SS-1, SS-1h, CSS-1, CSS-1h, AE-60, RS-1, or CRS-1. For the asphalt mixture, use PG 64-22 or 58-22.

411.02.02 Aggregate. Conform to Sections 804 and 805. Use a gradation that conforms to the following table:

Sieve Size	Percent Passing
1/2 inch	100
No. 4	60-80
No. 8	45-65
No. 16	13-25
No. 200	6-12

Test gradation according to KM 64-433 or KM 64-620.

Use an asphalt binder content (AC) between 6 and 8 percent by weight of the mixture. When using a porous aggregate, increase the AC as needed to compensate for asphalt absorption by the aggregate. Submit a JMF to the Engineer for AC approval according to KM 64-421. Maintain the approved AC within ± 0.5 percentage points as determined according to KM 64-405, KM 64-436, KM 64-437, KM 64-438, or AASHTO T 308.

The Department may allow an alternate JMF. Submit alternates for the Engineer's approval. When the Engineer determines that the results from an alternate JMF are not satisfactory, repair or replace the defective work, and complete the remainder of the work using the JMF specified in this section.

411.02.03 Extrusion Equipment. Furnish a self-propelled machine for placing extruded asphalt sections. Ensure that it is equipped with a material hopper, a distributing screw, and adjustable forming devices; and capable of placing and compacting the asphalt mixture to the lines, grades, and cross section specified in a smooth, homogenous section free of honeycomb areas.

411.03 CONSTRUCTION. Conform to Section 403 except as specified in this section and in the Contract.

Thoroughly clean the surface where the extruded asphalt sections are to be placed, and apply tack at a rate to achieve an undiluted asphalt residue of 0.4 pounds (0.05 gallons) per square yard. Allow the tack material to cure before covering it.

For curbs and medians of constant width, extrude the asphalt sections at the locations and to the dimensions specified in the Contract.

In areas inaccessible to the machine and on variable-width medians, the Department will allow hand-placing. Ensure that the mixture is compacted and finished to a dense, uniform section comparable to the machine-placed mixture.

Apply an asphalt paint coat to the sections after construction. Prevent spotting or discoloring of concrete curbs, headwalls, and other structures, and remove any discolorations that do occur.

411.04 MEASUREMENT.

411.04.01 Asphalt Wedge Curb. The Department will measure the quantity in

linear feet along the top of the curb. The Department will not measure tack and paint coats for payment and will consider them incidental to this item of work.

411.04.02 Mountable Medians. The Department will measure the quantity of each type in square yards. The Department will not measure tack and paint coats for payment and will consider them incidental to this item of work.

411.05 PAYMENT. When an alternate JMF is approved for use, the Department will not make any change to the Contract unit price for this item. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1897	Asphalt Wedge Curb	Linear Foot
1935-1950	Mountable Median, Type	Square Yard

The Department will consider payment as full compensation for all work required under this section.

DIVISION 500

PCC PAVEMENT AND NON-STRUCTURAL CONCRETE CONSTRUCTION

SECTION 501 ¾ PCC PAVEMENT, BASE, AND SHOULDERS

501.01 DESCRIPTION. Construct a single course of PCC pavement, base, or shoulders. Construct longitudinal and transverse joints when required. Construct pavement, base, and shoulders on a prepared subgrade or an aggregate base course.

501.02 MATERIALS AND EQUIPMENT.

501.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

501.02.02 Joint Materials. Conform to Section 807.

A) Sealers. Use hot-poured elastic, preformed, or silicone.
B) Filler. Use preformed sponge rubber, preformed cork, or preformed asphalt.

501.02.03 Tie Bars. Conform to Section 811 for steel reinforcement, No. 16, Grade 60.

501.02.04 Miscellaneous Steel. Conform to Section 811 for chairs, hook tie-bolts, spacers, aligning bars, and upper tie bars used in joint assemblies.

501.02.05 Epoxy Coating Material. Conform to Section 811.

501.02.06 Dowel Bars and Sleeves. Conform to Section 811.

501.02.07 Curing Materials. Conform to Section 823.

501.02.08 Batching Plant Equipment. Conform to Subsection 601.02, except do not use continuous mixers.

501.02.09 Mixers. Conform to Subsection 601.02.

501.02.10 Slip Form Pavers. Provide slip form pavers of an approved self-propelled type designed to spread, consolidate, and finish the concrete in one complete pass of the paver, and in such a manner that minimizes hand finishing. Ensure that the paver consolidates the concrete without damaging or displacing the load transfer devices and finishes the concrete to produce a smooth, uniformly textured surface having the specified crown and slope ready for final finishing. Use an automatic sensing device in continuous contact with a sensing guide to control the alignment. Maintain pavers according to the manufacturer's specifications.

501.02.11 Auxiliary Equipment for Slip Form Paving. Provide auxiliary equipment used in placing and finishing slip formed concrete, that is self-propelled and designed to operate without unnecessary contact with the newly placed concrete.

501.02.12 Forms. Provide form sections 10 feet long or longer and with a base width sufficient to ensure form stability. Use steel forms with self-aligning joints, designed to withstand the lateral and vertical loads imposed by spreaders, finishing machines, or other types of form-riding equipment. Use form sections that have the base of one end of each form section cut on a diagonal so the forms can be assembled to negotiate the inside and outside curves of roadways.

Ensure that each 10-foot length of form has at least 3 stake pockets securely riveted or welded to the web and base to act as diagonal braces. Equip each stake pocket with at least one steel wedge to securely key the form to the stake.

Provide each form section with one lock-joint plate made of metal of a thickness equal to the form and of sufficient length to ensure stability, located on one end of the form in such a manner as to connect to the adjoining form. Construct the joints so that there will be no difference in the elevation of the end of each form, providing a smooth

level track surface. Use plates formed or reinforced to allow hammering or driving without distortion or breakage.

Use approved flexible forms for construction of circular pavement edges where the radius is 100 feet or less.

501.02.13 Fine Grading Machines. Provide fine grading machines that are capable of preparing the grade for the paving equipment to the specified base tolerance and to ensure that the finished pavement conforms to the specified surface tolerances.

501.02.14 Spreaders. Provide spreaders that distribute the concrete uniformly without segregation and strike off the concrete to a uniform depth. Use spreaders equipped with scraping devices designed to clean the top of the forms when traveling in either direction.

501.02.15 Finishing Machines and Floats. Provide transverse finishing machines, longitudinal floats, and combination float finishers that are power driven and designed to operate without slipping on the forms or displacing the forms. Use finishing machines and floats that screed and finish the pavement within the specified tolerances.

501.02.16 Vibrators. Use vibrators for full width vibration of concrete paving slabs of either the surface pan type or the internal type. When using the internal type, provide vibrators having immersed tube or multiple spuds. When only spuds are used, space the spuds no more than 2 feet apart. Either attach the spuds to the spreader or the finishing machine or mount the spuds on a separate carriage. Make the frequency of the vibrators such as to satisfactorily vibrate and consolidate the concrete throughout its full width and depth. Achieve consolidation using industry standards according to the guidelines in ACI 309R including frequency recommendations, performance, and application of internal vibrators. Do not use electrical, multiple speed, internal vibrators.

Operate all consolidating devices so that when the forward movement of their mount stops the consolidating devices immediately stop.

501.02.17 Miscellaneous Equipment.

A) Straightedges. Provide straightedges required for testing the surface of the plastic concrete that are accurate 10-foot square-edged straightedges with a handle that is at least 3 feet longer than half the width of the slab.

B) Bulkheads. Construct bulkheads for construction joints of lumber of at least 2-inch nominal thickness or use an approved metal type. Shape bulkheads to conform to the cross section of the pavement. Design bulkheads to provide for correct installation of tie bars.

C) Footbridges. Design and construct the bridges so they will not come in contact with the concrete.

D) Hand Screeds. Provide hand screeds that are a minimum of 2 feet longer than the maximum width of the pavement to be struck off, so shaped and sufficiently rigid to strike off the pavement true to the required cross section.

E) Hand Vibrators. Use spud type internal vibrators for hand finishing.

F) Transverse Floats. Provide transverse floats for hand finishing that are of lightweight, rigid construction, free of warps, and with handles of sufficient length to allow operation from off the pavement. Use floats with finishing faces that are at least 10 feet long and 3 inches in width. Use metal floats that are formed to a channel cross section so as to provide sides one inch high and perpendicular to the finishing face.

G) Longitudinal Floats. Provide longitudinal floats for hand finishing that are at least 10 feet long, 6 inches wide, rigidly constructed, and equipped with handles.

H) Small Tools. Provide straightedges and templates for testing hardened

pavement and forms, and all other small tools necessary to completely and satisfactorily finish the work.

501.02.18 Water Supply Equipment. Provide approved truck tanks or pumps and pipe lines that are of such capacity and efficiency to ensure an ample supply and an adequate pressure of water simultaneously for all requirements of the work, including mixing, curing, sprinkling the subgrade, and cleaning hauling equipment as necessary.

501.02.19 Concrete Saws. Provide concrete saws for sawing joints that are power-driven, having diamond-edge or abrasive saw blades, capable of cutting to the alignment, depth, and width specified for the joints, and in sufficient numbers to ensure all joints are sawed within the specified time limits.

501.02.20 Equipment for Applying Membrane Curing Compound. Conform to Subsection 601.02.

501.02.21 Air Compressors. Furnish air compressors having separators and traps.

501.02.22 Profiler. The Department will use a profiler conforming to Subsection 410.02.

501.02.23 Profilograph. The Department will use a Rainhart Profilograph Catalog No. 860 with a 0.1 inch blanking band according to ASTM E 1274 and will determine the Profile index (PI).

501.03 CONSTRUCTION.

501.03.01 Care, Storage, and Handling of Aggregates, Cement, and Fly Ash. Furnish, store, and handle aggregates, cement, and fly ash according to Subsection 601.03.

501.03.02 Admixtures. Furnish admixtures according to Subsection 601.03, except the Department will not require a water-reducing admixture. For water-reducing admixtures, the Department will not allow an increased slump when using slip forms.

501.03.03 Concrete Producer Responsibilities. Design concrete mixtures and perform quality control and process control according to Subsection 601.03.

501.03.04 Proportioning and Requirements. Furnish Class P concrete according to Subsection 601.03.

501.03.05 Weather Limitations and Protection. Mix, place, and finish concrete when the lighting is sufficient.

Discontinue mixing and concreting operations when a falling air temperature in the shade and away from artificial heat reaches 40 °F. Do not resume mixing and concreting operations until rising air temperature in the shade and away from artificial heat reaches 35 °F.

In cold weather, when the Engineer authorizes concreting of small or irregular areas such as crossovers, temporary openings, turnouts, narrow or irregular widening, and other areas where hand finishing is allowed, the Engineer may require the water and aggregates to be heated to no more than 150 °F. Heat the aggregates prior to being placed in the mixer. Use an apparatus that heats the mass uniformly and is arranged to preclude the possible occurrence of overheated areas. Ensure that the temperature of the heated mixture is no less than 50 °F and no more than 90 °F at the time of placing.

Do not place concrete on a frozen base. Do not use frozen aggregates in the concrete.

When deemed necessary, install and maintain protective coverings and heating devices to protect the concrete in place and to prevent its temperature from falling below 45 °F until the concrete is 7 calendar days old or has attained the required strength according to Subsection 501.03.19. Do not use admixtures to prevent freezing.

In hot weather, make an effort to maintain the temperature of the mixture below 90 °F. Do not place concrete in areas where hand finishing will be used if the ambient temperature is above 100 °F.

Protect newly placed pavement that is threatened with damage by rain. If the texture is damaged so the specified groove dimensions are not met, restore acceptable texture to the damaged areas by sawing to conform to groove requirements.

501.03.06 Slump. Conform to Subsection 601.03.06.

501.03.07 Preparation of Aggregate Base Course. When placing the concrete by the slip form process, prepare the grade for the paving equipment to the accuracy necessary to ensure that the finished concrete conforms to all surface tolerance requirements.

When placing the concrete using fixed forms, prepare the aggregate base course to the required lines, grades, and cross section. Backfill low places and cavities in the base course detected during the final shaping with concrete placed in conjunction with the pavement, base, or shoulders.

Maintain the finished aggregate base course in a smooth, compacted condition. Ensure that the base course is moist when placing the concrete. When required, wet the base course prior to placing the concrete. Avoid creating mud or pools of water.

501.03.08 Forming. Stake and brace the forms to resist concrete pressure and the lateral thrust of form-riding equipment. Set the forms so that they uniformly bear on the base course throughout their entire length and width. Set the forms directly in contact with the finished aggregate base course.

When the aggregate base is disturbed or loosened, thoroughly tamp the material supporting the forms either mechanically or by hand at both the inside and outside edges of the base of the forms.

Join all forms neatly and tightly, and thoroughly clean and oil all forms before placing concrete against them.

After setting the forms in place, check their top surfaces for grade and alignment. Reset, or remove and replace, any forms showing a top surface variation greater than 1/8 inch in 10 feet.

501.03.09 Mixing. Produce concrete by central plant mixing according to Subsection 601.03.08. The Engineer may allow the use of truck-mixed concrete in the construction of small or irregular areas, such as crossovers, temporary openings, turnouts, narrow or irregular widening, and other areas where hand finishing is allowed. The Department will allow truck mixing for shoulder construction. The Department reserves the right to stop the use of truck-mixed concrete in construction of concrete pavements, bases, and shoulders when concrete fails to conform to the specified requirements for proportioning, consistency, slump, or expected strength. Perform truck mixing according to Subsection 601.03.08.

501.03.10 Delivery. Deliver according to Subsection 601.03.07 except when concrete produced by central mixing is delivered by approved truck mixers, the Engineer will allow maximum slump applicable to truck-mixed concrete.

501.03.11 Placing Concrete. Obtain the Engineer's approval of the condition of the base course before placing any concrete. Deposit the concrete on the grade to require as little rehandling as possible. Unless hauling equipment is equipped with means for discharge of concrete without segregation of the materials, unload the concrete into an approved spreading device and mechanically spread it on the grade in a manner to prevent segregation of the materials. The Department will not require a

mechanical spreader for PCC Base. Perform necessary hand spreading with shovels, not rakes.

During any temporary shutdown of less than 30 minutes, cover the concrete at the unfinished end of the slab with wet burlap. When an interruption of the work exceeds 30 minutes duration, the Engineer may require that a construction joint be installed.

Consolidate all concrete with mechanical vibratory equipment throughout its full width and depth. The Engineer will allow small manually operated vibrators for variable width areas such as tapers, transitions, blockouts, parking areas, and other similar construction where hand finishing may be necessary. On mainline construction, vibrate the concrete by equipment specifically used for that purpose, in addition to vibration resulting from the operation of other placing or finishing equipment.

Thoroughly consolidate concrete against and along the faces of all forms and headers and along the full length and on both sides of all joint assemblies. When vibrating, do not disturb load transfer devices, tie bars, hook bolts, side forms, or the aggregate base course.

When slip form pavers are used, spread or distribute the concrete in front of the paver in a manner that will allow the paver to proceed uniformly without bulldozing large piles of concrete. Maintain the head of concrete at a uniform height and not so great as to cause erratic movements of the paver.

If placing concrete adjacent to a previously constructed lane of pavement, base, or shoulder and mechanical equipment is to be operated upon the previously constructed lane, conform to the strength requirements of Subsection 501.03.20 for that lane and place temporary seals according to Subsection 501.03.18 before placing equipment in that lane.

When constructing the pavement using fixed forms, provide at least 2 movable bridges from which finishers may satisfactorily finish the pavement.

501.03.12 Final Strike-Off. Perform operations in the following sequence: consolidation, strike-off, machine finishing, straightedging, minor hand finishing, and texturing.

Do not add water to the surface of the concrete to aid finishing operations unless hand finishing. When hand finishing, the Engineer may allow application of water to the surface to aid finishing. When the Engineer allows water, apply it as a fog spray by means of approved spray equipment.

501.03.13 Finishing.

A) Finishing for Slip Form Paver. Ensure that slip form pavers consolidate and finish the concrete, in one pass of the paver, in such a manner that a minimum of hand finishing is necessary, producing a smooth, uniformly textured surface with the specified cross section ready for final straight edging and texturing.

When using tube float finishing machines, conform to the following conditions:

1) Make no more than 5 passes of the tube float at any location. The Engineer will consider one trip in one direction as one pass.
2) Do not add water to the pavement surface to aid finishing. When desired, moisten the tube float by a water fog sprayer only on the initial pass over any area of pavement being finished.
3) Operate the tube as a floating finisher without external down pressure.
4) Keep the water fog spray nozzle, water lines, and water tank in good repair to avoid leakage of excessive water onto the pavement surface.
5) If the wet burlap drag is attached to the tube float finishing machine, provide means to raise the burlap so the pavement, base, or shoulder surface is dragged by the burlap only on the last pass of the machine.
6) The Engineer may allow fog spray of the tube on 2 passes, but only in unusual situations such as when constructing a joint at a header or after

an equipment breakdown.

B) Machine Finishing. Finish all concrete, except that placed by the slip form process or in areas where hand finishing is allowed, by machine methods. Distribute or spread the concrete while placing it. Immediately after placing the concrete, consolidate it by vibration, strike it off, and screed it using approved finishing machines. Pass the machines over each area of pavement, base, or shoulder as many times and at such intervals to produce a surface of uniform texture. The Department will allow an approved manually operated strike-off screed in lieu of a finishing machine for PCC base. Avoid excessive operation over a given area. Keep the tops of the forms clean by an effective device attached to the machine. Maintain the travel of the machine on the forms true without lift, wobbling, or other variation tending to affect the precision finish.

During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length.

C) Hand Finishing. The Engineer may allow hand finishing methods when the following occurs:

1) Mechanical equipment breaks down after concrete has already been deposited on the grade;
2) Narrow widths or other small, irregular dimensions where operation of mechanical equipment is impractical; and
3) Lengths less than 2 feet.

Consolidate the concrete using a vibrator immediately after placing, then strike-off and screed the pavement with a Department approved portable screed.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and manipulated so that neither end is raised from the side forms during the striking and screeding process. When necessary, repeat this until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

D) Floating. Immediately after completing the transverse screeding operation, float the surface smooth using a longitudinal float or a pan float. The Department will not require floating on PCC base. Use transverse hand floats only when the Engineer allows. The Department will allow the use of straightedges in lieu of hand floats for minor hand finishing done in connection with machine finishing. Use a mechanical float behind slip form pavers.

Operate the longitudinal float transversely across the concrete with a sawing motion, always maintaining the float parallel to the centerline of the work. Remove all variations in the surface. Remove all surplus water, laitance, and inert material. Float until the concrete shows no variation from straightedge requirements.

Add additional concrete to fill depressions during the longitudinal floating operation. Do not move the longitudinal float ahead more than half its length at one time. Use care to preserve the cross section of the pavement, base, and shoulders including the crown.

When using the pan type float finisher, adjust the suspended screeds and float pans to conform to the required grade and cross section and operate it to produce a smooth, dense surface free of irregularities or porous areas. When the float finisher is attached to a finishing machine equipped with approved screeds, the Engineer may allow the float finishing at the same time as the last pass of the screeding operation.

E) Surface Correction. While the concrete is still plastic, scrape the pavement and shoulder surface to remove all laitance, excess water, and inert material, and test the surface for trueness with a straightedge. Hold the straightedge

in successive positions parallel to the road centerline in contact with the surface, and swing it across the entire area from one side of the slab to the other until the entire surface is free from visual departures. Advance along the road in successive stages of no more than half the length of the straightedge. Immediately fill any depressions found with freshly mixed concrete, strike-off, consolidate, and refinish them. Continue the straightedge testing and refloating until the entire surface is free from observable departures from the straightedge and the slab has the required grade and cross section. Ensure that at the time of testing, the surface is free from soft mortar or excess water.

F) **Edging.** Finish the outside edges of the slab when using fixed forms and the edges of all expansion joints with an edging tool to a radius of 1/8 inch.

G) **Burlap Drag.** Finish the pavement using a burlap drag having a double thickness of burlap at least 4 feet wide. Attach the burlap to a bridge and keep it saturated while in use. Lay the burlap on the pavement surface and drag it in the direction that the pavement is being placed with approximately 2 feet of width in contact with the pavement surface. The Engineer will allow hand finishing of the outer edges with smaller pieces of burlap when necessary to avoid rounding or slumping of the edges of slip formed pavement. In all other instances, use burlap of sufficient width such that the full width of the pavement receives the burlap finish. When allowing hand finishing on areas, the Engineer will allow manual means for the entire surface. Maintain drags clean and free from encrusted mortar. Discard drags that cannot be cleaned, and replace them with new drags.

H) **Texturing.** Immediately after finishing the concrete with the burlap drag, texture the surface by forming transverse grooves. The Department will waive the requirement for transverse grooves when the pavement is to be diamond ground before opening to traffic.

Form the transverse grooves by mechanical equipment using a comb made with steel tines. When allowing hand finishing on areas, the Department will allow the use of manual tools such as rakes with spring steel tines.

Form the grooves in the concrete at an appropriate time during the stiffening of the concrete mixture, so that in the hardened concrete, the grooves will be between 0.09 inch and 0.13 inch in width, between 0.12 inch and 0.19 inch in depth, and will be spaced at random intervals between 0.3 inch and one inch.

Regardless of the method used to form the grooves, ensure that the grooves are relatively smooth and uniform, and form the grooves without tearing the surface or bringing pieces of the coarse aggregate to the top of the surface.

Correct any individual areas of 50 square yards or larger of the hardened grooved concrete that do not conform to the above requirements. Correct by cutting acceptable grooves in the hardened surface with an approved cutting machine or by other methods approved by the Engineer.

The Department will not require texturing on PCC base.

I) **Station Numbers.** Stencil station numbers into the pavement before it takes its final set. Mark the complete station number every 500 feet. Mark equations in the alignment, when they occur, in the pavement in the same manner and at the same locations as specified in the Contract.

Size and place the stencils according to the Standard Drawings.

J) **Rumble Strips In Shoulders.** After finishing the shoulders, form rumble strips according to the Standard Drawings. When the shoulder is used to maintain traffic during construction, do not form rumble strips until the mainline is opened to traffic. When the mainline is open to traffic saw cut Type 3 rumble strips according to the Standard Drawings. Seal saw cut grooves with epoxy sealer according to Section 510.

501.03.14 Removing Forms. Remove forms as soon as the concrete has

hardened sufficiently to allow sawing the transverse joints. Immediately fill all honeycombed areas appearing in the edges of the pavement, base, or shoulders with mortar composed of one part cement and 2 parts fine aggregate by loose volume. Then, cure the edges of the pavement, base, or shoulders.

501.03.15 Curing. Immediately after completing finishing operations and the concrete has set sufficiently to prevent marring the surface, cover and cure the entire surface of the newly placed concrete, including the face of all construction joints. In all cases in which curing requires the use of water, ensure that water is available. The Department may suspend the placement of concrete when failure to provide sufficient cover or adequate water for curing occurs.

When it becomes necessary to uncover an area of the pavement before the end of the curing period, do not expose the pavement for more than 30 minutes.

Cure according to one of the following methods:

A) White Membrane Curing. After completely finishing the concrete and immediately after any free water has disappeared, completely and uniformly coat the entire pavement surface with Type 2 (white pigmented) liquid membrane-forming curing compound. Apply the compound in one or 2 applications. When 2 applications are necessary to meet the required rate, apply the second application within 30 minutes of the first. If there is a delay in applying the first application of the curing compound, cover the pavement surface with wetted burlap.

Apply the curing compound through a pressure sprayer at the rate of one gallon to no more than 120 square feet total application, whether applied in one or 2 applications. When desired, decrease the application rate to one gallon to no more than 150 square feet when texturing is not required. During its application, ensure that the compound is in a thoroughly mixed condition with the pigment dispersed throughout the vehicle. Continuously stir the compound by effective mechanical means while applying it. The Engineer will allow hand sprayers for coating odd widths or shapes and for coating areas exposed by the removal of forms. Correct honeycomb areas, then coat the sides of the slab within 30 minutes following removal of the forms.

The Department will not require removal of curing compound overspray from tie bars when the deformations are still visible.

When the compound is too thick to satisfactorily apply during cold weather, warm it in a water bath at a temperature no greater than 100 °F. Do not thin the compound with solvents.

When rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or when the film is damaged or is noticeably faulty, apply a new coat of the compound to the affected areas.

Protect the treated surface against damage for a period of at least 72 hours or until attaining the required strength. The Engineer will consider all traffic, pedestrian or otherwise, as injurious to the film of the applied compound. The Engineer will allow a minimum of traffic on the dried film as necessary to carry on the work, such as joint sawing and sealing equipment. When putting minimum traffic on the dried film, immediately repair any damage to the film by an additional application to the affected areas.

Take precautions to ensure proper curing at joints, and to prevent any of the curing compound from entering the joints. Protect sawed joints by closing the opening with a moistened rope of paper or other approved fiber, by covering the opening with a one-foot strip of curing paper or 4-mil white polyethylene film, or by other approved methods before repairing the damaged areas adjacent to the joints with an additional application of the compound.

Provide approved standby facilities or approved alternate methods for curing concrete pavements at a readily accessible location at the site of the work for use in the event of mechanical failure of the spraying equipment or other conditions which may prevent the proper application of the curing

compound.

The Engineer may stop this method of curing when unsatisfactory results are obtained and may require the remainder of the concrete to be cured with wet burlap or curing blankets.

Do not use white membrane curing on PCC base that is to be surfaced with an asphalt mixture.

B) Wet Burlap. Thoroughly wet the burlap before placing. Carefully place the burlap over the finished surface to completely cover the surface and sides of the slab. Clean the burlap of all coating of earth or other deleterious substances before using it. Soak new burlap in water for 12 hours before use.

During the first 6 hours, the Engineer will require a single thickness of burlap. After the first 6 hours, use a double thickness. Overlap adjacent burlap strips at least 3 inches.

Keep the burlap thoroughly saturated and in place for at least 72 hours even when required strength is attained.

C) Curing Blankets. Cure according to Subsection 601.03.17 C). Place curing blankets to completely cover the surface and the sides of the slab for 72 hours or until attaining the required strength.

501.03.16 Diamond Grinding. When electing to or when the Contract specifies to diamond grind the pavement to achieve texture or ride quality, conform to Subsections 503.02 and 503.03 excluding 503.03.09. The Department will determine pavement thickness according to Subsection 501.03.21 after diamond grinding.

501.03.17 Joints. Construct all joints, longitudinal and transverse, according to the Plans and Standard Drawings. Use epoxy coated or other approved corrosion resistant tie bars and hook bolts. Construct all joints perpendicular to the surface of the pavement and to true alignment.

Ensure that sawed joints are of uniform width throughout. Use sawing equipment to cut the joint in strict conformity with the required alignment and depth. Cut transverse saw cuts for joints that are to be sealed with preformed compression joint seals in one continuous cut across the pavement. The Engineer will allow spraying of water on the saw blades during the cutting. Do not saw the joints until the concrete has hardened to the extent that tearing and raveling will not occur, but as soon as necessary to preclude random cracking. The Engineer may require the construction of sawed joints at the time, day or night, and in the order or sequence that will most effectively hold random cracking to a minimum. Provide a standby machine and a sufficient supply of saw blades available at all times.

Thoroughly flush all sawed joints with clean water or clean with compressed air immediately after sawing so the vertical surfaces of the joint will be clean and will allow proper adherence of joint sealer to the surfaces.

Protect all joints from intrusion of injurious foreign material, including mortar or cuttings from adjacent sawing operations, until sealed.

When curbs or concrete medians are constructed integral with the pavement, construct all transverse joints continuous through the curb or median.

When constructing PCC Base, for adjacent slabs with approximately 50-foot joint spacing, match joints and construct additional joints at third points. For adjacent slabs with 25-foot joint spacing, match joint and construct additional joints at midpoints.

A) Longitudinal Joints. Install longitudinal joints on the centerline, or parallel to the centerline within 1/2 inch from the true theoretical position. Construct longitudinal sawed joints with tie bars when the width of the pavement, base, or shoulder is more than 16 feet.

Saw the joints no later than the day following the end of the curing period, and before allowing any traffic on the pavement.

Cut longitudinal joints to true alignment within the tolerances specified in Appendix A, Table of Construction Tolerances, and to the depth specified in the Contract, and fill them with joint sealer according to Subsection

501.03.18.

Place deformed steel tie bars of the dimensions shown on the Standard Drawings transversely through the longitudinal joint. Space the tie bars as indicated, and rigidly secure them at both ends by Department approved supports. After the Contractor places and strikes off the concrete, the Department may allow him to install tie bars using a mechanical device designed to install the bars true to position and alignment.

Construct longitudinal saw construction joints between adjacent lanes or widths that are constructed separately according to the Standard Drawings. The Department will allow bending tie bars back, when necessary, while constructing the initial width, and straighten them to the correct position before constructing the adjoining width. When desired, use approved epoxy coated hook tie bolts in lieu of tie bars. When used, install hook tie bolts so the length is equally divided between the 2 slabs.

When placing pavement using slip form pavers, use approved methods to construct longitudinal construction joints according to the Contract.

B) Transverse Expansion Joints. Place transverse expansion joints at all bridge approaches according to the Standard Drawings.

Install the joints so the plane of the finished joint will be perpendicular to both the centerline and the surface of the pavement within 1/4 inch of true alignment in one lane width.

Provide a continuous joint through the full width of the pavement, with the length of individual pieces of joint filler no less than the width of one traffic lane. Securely connect adjoining sections to avoid an offset at their juncture. Install the joint filler for the full pavement width and from the bottom of the pavement to the bottom of the joint sealer, as shown on the Standard Drawings.

Place dowel bars, or other approved load transfer devices, when required, through transverse joints according to the Contract. When used, secure the dowels in position parallel to the surface and the centerline of the slab by a metal device that remains in the pavement.

Securely stake the load transfer device to the subgrade with anchor hooks according to the Standard Drawings. The Engineer may allow hooks less than 18 inches in length when used in conjunction with rock subgrade or cement stabilized base, however, the Engineer may require additional hooks to securely hold the assembly in place.

Place a No. 10 gage, 0.135-inch thick metal removable finishing cap over the expansion joint material during construction operations to provide protection and support to the material.

After the Engineer checks the joint for proper installation, deposit the concrete on the base course as near the expansion joint as possible without touching it. Then, shovel it against both sides of the joint simultaneously, maintaining equal pressures. Deposit concrete to a height of approximately 2 inches more than the depth of the joint, and carefully work the concrete under the load-transfer devices. Do not dump concrete directly upon or against the load-transfer devices. Prevent displacement of the dowel bars during placing and finishing operations.

Work concrete around load-transfer devices and against the body of the joints at all points. Reset and realign any displaced dowels before passing the finishing machine over them. When necessary, remove concrete to reset and realign any displaced dowels.

Move the finishing machine forward during finishing operations and operate it in a manner that will avoid damage or misalignment of joints.

Immediately after completing all finishing operations and before the concrete has taken its initial set, finish the edge of the slab to the required radius adjacent to all expansion joints. Manipulate the edging tool to produce a well-defined continuous radius and a smooth, dense mortar finish. Do not tilt the edging tool while manipulating it. Remove the edging tool marks from the surface so the texture blends with the final finish.

Place 1/2-inch expansion joint material against all box inlets, manholes, concrete barriers, retaining walls, bridge abutments, concrete gutter, and similar structures that project through, into, or against the pavement.

C) Longitudinal Expansion Joints. Construct longitudinal expansion joints according to Subsection 501.03.17 B) at locations specified in the Contract.

D) Transverse Contraction Joints. Construct transverse contraction joints in ramp tapers, intersections, and similar areas at locations specified in the Plans and Standard Drawings. On uniform width roadway construction, install transverse contraction joints at the spacing specified in the Plans and Standard Drawings.

Form transverse contraction joints by sawing, perpendicular to the surface of the pavement, within the tolerances specified in Appendix A, Tabulation of Construction Tolerances. Fill the joints with joint sealer as specified in Subsection 501.03.18.

Install load transfer assemblies, when specified in the Contract, according to Subsection 501.03.17 B) for transverse expansion joints. The Department will not require dowel bar sleeves, finishing caps, expansion joint fillers, or hand placement of concrete around the assemblies. The Department will not require load transfer assemblies for contraction joints in PCC base.

E) Transverse Construction Joints. Form the joints with a Department approved metal or wooden bulkhead, shaped to the cross section of the pavement, and designed to allow correct installation of tie bars according to the Standard Drawings. Rigidly secure the bulkhead to the subgrade so the finished joint will conform to all requirements for position and alignment. After removing the bulkhead and constructing the adjacent slab, saw the joint as specified in the Plans, and subsequently fill with joint sealer.

When using a construction joint, construct the joint no closer than 5 feet or one-half the spacing between adjacent joints, whichever is less, to any transverse contraction joint or transverse expansion joint. When the need for a construction joint occurs within the above distance from the preceding joint, remove the concrete to the specified distance behind the preceding joint and install the bulkhead at that location.

501.03.18 Sealing Joints.

A) Requirements for Sealing All Joints. Seal all joints as soon as practical and before opening the pavement, base, shoulders or any section of the pavement, base or shoulders to any traffic. Configure joint sealant according to the Standard Drawings.

Do not seal any joints until the Engineer inspects and approves them for sealing. Before applying the sealer, completely clean all joints of all loose scale, laitance, oils, greases, dirt, and other foreign substances, and remove all free water and loose particles by jetting with compressed air.

B) Uses of Sealant Types. Use any of the following sealant types for the indicated types of joints for PCC Pavement and Shoulders (For PCC base, use hot-poured elastic):

1) Preformed Neoprene Seals .

   a) transverse and longitudinal sawed joints
   b) expansion joints

2) Silicone Rubber Seals.

   a) transverse and longitudinal sawed joints
   b) transverse and longitudinal expansion joints
   c) longitudinal and transverse construction joints
   d) joints between pavement and shoulders and fixed objects such as box inlets, manholes, retaining walls, and concrete barriers

3) Self-Leveling Silicone Rubber Sealant.

a) resealing random cracks in PCC pavement, base, and shoulders
b) sealing joints between PCC pavement, base, and shoulders and asphalt pavement or shoulders
c) longitudinal and transverse construction joints
d) joints between pavement and shoulders and fixed objects such as box inlets, manholes, retaining walls, and concrete barriers; and sealing joints cut in asphalt overlays of PCC pavement, base, and shoulders for control of reflective cracking

4) Hot-Poured Elastic.

a) longitudinal and transverse construction joints
b) joints between pavement, base, and shoulders and fixed objects such as box inlets, manholes, retaining walls, and concrete barriers
c) for applications where the Department allows self-leveling silicone joint sealant

C) Preformed Neoprene Seals. Seal and repair damaged seals according to Subsection 609.03.04 for preformed neoprene seals. Remove and replace all seals that are damaged, twisted, curled, improperly positioned, or stretched more than 5 percent.

Do not seal transverse joints in the pavement until all adjacent sawed longitudinal joints have been sealed. Install each transverse seal in one piece, without field or factory splicing, for the full length of the transverse joints.

Install continuous longitudinal joint seals for lengths no less than 50 feet except where intersected by transverse joint seals. Where the longitudinal joints intersect the transverse joints, either sever the longitudinal seal after installation or insert it deeper at junctions with transverse joints. Thoroughly coat all intersections between longitudinal and transverse seals with an additional application of Department approved lubricant adhesive so that the openings in the longitudinal seal are completely closed. Install continuous longitudinal seals through transverse construction joints sealed with hot-poured sealer.

When the Department requires partial width construction, the Department will allow cutting the transverse seal at the longitudinal construction joint, and installing it in part width. Thoroughly coat all intersections between the transverse and longitudinal seal with an additional application of approved lubricant adhesive so that the opening in the transverse seals is completely closed and sealed.

Trim all transverse seals flush with the edge of the pavement, base, or shoulder after installation.

D) Silicone Rubber Sealant. Seal joints according to the Contract and the written recommendations of the manufacturer. Place seals when the ambient temperature and the pavement temperature is 40 °F or higher.

Completely clean and dry joints, and ensure that they are frost free. Immediately after sawing, flush with a jet of water and use other tools as necessary to remove all cuttings. After flushing, blow the joint out with compressed air. When the surfaces are thoroughly dry and within 24 hours prior to sealing the joint, clean the joints by sandblasting followed by blowing out with compressed air. Sandblast in 2 passes, one for each joint face, with the nozzle held at an angle to the joint face and within one to 2 inches of the pavement. Direct the air blast following the sandblast in one direction to prevent recontamination of the joint. If cleaned joints are not sealed within 24 hours after sandblasting, reclean them by lightly sandblasting and blowing out again using compressed air.

Supply compressed air free of water, oil, or any other injurious substances.

Install foam back-up rods according to the Standard Drawings. When sealing 2 intersecting joints, first place a continuous foam back-up rod through the intersection. Either place this rod low at the intersection, and place the intersecting rod over it at the specified depth; or cut the intersecting rod, and place it against the first rod at the intersection.

When necessary, use additional air blasting to completely remove all moisture, dust, or debris that has accumulated in the joint after placing the back-up rod. Ensure that the joint is completely clean, dry, and frost-free immediately prior to placement of the sealant.

Install silicone rubber seals with an applicator having a built-in grooving tool. Install the seals by pushing, not pulling, the sealant ahead to form a uniform head. This pushing of the sealant will ensure that the joint is filled from the top of the backer rod to at least 3/8 inch below the pavement surface. Tool the sealant so that it is forced against the joint faces and recessed below the pavement surface. Use the same tool for both application and grooving. Demonstrate satisfactory results during production and the Engineer may allow separate tools for application and grooving.

Seal joints as soon as practical after sawing and before allowing traffic, except construction traffic, on the pavement. Do not allow any traffic over the sealed joints for the period of time recommended by the manufacturer for proper adhesion or curing or for a longer period if the seals have not completely adhered or cured.

For each working day, the Engineer will remove 5 sample plugs at locations determined by the Engineer. The Engineer will test each plug for conformity to the geometry specified for the joint seals. If the test plugs do not conform, the Engineer will remove additional plugs and will identify the location of the joint from which each plug was removed. The Engineer will test each plug to determine if any joints are deficient. When joints are determined to be deficient, remove and rework those joints. After deficient joints have been reworked, the Engineer will remove sample plugs at locations determined by the Engineer. The Engineer will repeat the sampling and testing. Repair holes from sample plugs no later than the next working day.

E) Self-Leveling Silicone Rubber Sealant. Install the self-leveling rubber sealant according to the manufacturer's instructions.

F) Resealing Joints. Saw cut, and clean all joints to minimum widths or greater according to the specifications for each joint type. The minimum width for transverse joints before resealing is 3/4 inch and the minimum width for longitudinal joints is 1/2 inch. If the saw cut of an existing joint is not of sufficient width to clean the joint faces, resaw the joint to a width that will expose clean vertical faces of the joint. Perform all additional resawing of an existing joint to clean the faces of the joint and install seals appropriate for the resawed width. Clean joints before resealing according to the requirements for new seals. Install additional silicone rubber sealant following additional resawing of joints to clean faces, or install wider preformed neoprene seals following additional resawing of an existing joint to clean faces. Remove all debris and old joint sealer resulting from the sawing operation from the pavement before opening to public traffic.

When necessary, saw the pavement to the required depth at the pavement edge, extend the saw cut into existing asphalt shoulders. When edge drain construction is included in the Contract and edge drains are to be placed in the asphalt shoulder adjacent to the PCC pavement being saw cut and resealed, perform edge drain construction after sawing and sealing of the pavement so that sealing of cuts in the asphalt shoulder will not be necessary. When edge drain construction is not included in the Contract or an alternate construction sequence is specified, seal all saw cuts in the asphalt shoulders that will remain in the finished work using hot-poured

elastic joint sealer or self-leveling silicone rubber sealant. Perform sealing of cuts in the asphalt shoulder as soon as practical after completing pavement sealing in the adjacent lane.

G) Temporary Seals. When using temporary seals, firmly embed them in the joint. Place the material 1/4 inch below the pavement surface. Provide a material that is sufficiently strong and durable to resist intrusion of incompressible materials, and to allow complete removal after its usefulness has ended.

501.03.19 Surface Tolerances and Testing Surface.

A) Edge Slump. Prevent and correct the slumping of the pavement, base, or shoulder edges. Ensure that edge slump does not exceed 1/8 inch when the Plans indicate the edge of the pavement, base, or shoulder being constructed is to be abutted by subsequently constructed pavement, base, or shoulders, either by this Contract or future contracts. Ensure that edge slump does not exceed 1/4 inch where the edge is not to be abutted by subsequent pavement, base, or shoulder. Measure the edge slump with a straightedge laid on the pavement, base, or shoulder perpendicular to the edge.

Use a planing device or a device consisting of multiple saws to perform corrective work. Use rotary grinders only on isolated irregularities less than 50 square feet. Prohibit the use of bush hammers or other impact devices. Texture all areas of the concrete corrected by grinding in the same manner as the undisturbed pavement, base, or shoulder. When the specified texture is the transverse grooves, texture the ground areas by sawing the transverse grooves. Provide a final surface comparable to the adjacent pavement that does not require corrective work for texture, appearance, or skid resistance. Complete all corrective work within a section before the Department checks the thickness tolerance of that section. The Department will allow corrective work by diamond grinding according to Subsection 503.03.

B) Ride Quality. When the Contract specifies that ride quality requirements apply, the Department will determine the ride quality of the pavement as in terms of a Profile Index (PI) and Rideability Index (RI).

1) PI. The Engineer will test pavement surface with the profilograph as soon as practical, preferably before the Contractor saws the final joint. The Department will be using the profilograph to test other projects. Cooperate in the scheduling of testing as necessary in order that the testing can be performed efficiently on all projects.

When the pavement is 12 feet wide or less, the Department will take pavement profiles 3 feet from each edge and parallel thereto. When the pavement is placed wider than 12 feet, the Department will take profiles 3 feet from and parallel to each edge and at the approximate location of each planned longitudinal joint. The Engineer will exclude from testing all pavement within 20 feet of any discontinuity in the pavement such as bridges. However, the Engineer will require these excluded areas to meet the 1/8-inch longitudinal tolerance with a 10-foot straightedge.

The Engineer will determine an average PI for each section. The Department will consider a PI section to be 1,000 linear feet of full lane width pavement. When a test section at the end of a lane is less than 1,000 feet, the Department will include it in the preceding 1,000-foot test section. When an average PI of 12 inches per mile is exceeded in any section the Engineer will suspend the paving operation and will not allow paving to resume until the corrective action is taken. Regardless of the PI, remove all areas represented by high points having deviations in excess of 0.3 inch in 25 feet or less using methods the Engineer approves. The Engineer will determine deviations in excess of 0.3 inch from the profilograph.

When the section's average PI is between 8 and 12 inches per mile, correct pavement deviations to achieve a ride quality of a maximum PI of 8 inches or accept an adjustment to the contract unit price. For sections with an average PI of 12 inches or greater per mile, the Department will require corrective work.

2) RI. The Department will test the ride quality of the pavement for incentive payments when the PI is 8 or less and the Contractor either makes a request at least 2 weeks in advance or completes all main line paving.

The Department will determine the RI by applying a linear transform, determined by correlation, to the values (average of 2 wheel paths) determined by ASTM E 1926. Thoroughly clean the surface of all dirt and other foreign matter immediately before the Department performs the testing.

The Department will divide and test each traffic lane using one-mile test sections starting at the beginning of the lane and proceeding in the direction of traffic. The Department will exclude discontinuities, such as a bridge, from the measurement. When a test section adjacent to a discontinuity or at the end of a lane is less than one mile long, the Department will include that section with the adjacent section. When requested, the Department will retest the pavement after any corrective work is completed. The Department will create a strip chart showing the elevation and distance traveled upon request.

When the Contract does not specify that ride quality requirements apply, straightedge the pavement or shoulder in the presence of the Engineer. Place a 10-foot straightedge parallel to the centerline to bridge all depressions and touch all high spots. Perform straight edging as soon as the concrete has hardened sufficiently to support walking, but not later than 10:00 AM of the day following the placing of the concrete. Plainly mark all high spots, indicated by a variation exceeding 1/8 inch from the straightedge, that are 6 inches or more from the pavement, base, or shoulder edge.

501.03.20 Opening to Public Traffic. Open the pavement, base, or shoulders to traffic anytime 3,500-psi strength is attained, except when curing with wet burlap. When curing with wet burlap, wait at least 72 hours before opening the pavement to traffic. If 3,500 psi is not attained within 28 days, the Department may allow opening according to KM 64-314.

Complete the construction of shoulders and thoroughly clean the pavement, base, or shoulders and seal all joints, as required, before opening the pavement to traffic other than construction equipment.

Prior to opening the pavement to traffic, other than the construction equipment, complete the construction of shoulders in a satisfactory manner.

When operating any equipment entirely or partially on the pavement, provide means to protect the pavement from damage regardless of its age. Either provide the equipment with rubber-tired wheels or operate the equipment over protective mats designed and constructed to prevent damage to the pavement surface and joints. Use mats consisting of wooden strips having a nominal thickness of 2 inches and a width of at least that of the treads. The Engineer may allow mats made of other suitable material. Sweep the pavement surface free of debris prior to placing the protective matting.

Construct a ramp of compacted earth, or other material of sufficient strength, to prevent undue stress in the pavement slab from equipment moving on and off the pavement.

Open residential entrances to traffic, on which only automobile traffic is expected, only at the end of the 72-hour curing period, or at an attained strength of 3,500 psi. Clean the pavement and seal all joints before opening the residential entrances to traffic.

501.03.21 Tolerance in Pavement Thickness. The Engineer will determine the thickness of the pavement and concrete shoulders according to KM 64-309. The Engineer will evaluate areas of the pavement and shoulders found deficient in thickness by more than one inch. When the Engineer deems the areas warrant removal, remove and replace the areas with concrete of the thickness specified in the Plans.

501.04 MEASUREMENT.

501.04.01 PCC Pavement. The Department will measure the quantity in square yards according to the Plan dimensions as shown in the Record Plans. The Department will determine the final quantity based on the design quantity with increases or decreases by authorized adjustments. Authorized adjustments include changes in the Record Plan dimensions, additional areas not shown in the Record Plans, and errors and omissions in the design quantity in excess of one percent.

The Department will not measure reinforcing steel, load transfer assemblies, dowels, joint construction (including removal of concrete to accommodate a construction joint bulkhead), joint sealing, joint repair, form pins, texturing, additional work for drilling holes for form pins, texturing areas of the pavement that have been corrected by grinding, fly ash, Type IP cement, Type III cement, additional Type I cement for high early strength, formed rumbles strips, and all other items necessary to construct the pavement according to the Contract for payment and will consider them incidental to this item of work.

501.04.02 PCC Base. The Department will measure the quantity in square yards according to Subsection 501.04.01.

501.04.03 PCC Shoulders. The Department will measure the quantity in square yards according to Subsection 501.04.01.

501.04.04 Rumble Strips, Type 3. The Department will measure the quantity in linear feet. The Department will not measure Type 3 rumble strips for payment unless they are constructed because the shoulder is used to maintain traffic during construction. The Department will not measure epoxy sealer for payment and will consider it incidental to this item of work.

501.04.05 Diamond Grinding. When listed as a bid item, the Department will measure the quantity according to Subsection 503.04. The Department will not measure diamond grinding for payment when it is performed at the Contractor's option or for corrective work and will consider it incidental to PCC Pavement.

501.04.06 PCC Thickness. The Department will measure the pavement thickness tolerance in inches by coring according to KM 64-309. The Department will not measure the pavement thickness tolerance as a separate pay unit, but will use the pavement thickness tolerance to calculate an adjusted Contract unit price for PCC Pavement, PCC Base, or PCC Shoulders.

501.04.07 Ride Quality. The Department will not measure the PI or RI as a separate pay unit, but will use the RI or PI to calculate a ride quality adjustment for PCC Pavement. When the Contract specifies that the Department will measure the ride quality, the Department will use the RI for incentive payments and, if none, will use the PI for acceptance and disincentive payments.

501.05 PAYMENT. Department will make payment for the completed and accepted quantities under the following:

501.05.01 PCC Thickness. The Department will adjust the Contract unit price for PCC Pavement, PCC Base, and PCC Shoulders by the Schedule for Adjusted

Payment for Thickness Deficiency. The adjusted quantity is equal to the area of PCC Pavement, PCC Base, or PCC Shoulder specified in the Kentucky Method, multiplied by the Contract unit price for the PCC item and the Price Adjustment. The Department will not make additional payment for average thicknesses of pavement, base, or shoulders in excess of the specified thickness.

501.05.02 Ride Quality. The Department will apply a Ride Quality Adjustment for each section tested. The Department will calculate the Ride Quality Adjustments by multiplying PCC Pavement payment for each test section by its appropriate ride quality Pay Value found in the Ride Quality Adjustment Schedule.

Code	Pay Item	Pay Unit
2069-2071, 2073, 2075, 2084, 2086, 2088	PCC Pavement Non-Reinforced, thickness	Square Yard
2072, 2077, 2078, 2081-2083, 2087, 2089	PCC Pavement Non-Reinforced Shoulder, thickness	Square Yard
2061, 2064, 2065	PCC Base, thickness	Square Yard
2695	Rumble Strips, Type 3	Linear Foot
----	Rideability Testing	Each
2060	PCC Pavement Diamond Grinding	See Subsection 503.05

Schedule for Adjusted Payment for Thickness Deficiency

Thickness Deficiency (inches)	Price Adjustment (Percent of Contract Unit Bid Price)
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
0.51 to 0.75	57
0.76 to 1.00	50
Greater than 1.00	(1)

(1) *Remove and replace these areas with concrete of the specified thickness at no expense to the Department when the Engineer directs.*

Ride Quality Adjustment Schedule

Rideability Index	Pay Value(1)
4.15 or higher	+0.03
4.10 to 4.14	+0.02
4.05 to 4.09	+0.01
Average for PI (inches per mile)(2)	Pay Value
8 or less	0.00
over 8, up to 9	-0.02
over 9, up to 10	-0.05
over 10, up to 12	-0.08
over 12	Corrective work required

(1) *Contractor may correct areas to achieve a positive adjustment. The Department will perform additional requested testing and retesting for corrective work at a cost of $150.00 per lane mile. The Department will deduct charges for requested additional testing and retesting for corrective work from monies due on the Contract.*

(2) *The Department will apply the unit bid price adjustment to the total area of the 1,000-foot section of the traffic lane represented by the*

Profile Index. The Department will not make payment in excess of 50 percent for any main line pavement that has an average Profile Index in excess of 12 inches per mile until the Contractor completes the corrective work and the Department reprofiles and verifies that the average Profile Index has been reduced to 12 inches per mile or less.

The Department will consider payment as full compensation for all work required under this section.

SECTION 502 ¾ PCC PAVEMENT 24/48/72

502.01 DESCRIPTION. Construct a single course of PCC pavement capable of attaining a 3,500 psi compressive strength within 24 hours, 48 hours, or 72 hours.

502.02 MATERIALS AND EQUIPMENT. Conform to Subsection 501.02.

502.03 CONSTRUCTION. Conform to Subsection 501.03 with the following exceptions and additions:

A) Proportioning and Requirements.

MODIFIED INGREDIENT PROPORTIONS AND REQUIREMENTS FOR CLASS P CONCRETE FOR EARLY STRENGTH PAVEMENTS				
Class P Modified Mixture	Maximum Free Water by W/C Ratio (lb/lb)	Maximum Slump [(1)] (inches)	Minimum Cement Factor[(2)] (lb/yd^3)	Required Time to Attain 3,500 psi Compressive Strength (Hours)
PCCP/24	0.33	2	799	24
PCCP/48	0.34	2	729	48
PCCP/72	0.35	2	658	72

[(1)] *The Department will allow up to 7-inch slump when using fixed forms.*
[(2)] *The Department will allow a 94-lb reduction in the cement factor when using Type III cement.*

Add Water-Reducing, High Range (AASHTO M 194, Type F) or Water-Reducing, High Range, and Retarding (AASHTO M 194, Type G) admixtures at a rate of 12 to 25 ounces per 100 pounds of cement.

When proposing an alternate mix design, meet only the following requirements:

1) attain a 3,500 psi compressive strength at the required time;
2) furnish concrete having a minimum cement factor of 658 pounds per cubic yard when using Type I cement or a minimum cement factor of 564 pounds per cubic yard when using Type III cement;
3) furnish concrete having an air content according to Subsection 601.03, Class P concrete.

B) Placing. When water is permitted, apply to the surface as a fog spray using equipment that the Engineer approves. Place concrete within the mixture temperature range of 50 to 90 °F.

C) Curing and Protecting Pavement.

1) When overnight ambient temperatures are expected to be below 50 °F, cover the concrete with one of the following:

   a) one layer of closed-cell polystyrene foam protected by at least one layer of plastic film;
   b) 2 layers of burlap covered with one layer of 4-mil plastic;
   c) 3 inches of hay or straw covered with one layer of 4-mil plastic;
   d) a Department approved alternate.

2) When overnight ambient temperatures are expected to be below 40 °F, cover the concrete with one of the following:

a) 2 layers of closed-cell polystyrene foam protected by at least one layer of plastic film;
b) 4 layers of burlap covered with one layer of 4-mil plastic;
c) 6 inches of hay or straw covered with 4-mil plastic;
d) a Department approved alternative.

3) The Department will allow placement of the insulating cover to be delayed for up to 4 hours to accommodate sawing joints. The Department will allow temporary removal of the cover to accommodate sawing and sealing joints. The Department will allow permanent removal of the cover when the concrete attains the required compressive strength of 3,500 psi.

D) Strength Testing and Opening to Traffic.

1) Cylinders. The Department will cast, cure, and test 6 cylinders (3 sets) from each 150 cubic yards of concrete. The Department will cast and test the cylinders according to KM 64-305. The Department will store the cylinders on or near the PCC pavement to provide protection and a curing environment similar to that of the slab. The Department will not remove cylinders from the molds until just before testing.
2) Testing. The Department will test one set of cylinders no later than 24 hours for PCC pavement/24; 48 hours for PCC pavement/48; and 72 hours for PCC pavement/72; ± one hour from time of molding.

   When the average compressive strength is 3,500 psi, the Department will allow the pavement to be opened to traffic and will discard the remaining sets of cylinders. When the average compressive strength is less than 3,500 psi, the Department will test the remaining sets of cylinders at an age that the Engineer deems appropriate. If the average compressive strength of the second set of cylinders is less than 3,500 psi, do not open the pavement to traffic until the pavement has been in place for 7 days. The Engineer will accept the pavement based on additional testing.

   When 2 consecutive first sets of cylinders or when 2 sets of any 4 sets do not reach 3,500 psi, suspend work and propose a satisfactory mix design adjustment. Make the adjustment in the subsequent mixture. The Department will not require additional trial batches.
3) Coordinate work so that all joint sawing, joint sealing, shoulder or curb construction, sweeping, cleaning and other activities are complete when the pavement has attained the required strength to be open to traffic.

502.04 MEASUREMENT.

502.04.01 PCC Pavement/24. The Department will measure the quantity according to Subsection 501.04.01.

502.04.02 PCC Pavement/48. The Department will measure the quantity according to Subsection 501.04.01.

502.04.03 PCC Pavement/72. The Department will measure the quantity according to Subsection 501.04.01.

502.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	PCC Pavement/24[(1)]	See Subsection 501.05
----	PCC Pavement/48[(1)]	See Subsection 501.05
----	PCC Pavement/72[(1)]	See Subsection 501.05
----	Rideability Testing	See Subsection 501.05

[1]When the Contract designates areas as "Must be opened on schedule" and those areas do not attain the required compressive strength within the specified time period, the Department will adjust the Contract unit price by the Schedule of Adjusted Payment for Delay of Opening.

Schedule for Adjusted Payment for Delay of Opening

Delay of Opening (Hours)			Price Adjustment (Percent of Contract Unit Bid Price)
PCCP/24	PCCP/48	PCCP/72	
4	8	12	90
8	16	24	80
12	24	36	70
16	32	48	60
20	40	60	50

The Department will consider payment as full compensation for all work required under this section.

SECTION 503 ¾ DIAMOND GRINDING PCC PAVEMENT

503.01 DESCRIPTION. Diamond grind existing PCC pavements. Eliminate faulting at joints and cracks, restore the ride quality to meet or exceed limits specified, and restore texture to the entire pavement surface.

503.02 MATERIALS AND EQUIPMENT.

503.02.01 Grinding Machine. Furnish a self-propelled grinding machine with diamond blades that is specifically designed to smooth and texture PCC pavement. Furnish a machine that is capable of cutting or planing at least 3 feet wide on each pass and that does not encroach on traffic movement outside the work area.

503.02.02 Joint Sealer. Conform to Section 807. Use preformed or silicone rubber.

503.03 CONSTRUCTION.

503.03.01 Test Section. At the beginning of work, grind an initial test section at least 3 feet wide and 100 feet long. The Engineer will evaluate the initial test section to determine if the texture meets the requirements of this section. Modify the blade spacing or other features as necessary to produce the specified texture. Make similar modifications throughout the project to ensure acceptable surface texture.

503.03.02 Diamond Grinding. Grind the entire surface of the PCC pavement mainline. Grind ramps, tapers, acceleration and deceleration lanes, turn lanes, median crossovers, and bridge decks as the Contract specifies. Grind shoulders or gutters when necessary for proper pavement drainage.

Grind in a longitudinal direction and parallel to the pavement centerline. Begin and end at lines normal to the pavement centerline. When the end of the cut is subject to public traffic, grind a smooth transition from the smooth pavement to the non-ground pavement. Maintain a constant cross-slope between grinding extremities in each lane to ensure positive lateral drainage. Overlap the edge of grinding passes by less than 2 inches.

503.03.03 Cleaning. Remove solid residue from the pavement surface before traffic or wind blows it. Perform a separate washing operation to remove residue that may cause dust after the completion of grinding when the Engineer directs. Ensure that waste water and residue do not flow across the pavement, into gutters, or into drainage structures. Dispose of waste water and residue as the Engineer approves.

503.03.04 Lighting. Provide lighting, as the Engineer approves, when grinding between dusk and dawn.

503.03.05 Joint Seals.

A) Resealing Existing Joints. After grinding is complete on areas adjacent to the joints and after conforming to the ride quality requirements, clean and reseal the joints according to Subsection 501.03.

B) Preserving Existing Joints Seals. After grinding is complete and when the Engineer directs, remove and replace any damaged seals with new seals. The Engineer may require replacement of preformed compression joint seals when damage penetrates the top void of the seal and replacement of silicone joint seals when the seal shows loss of bond with the sides of the joint or significant loss of the profile of the seal. Remove damaged seals for the full traffic lane width, thoroughly clean the joint, and install new seals according to Subsection 501.03.18.

503.03.06 Pavement Marking. Remove existing pavement marking and provide temporary pavement markings according to Section 112 where the Contract specifies.

503.03.07 Texture. The Department will measure the dimensions of the longitudinal grooves. If the dimensions are not within the following limits, make adjustments to the grinding equipment to achieve the required texture:

Groove Dimension	Value (inch)
Width of grooves	Between 0.09 and 0.130
Width between grooves	Between 0.08 and 0.125
Height of groove (Peak to bottom)	Between 0.031 and 0.063

503.03.08 Alignment Tolerances. The Department will measure the transverse slope of ground pavement with a straightedge placed normal to the centerline. If a depression or misalignment of slope greater than 0.25 inch in 12 feet occurs, adjust the grinding equipment to correct the misalignment.

The Engineer will measure the alignment of the top of the pavement surface across the joint and cracks. Correct all misalignments that exceed 0.063 inch by additional grinding.

503.03.09 Ride Quality. Conform to Section 410 with the following exceptions:

1) The lift thickness adjustment does not apply.
2) All references are to PCC pavement in lieu of asphalt pavement.
3) All references are to diamond grinding in lieu of paving.
4) Achieve an RI of 3.60 or greater for each one-mile section and an RI of 3.80 or greater for each traffic lane.
5) Perform corrective work to achieve the required RI by regrinding the entire width of the traffic lane at areas having a low RI. The Engineer may exclude pavement areas where grinding alone will not correct deficiency.
6) The Department will create a strip chart when the test results show that the RI is less than 3.80 or upon request for higher RI values.

503.04 MEASUREMENT.

503.04.01 PCC Diamond Grinding. The Department will measure the quantity in square yards. The Department will measure the width as the width shown on the typical cross section of the Plans and the length horizontally along the centerline of each lane or ramp. The Department will not measure corrective work for payment. The Department will not measure the ride quality to calculate an adjusted unit price for this item of work.

503.04.02 Joint Sealing. The Department will measure Joint Sealing by linear feet. The Department will not measure removing existing joint material or cleaning joints for payment but will consider them incidental to this item of work.

503.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2060	PCC Pavement Diamond Grinding	Square Yard
8540	Joint Sealing	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 504 ¾ BREAKING AND SEATING PCC PAVEMENT

504.01 DESCRIPTION. Break and seat existing PCC pavement for full depth and full panel width.

504.02 MATERIALS AND EQUIPEMENT.

504.02.01 Asphalt Material. Conform to Subsection 403.02.

504.02.02 Impact Hammer. Break the pavement with an impact hammer capable of delivering sufficient energy to break the pavement. Furnish a hammer having a breaker equipped with a plate-type shoe designed to prevent penetration into the existing surface. The Department may approve other equipment according to Subsection 108.06. When necessary, provide a screen for the hammer to protect vehicles in the adjacent lane from flying concrete chips during the breaking process.

504.02.03 Pneumatic-Tire Proof Roller. Furnish a pneumatic-tire proof roller, weighing a minimum of 35 tons, of one of the following types.

A roller having the following:

1) 4 rubber-tired wheels equally spaced across the full width and mounted in line on a rigid steel frame in such manner that all wheels carry equal loads, regardless of surface irregularities.
2) Roller tires capable of satisfactory operation at a minimum inflation pressure of 100 psi when inflated to the pressure necessary to obtain proper surface contact pressure to satisfactorily seat pavement slabs. The Department will allow tires to contain liquid.
3) A rubber-tired prime mover for towing.

or

1) Two-axles.
2) Self-propelled.
3) No more than 7 tires.
4) Tires capable of meeting inflation pressure and surface contact pressure requirements in 2) above.

504.03 CONSTRUCTION. Break and seat the existing pavement. Place specified succeeding leveling, asphalt base, and asphalt binder courses one lane at a time. Furnish and place asphalt mixtures according to Division 400 for the appropriate mixture.

Exercise care during breaking and seating to prevent damage to underground utilities and drainage facilities.

504.03.01 Breaking of PCC Pavement.

A) Size Requirements. Break the existing PCC pavement to the extent that no more than 20 percent of the broken fragments are larger than 2 feet, and no individual fragments are larger than 30 inches. Determine the extent of the breakage based on cracks visible to unaided normal vision when the pavement surface is dry. Do not use water to detect additional cracks.

Accomplish breaking uniformly to produce the desired size without displacing the concrete more than 1/2 inch vertically above the original PCC pavement surface elevation.

Continuously monitor the breaking operation. Make adjustments in the striking pattern, striking energy, number of passes, or other factors to continually achieve acceptable breaking throughout the project.

B) Test Section. Before breaking operations begin, the Engineer will designate a

test section. Break the test section using varying energy and striking patterns. When necessary, repeat passes of the equipment over the pavement until the test section is acceptably broken according to A) above. Use the extent of breakage of the test section as a guide for breaking the pavement on the remainder of the project. The Engineer may require additional test sections at any time during the course of the work when sizes do not conform to the size requirements of A) above.

504.03.02 Seating of Broken PCC Pavement. After breaking, seat the broken concrete by rolling with a pneumatic-tire proof roller. Make at least 5 one-way passes with a minimum 50-ton roller, or 7 one-way passes with a minimum 35-ton roller. Use a rolling pattern that will ensure that the entire area of the broken pavement is well seated and is thoroughly and uniformly compacted. Remove any large rocking fragments and fragments that are displaced more than 1/2 inch above the original pavement surface elevation after seating and fill the resulting void with asphalt and compact or tamp.

504.03.03 Placement of Edge Drains. When the Contract includes installation of pavement edge drains, install the edge drains at least 2 weeks before breaking and seating operations.

504.03.04 Placement of Asphalt. Sweep the broken and seated pavement clean of foreign material using mechanical sweepers and hand brooms.

Place the asphalt base following the breaking and seating operation as closely as practical according to Subsection 403.03. Do not allow the broken pavement to remain exposed more than 24 hours. If the broken pavement is exposed more than 24 hours, suspend the breaking operations until all broken existing pavement has been covered by at least one course of asphalt base.

Make any required changes to the cross slope with the paving of the base courses. Cure the fist course of base at least 8 hours before placing the second course. Do not open a lane to public traffic until 2 courses of asphalt (not including leveling courses) are in place. Offset the longitudinal joints in the asphalt 6 inches according to Subsection 403.03.07.

Perform leveling and wedging according to Subsection 403.03.09 on top of the first course of asphalt, and not on the existing pavement. However, at specific locations where the Engineer deems a substantial amount of leveling is necessary, level and wedge directly on the broken and seated pavement. Correct deviations in the surface by leveling and wedging on each succeeding course unless the Engineer directs or approves in writing that the leveling and wedging be delayed until after placing the succeeding courses. Construct asphalt courses succeeding the first 2 courses according to the Contract.

504.04 MEASUREMENT.

504.04.01 Breaking and Seating Pavement. The Department will measure the quantity in square yards. The Department will measure the width as the actual width of the original PCC pavement, and the length as the horizontal length along the centerline of each roadway or ramp.

504.04.02 Leveling and Wedging. The Department will measure quantity according to Subsection 403.04.

504.04.03 Asphalt Mixtures. The Department will measure quantity according to Subsection 403.04 for the appropriate mixture.

504.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2107	Breaking and Seating Pavement	Square Yard
0190	Leveling and Wedging	See Subsection 403.05
----	Asphalt Mixtures	See Subsection 403.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 505 ¾ CONCRETE SIDEWALKS, STEPS, AND ENTRANCE PAVEMENTS

505.01 DESCRIPTION. Construct concrete sidewalks, steps, and entrance pavements, with or without reinforcement, on a prepared subgrade, in one course, to the dimensions and design specified in the Plans and Standard Drawings. This work does not include sidewalks constructed integral with bridges or culverts.

505.02 MATERIALS AND EQUIPMENT

505.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

505.02.02 Steel Reinforcement. Conform to Section 811.

505.02.03 Joint Materials. Conform to Section 807, preformed fillers.

505.02.04 Aggregate. Conform to Section 804 and 805.

505.02.05 Forms. Conform to Subsection 601.02.

505.03 CONSTRUCTION. Construct sidewalks, steps, and entrance pavements on a prepared, compacted, smooth subgrade of uniform density formed by trenching or filling to the required elevation. Use Class A concrete according to Subsection 601.03. When desired, use Class P concrete according to Subsection 501.03 for the construction of entrance pavements. Remove large boulders and ledge rock found in the subgrade to a minimum depth of 6 inches below the finished subgrade elevation, backfill the space with material that the Engineer approves, and thoroughly compact by rolling or tamping. Furnish a template, and check the subgrade before depositing concrete. Moisten the subgrade immediately before placing concrete.

Place a 2-inch thick course of No. 610 coarse aggregate on the prepared subgrade before placing concrete for steps. Form all steps and cast them to the dimensions specified in the Contract. Reinforce all steps according to the Standard Drawings. Round all exposed edges and corners to a 1/4 inch radius. When there are 3 or more steps, install handrail of the type specified in the Contract according to Section 720.

505.03.01 Forming. Place sidewalks and entrance pavements by use of side forms or an approved slip form method according to Subsection 601.03.12.

A) Side Form Method. Deposit concrete on the moistened subgrade strike, and compact to the required thickness, and tamp sufficiently to bring mortar to the surface. Then, finish the surface smooth and even with wooden floats and brushes and broom for texturing.

B) Slip Forming. Correct any excess slumping or irregularities immediately after passage of the slip form machine, and finish and broom to blend with the general appearance of the adjacent concrete.

505.03.02 Straightedging and Edging. Before giving the concrete sidewalk and entrance pavement the final finish and brooming, check the surfaces with a 10-foot straightedge and eliminate all irregularities of more than 1/4 inch.

505.03.03 Joints.

A) Joints for Sidewalks. Either divide the surfaces of sidewalks into rectangular areas by means of a jointer having a radius of 1/4 inch and forming a groove no less than one inch in depth for the full width of the walk or saw the joints according to Subsection 501.03.17 and the Contract. Ensure that the length of the rectangles formed does not exceed the width of the sidewalk being constructed.

When the sidewalk is constructed integral with the curb, ensure that the width and spacing of the joints conform to that in the curb. Round the edges of the sidewalk at all expansion joints with an approved edging tool to a 1/4 inch radius. Install 1/2-inch premolded expansion joint material to the full depth of the sidewalk where the sidewalk abuts any rigid structure or fixture, such as curbs, columns, castings, buildings, and light standards.

B) Joints for Entrance Pavements. Construct 1/4-inch wide sawed contraction joints in entrance pavements according to Subsection 501.03.17. Construct these joints at locations shown on the Standard Drawings. The Department will not require steel reinforcement in contraction joints. Saw the joints to a minimum depth of 2 inches. Install 1/2-inch wide expansion joints where shown on the Standard Drawings. Seal both expansion joints and contraction joints according to Subsection 501.03.18 and the Standard Drawings.

505.03.04 Curing and Backfilling. Cure concrete sidewalks, steps, and entrance pavements according to Subsection 601.03.17.

After the concrete has set sufficiently, remove forms and backfill areas adjacent to the concrete. Compact and grade the backfill.

505.04 MEASUREMENT.

505.04.01 Concrete Sidewalk. The Department will measure the quantity in square yards.

505.04.02 Concrete Entrance Pavement. The Department will measure the quantity in square yards.

505.04.03 Class A Concrete for Steps. The Department will measure the quantity according to Subsection 601.04. The Department will not measure excavation, steel reinforcement, or crushed aggregate for steps for payment and will consider them incidental to this item of work.

505.04.04 Roadway Excavation. The Department will measure the quantity according to Subsection 204.04.

505.04.05 Embankment-In-Place. The Department will measure the quantity according to Subsection 206.04.

505.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2719, 2720, 2723	Concrete Sidewalk, Thickness	Square Yard
2101, 2099	Cement Concrete Entrance Pavement, Thickness	Square Yard
2551	Class A Concrete for Steps	See Subsection 601.05
2200	Roadway Excavation	See Subsection 204.05
2230	Embankment-In-Place	See Subsection 206.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 506 ¾ CONCRETE CURBS AND GUTTERS

506.01 DESCRIPTION. Construct, on a prepared subgrade according to the Standard Drawings, concrete curb and gutter, concrete valley gutter, concrete header curb, and concrete integral curb.

506.02 MATERIALS.

506.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

506.02.02 Steel Reinforcement. Conform to Section 811.

506.02.03 Joint Fillers. Conform to Section 807, preformed fillers.

506.02.04 Forms. Conform to Subsections 501.02. and 601.02.

506.02.05 Fine Aggregate. Conform to Section 804.

506.02.06 Coarse Aggregate. Conform to Section 805.

506.03 CONSTRUCTION.

506.03.01 Header Curb, Valley Gutter, and Curb and Gutter (Combination). Use combination curb and gutter in conjunction with asphalt pavements. Construct combination curb and gutter according to the typical section in the Plans. Use header curb in conjunction with either asphalt or PCC pavement where the depth of pavement is a minimum of one foot or where the thickness of asphalt pavement is variable. Construct header curb before placing pavement. Construct valley gutter according to the Plans and Standard Drawings.

Prepare the foundation by excavating or constructing the embankment to the required subgrade elevation on which the curb, gutter, or combination curb and gutter is to be placed. Remove all soft, yielding, or otherwise unsuitable material, and replace it with stable materials according to Section 207, and compact and finish the subgrade to a firm even surface.

Use Class A concrete according to Subsection 601.03. Place concrete either by use of side forms or by an approved slip forming method according to Subsection 601.03.12.

When indicated or directed, form entrance and drainage openings of the required dimensions through the curbs at the designated location.

Prepare the subgrade as required and moisten before placing concrete. During placement, thoroughly spade the concrete and vibrate or tamp it until the mortar entirely covers the surface and eliminate all honeycomb and voids. Place concrete so that no concrete reaches initial set before placing the following lift. Strike off and float surfaces so all coarse aggregate is well below the surface.

Place reinforcing steel according to the details specified in the Contract. Construct contraction joints as specified in Subsection 601.03.16.

Construct expansion joints at all breaks in alignment, at all drainage boxes and other fixed objects, at the beginning and ending points of curves, and at the beginning, quarter, middle, and ending points of semicircular curves, except the Engineer will not require joints at the quarter points for semicircles having radii of 5 feet or less.

Give the top surfaces of curbs a uniform float finish and round edges according to the Standard Drawings. Correct all honeycombed areas by filling with mortar. Do not plaster. Finish the top and face of all curbs while the concrete is plastic by wetting and rubbing with a carborundum brick or wooden block. Finish the face of header curbs to 2 inches below the gutter line or the finished groundline. Before giving the concrete the final finish, check surfaces with a 10-foot straightedge and eliminate all irregularities of more than 1/4 inch. Finish concrete to a smooth surface, presenting a

uniform texture and color.

Cure the concrete according to Subsection 501.03.15.

Construct precast curbs to the length and shape, and reinforce according to the Standard Drawings. Cast, finish, and cure precast curbs according to Section 605.03. Set precast curbs to conform to the line and grade specified in the Plans with tight joints. Fill all joints except expansion joints with mortar. When the precast curb is set, fill all remaining excavated areas with material that the Engineer approves in lifts not exceeding 6 inches in depth and tamp.

506.03.02 Integral Curb. Use integral curb in conjunction with PCC pavements where a portion of the PCC pavement is the gutter. Construct according to Subsection 506.03.01 except for the following:

1) Use either Class A concrete according to Subsection 601.03, or Class P concrete according to Subsection 501.03.
2) Construct integral curbs monolithic with the pavement or as a separate operation by anchoring to the pavement.

   For integral curbs constructed monolithic with the pavement in a separate operation from placement of the pavement concrete, place the curbs immediately following completion of the pavement finishing operations and before the concrete has taken its initial set. Do not exceed an elapsed time between placing concrete in the pavement and in the curb of one hour. Obtain a thorough bond between the pavement and curb by roughening the surface of the pavement covered by the curb by means of a trowel or wire brush. Place stirrups according to the Standard Drawings in the freshly finished concrete at intervals of 2 1/2 feet before placing the curb. Do not place stirrups closer than 3 inches to the center of sawed construction joints.

   When the curb is constructed as a separate operation, clean the surface of the concrete in the pavement of all foreign material before placing concrete in the curbs. Should it be necessary for stirrups to be bent in order to allow equipment to pass over the bars at the beginning of a days run, bend the bars before installation.
3) Insert preformed joint filler, and cut it to conform to the cross section of the curb, in the curb directly over the expansion joint in the pavement while placing the curb. Construct contraction joints at the same locations as those in the pavement.
4) Use side forms with a depth equal to that of the curb. Ensure that the forms are joined neatly, fastened securely, and held rigidly in place by adequate connections and bracing. Check curb forms for grade and alignment to the same degree of accuracy required for pavement forms. After the concrete in the curb has hardened sufficiently, but in no less than 6 hours after placement, remove the inside forms and finish the inside face of the curb to a uniform color and texture by rubbing with a wooden block or a carborundum brick. Correct any honeycomb or other surface defects by pointing with mortar of the same proportions of cement and sand used in the concrete.

To obtain a neat line on the thin edge of the integral curb lip, construct by placing a one-inch by 4-inch board, at least 10 feet long and surfaced on all 4 sides, on the concrete slab to act as a guide when forming the curb, or use other approved methods.

Seal all pavement joints according to Subsection 501.03.17 before integral curb is constructed. If the integral curb is constructed monolithically with the pavement, seal the curb in the same manner as the pavement.

506.04 MEASUREMENT.

506.04.01 Header Curb. The Department will measure the quantity in linear feet along the face of the curb.

506.04.02 Valley Gutter. The Department will measure the quantity in linear feet

along the flowline of the gutter.

506.04.03 Curb and Gutter (combination). The Department will measure the quantity in linear feet along the flowline of the gutter.

506.04.04 Integral Curb. The Department will measure the quantity in linear feet along the top of the curb.

506.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1875-1877, 1880, 1885, 1890, 1891	Type, Header Curb	Linear Foot
1895	Valley Gutter	Linear Foot
1810, 1811, 1815, 1820, 1821, 1825	Type, Curb and Gutter	Linear Foot
1830, 1831, 1840, 1841, 1845, 1847	Type, Integral Curb	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 507 ¾ CONCRETE MOUNTABLE MEDIAN AND STANDARD BARRIER MEDIAN

507.01 DESCRIPTION. Prepare the foundation for the mountable median or standard barrier median, furnish, place, consolidate, finish, and cure concrete, and construct all joints necessary for completing the work.

507.02 MATERIALS.

507.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

507.02.02 Steel Reinforcement. Conform to Section 811.

507.02.03 Joint Material. Conform to Section 807, preformed fillers.

507.02.04 Forms. Conform to Subsection 601.02.

507.03 CONSTRUCTION. Construct concrete mountable medians or standard barrier medians on the accepted prepared subgrade, or the completed and accepted base course or old pavement. Use Class A concrete according to Subsection 601.03 or Class P concrete according to Subsection 501.03. When required, place dowel bars according to the Contract. Place concrete either by use of side forms or by an approved slip forming method according to Subsection 601.03.12.

When constructing medians in conjunction with PCC pavement, construct transverse joints at the same intervals and locations as joints in the adjacent pavement. When constructing medians in conjunction with asphalt pavement, space transverse joints at intervals of 30 feet or less to provide uniform spacing. Construct all median joints as either 1/2-inch expansion joints filled with preformed joint filler or 1/8-inch sawed joints. When sawing, construct median joints according to Subsection 501.03.17. The Engineer will not require steel dowels in either type of joint.

Cure concrete placed in the median according to Subsection 501.03.15.

507.04 MEASUREMENT.

507.04.01 Standard Barrier Median. The Department will measure the quantity in square yards.

507.04.02 Mountable Median. The Department will measure the quantity in square yards.

507.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1915-1923	Standard Barrier Median, Type	Square Yard
1935-1950	Mountable Median, Type	Square Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 508 — PERMANENT CONCRETE MEDIAN BARRIERS

508.01 DESCRIPTION. Prepare the foundation for the median barrier; furnish, place, consolidate, finish, and cure the barrier; construct all transverse joints; construct other incidentals necessary to complete the work; and attach delineators and other appurtenances when specified in the Contract.

508.02 MATERIALS AND EQUIPMENT.

508.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

508.02.02 Steel Reinforcement. Conform to Section 811.

508.02.03 Joint Material. Conform to Section 807, preformed fillers.

508.02.04 Dowel Bars. Conform to Section 811.

508.02.05 Tie Bars for Precast Sections. Conform to Section 811.

508.02.06 Mortar Sand. Conform to Section 804.

508.02.07 Cement. Conform to Section 801.

508.02.08 Water. Conform to Section 803.

508.02.09 Masonry Coating. Conform to Section 828.

508.02.10 Delineators for Barriers. Use Stimsonite Marker 962, AKT Corporation Marker No. 181, or a Department approved equal.

508.02.11 Forms. Conform to Subsection 601.02. In addition to the requirements for slip forms, use a slip form or extrusion machine that is equipped with automatic guidance controls capable of sensing grade and alignment from an outside reference consisting of a taut line or wire.

508.03 CONSTRUCTION. Construct concrete median barriers of each type to the lines, grades, cross section, and details specified in the Plans and Standard Drawings. Use Class A concrete according to Subsection 601.03. When it is necessary to transition the concrete median barrier into a section different from the uniform section specified in the Plans, such as at a bridge pier, sign pedestal, or bridge end wall, do so in a smooth, uniform manner as shown on the Standard Drawings. Provide concrete median barrier that are precast, cast-in-place using fixed forms, or slip formed according to Subsection 601.03.12.

Bevel the upper longitudinal edge of the barrier 7/8 inch, or construct it to a radius satisfactory to the Engineer.

When required, construct items such as delineators and conduit according to the Contract. Secure conduit to prevent movement.

Cure cast-in-place concrete median barriers according to Subsection 501.03.15. Use the same method of curing on each continuous section of the barrier. Cure precast concrete median barriers according to Subsection 605.03.05.

508.03.01 Fixed Form Construction. Construct 1/2-inch transverse expansion joints throughout the entire cross section at uniform intervals of no less than 15 feet or greater than 25 feet. For construction in conjunction with PCC pavements, locate transverse expansion joints so that a joint occurs at the same stations as that of the rigid pavement transverse joints. Construct additional transverse contraction joints in the barrier if necessary to maintain the 15 to 25-foot interval. Fill all transverse and

longitudinal joints with preformed joint filler. Construct one-inch expansion joints over expansion joints in rigid pavement or base. Construct 1/2-inch expansion joints when the barrier abuts a bridge and at all box inlets, lamp posts, sign posts, and similar structures that project through, into, or against the concrete median barrier.

The Department will allow construction of joints according to Subsection 508.03.02.

Conform to the tolerance requirements of Appendix A, Tabulation of Construction Tolerances. Uniformly coat the median barriers with masonry coating.

508.03.02 Slip Form Construction. Suspend reference lines from supports set at intervals no greater than 10 feet on vertical and horizontal curves or 25 feet on uniform grades or tangents. Do not use ski or shoe sensors to reflect the grade of the subgrade unless the ski or shoe can ride on the completed pavement surface.

Provide a construction joint between the base and the barrier. Construct a 2 by 4-inch key, either depressed or raised, in the base. Insert steel dowels in the plastic concrete immediately behind the slip form machine at the locations shown on the Standard Drawing. Place the base using slip form or extrusion methods.

Immediately repair all surface pits larger than 1/2 inch in diameter and all gouges behind the slip form machine. The Engineer will not require further finishing, other than a light longitudinal brushing or brooming.

Provide short sections, such as sections adjacent to structures, terminal sections, etc. that are cast using fixed forms.

Construct one-inch transverse expansion joints at intervals no greater than 500 feet. Construct one-inch transverse expansion joints over all transverse expansion joints in rigid pavement or base. Construct 1/2-inch expansion joints when the barrier abuts a bridge and at all box inlets, lamp posts, and similar structures that project through, into, or against the concrete median barrier. Fill all transverse and longitudinal joints with preformed joint filler.

Construct 1/8-inch transverse contraction joints 2 inches deep at uniform intervals of 20 to 30 feet. Make contraction joints by cutting into the plastic concrete using an edging tool and trowel, using removable inserts, or sawing. When sawing contraction joints, saw as soon as practical after the concrete has set sufficiently to preclude raveling, and before any shrinkage cracking occurs in the concrete. The Engineer will not require sealing of contraction joints.

Construct construction joints as one-inch expansion joints. When constructing a concrete median barrier over PCC pavement or base, locate transverse joints in the barrier to match transverse joints in the pavement or base. Construct additional transverse contraction joints in the barrier if necessary to maintain the 20 to 30-foot interval specified above. When constructing transverse joints in the PCC pavement or base at variable intervals, adjust the joint interval in the wall to match the joint interval in the pavement or base and construct additional joints as necessary to avoid exceeding the 30-foot maximum interval.

Conform to the tolerance requirements of Appendix A, Tabulation of Construction Tolerances

508.03.03 Precast Construction. Construct precast units according to Subsection 605.03. Place the precast units on a bed of mortar, and trim and discard excess mortar. Uniformly coat the median barriers with masonry coating.

When precast concrete median barriers are specified or allowed for installation on an existing facility, anchor them as the Plans specify.

When using precast units, cast short sections, transitions, terminal sections, and other supplemental sections using fixed forms.

When casting threaded inserts into the barrier for use in lifting, protect the inserts by installing a solid, full-length, threaded, plastic bolt, coated with waterproof grease. Install the bolt immediately after manufacturing the barrier section. Leave the bolt in place at all times while the barrier is in storage or in service, except when using the insert for lifting.

Entirely fill joints between units, including the 2 by 10-inch groove, with grout composed of one part mortar sand and 2 parts cement with enough water to make the

mixture plastic.

When the barrier abuts a bridge or other rigid structure, cut off the tie bars or fill the groove with grout, as applicable, and install 1/2-inch preformed joint filler in the joints.

Install 1/2-inch preformed joint filler at all box inlets, lamp posts, sign posts, and similar structures that project through, into, or against the concrete median barrier.

Conform to the tolerance requirements for cast-in-place construction of Appendix A, Tabulation of Construction Tolerances.

Ensure that all concrete median barrier are uniform in appearance, and true to line and grade. Repair or remove and replace all portions of the barrier that are not within the specified tolerances, or precast units that cannot be correctly installed.

508.04 MEASUREMENT.

508.04.01 Concrete Median Barrier. The Department will measure the quantity in linear feet along the top centerline of the barrier. The Department will not measure furnishing, installing, or maintaining lifting devices in precast median barriers for payment and will consider them incidental to this item of work. The Department will not measure portions of the barrier that are not within the specified tolerances, precast units that are not correctly installed, or damaged units.

508.04.02 Concrete Terminal Sections. The Department will measure the quantity by each individual unit.

508.04.03 Delineators for Barriers. The Department will measure the quantity by each individual unit.

508.04.04 Masonry Coating. The Department will measure the quantity according to Subsection 601.04.

508.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1951-1955, 1958-1978, 1986-1999	Concrete Median Barrier, Type	Linear Foot
1956-1957	Concrete Terminal Section, Type	Each
1984, 1985	Delineator for Barrier, Color	Each
2998	Masonry Coating	See Subsection 601.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 509 ¾ TEMPORARY CONCRETE MEDIAN BARRIERS

509.01 DESCRIPTION. Furnish, install, maintain, and remove temporary precast concrete median barriers. The Department will furnish the concrete median barriers when specified in the Contract.

The Department may allow the use of similar units that conform to the typical features depicted by the Standard Drawings when the Engineer approves.

509.02 MATERIALS.

509.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

509.02.02 Steel Reinforcement. Conform to Section 811.

509.02.03 Connector Bar Pins. Conform to ASTM A 36. Galvanize after forming according to AASHTO M 111.

509.02.04 Top Connectors. Conform to ASTM A 36. Galvanize after forming according to AASHTO M 111.

509.02.05 Bottom Connectors. Conform to ASTM A 36. Galvanize according to AASHTO M 111 after forming.

509.02.06 Tack Welding. Conform to Subsection 605.03.04.

509.02.07 Delineators for Barriers. Use either Stimsonite Marker 962, AKT Corporation Marker No. 181, or a Department approved equal.

509.03 CONSTRUCTION. Construct concrete median barriers according to Subsection 605.03 and the Standard Drawings. Use Class A concrete and provide all concrete with an ordinary surface finish according to Subsection 601.03.18. Place delineators according to the Standard Drawings.

Lift and place the barrier units using a 2 point pickup, or another approved method. Do not lift units by the connectors. When casting threaded inserts into the barrier for use in lifting, protect the inserts by installing a solid, full-length, threaded, plastic bolt, coated with waterproof grease. Install the bolt immediately after manufacturing the barrier section. Leave the bolt in place at all times while the barrier is in storage or in service, except when using the insert for lifting.

Do not use any unit which has been cracked, chipped, scarred, or otherwise damaged or disfigured unless the Engineer approves.

Install the units at the locations specified in the Plans, and connect them in the manner detailed on the Plans and Standard Drawings. Keep delineators clean and provide replacement delineators when necessary. For all units in a continuous run, use units of the same type and height, and provide a smooth transition. Replace all units damaged after installation with an undamaged unit. When the units are no longer needed, remove the units from the project. Take ownership of all units except Department furnished units. Transport Department furnished units to the location specified in the Contract.

509.04 MEASUREMENT.

509.04.01 Temporary Concrete Median Barrier. The Department will measure the quantity furnished, installed, maintained, and removed by multiplying the nominal length of each unit in linear feet by the number of units. The Department will measure units installed to replace units damaged by traffic. The Department will not measure the disposal of units or units installed to replace units damaged by construction operations for payment and will consider them incidental to this item of work. The

Department will not measure furnishing, installing, or maintaining lifting devices for payment and will consider them incidental to this item of work.

509.04.02 Install Temporary Concrete Median Barrier. The Department will measure the quantity, installed, maintained, and removed by multiplying the nominal length of each unit in linear feet by the number of units. The Department will furnish the barrier. The Department will measure units installed to replace units damaged by traffic. The Department will not measure the disposal of units or units installed to replace units damaged by construction operations for payment and will consider them incidental to this item of work. The Department will not measure furnishing, installing, or maintaining lifting devices for payment and will consider them incidental to this item of work.

509.04.03 Relocate Temporary Concrete Median Barrier. The Department will measure the quantity relocated by multiplying the nominal length of each unit in linear feet by the number of units.

509.04.04 Delineator for Barrier. The Department will measure the quantity by the individual unit, including replacement units.

509.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1991	Temporary Concrete Median Barrier [(1)]	Linear Foot
1992, 1994	Install Temporary Concrete Median Barrier [(2)]	Linear Foot
2003	Relocate Temporary Concrete Median Barrier	Linear Foot
1984, 1985	Delineator for Barrier, Color	Each

[(1)]*The Department will pay 90 percent of the quantity upon satisfactory installation of the units. The Department will pay the remaining 10 percent upon removal of the units from the project or upon placement to their final location.*

[(2)]*The Department will pay 75 percent of the quantity upon satisfactory installation of the units. The Department will pay the remaining 25 percent upon removal of the units from the project or upon placement to their final location.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 510 ¾ SEALING AND PATCHING CONCRETE WITH EPOXY RESIN

510.01 DESCRIPTION. Seal concrete surfaces, except PCC pavement, with an epoxy resin seal, and patch concrete surfaces, except PCC pavement, with an epoxy resin mortar patch. Fill low areas with the patch material.

510.02 MATERIALS AND EQUIPMENT.

510.02.01 Epoxy Resin. Conform to Section 826.

510.02.02 Mortar Sand. Conform to Section 804.

510.02.03 Sand for Epoxy Seal Coats. Conform to Section 804.

510.02.04 Sandblasters. Provide sandblasters that are equipped with traps to prevent water or oil from being deposited on the surface.

510.02.05 Drills. Provide rotary, electric, 1/2-inch drills with a paddle or other mixing devices approved by the Engineer.

510.03 CONSTRUCTION. Allow new concrete to cure at least 14 calendar days before applying any epoxy sealant or epoxy mortar patch. Do not apply to PCC pavement. Seal and patch PCC pavement as specified in the Contract. Ensure that the surface temperature of concrete surfaces to be sealed or patched is at least 60 °F. In cool weather, provide artificial heat using space heaters or infrared heaters. When providing artificial heat, maintain a surface temperature between 60 and 90 °F until the epoxy seal or epoxy mortar patch has cured.

510.03.01 Preparation of Concrete Surface for Sealing or Patching. Prepare concrete surfaces to be epoxy sealed or epoxy mortar patched by removing all laitance, deteriorated concrete, and deposits of oil, grease, and other adherent foreign materials. Remove oil, grease, and other adherent foreign materials using solvents, heavy detergents, or mechanical means such as scraping. Then, prepare the surfaces by grinding, sandblasting, retexturing, or chipping to remove all laitance and unsound concrete. Immediately before applying the epoxy seal or epoxy mortar patch, remove all dust, grit, and debris from the surface.

510.03.02 Mixing Epoxy Resin. Thoroughly stir the contents of the separate packages containing component A and component B before combining the 2 components. Do not use the same mixer or paddle to mix component A as is used to mix component B. Combine the 2 components in a clean metal or polyethylene vessel. Combine the components in the proportions and mix them according to the manufacturer's recommendations. Only mix the material in quantities that can be used within the pot life of the mixture.

510.03.03 Mixing Epoxy Mortar for Patching. Establish the proportions of epoxy resin and mortar sand for the epoxy mortar mixture according to the manufacturer's instructions. Mix the epoxy mortar with a drill equipped for mixing. Gradually add mortar sand to the epoxy resin, and continue mixing the materials to obtain a uniform mixture.

510.03.04 Application of Epoxy Mortar for Patching. Prime areas to be patched immediately before placing the epoxy mortar. Thoroughly brush or scrub the epoxy resin for the prime onto the prepared surface to be patched. Then place the epoxy mortar over the primed area. Tamp, rod, and consolidate the epoxy mortar into place to exclude internal voids within the mortar mixture. Level or finish the mortar surface to the specified surface. Finish or treat the surface to conform to the surface texture of

the concrete surrounding the patched area.

After the patch has cured, broom, vacuum, or blow away all loose material from the area, and remove it from the pavement or deck. Do not allow traffic on the patched areas until the resinous material has hardened for the amount of time specified in the manufacturer's specifications.

510.03.05 Epoxy Seal Coat. Place the epoxy seal coat and the sand for the epoxy seal coat according to the manufacturer's instructions.

510.04 MEASUREMENT. The Department will not measure concrete sealing or patching for payment and will consider them incidental to the bid item being patched or sealed.

510.05 PAYMENT. The Department will not make payment for concrete sealing or patching.

SECTION 511 ¾ GROUTING AND EPOXY BOND COAT

511.01 DESCRIPTION. Install steel dowel bars or deformed reinforcement steel bars into existing concrete using grout that provides a bond between the steel and concrete, and bond plastic concrete to hardened concrete using an epoxy bond coat.

511.02 MATERIALS.

511.02.01 Epoxy Resin. Conform to Section 826.

511.02.02 Cement. Conform to Section 801.

511.02.03 Water. Conform to Section 803.

511.02.04 Mortar Sand. Conform to Section 804.

511.02.05 Steel Reinforcement. Conform to Section 811.

511.02.06 Dowel Bars. Conform to Section 811.

511.03 CONSTRUCTION.

511.03.01 Grouting. Drill holes of the size recommended by the manufacturer for the insertion of bars using masonry bits to the depth specified in the Contract or the manufacturer's specifications and to the tolerances in Appendix A, Tabulation of Construction Tolerances. Keep holes clean and dry at all times. Blow holes clean before grouting. Use bars that are free of rust, mill scale, oil, grease, and other foreign substances. Grout with epoxy grout, expanding grout, or other grout on the Department's List of Approved Materials. For epoxy grout, mix the epoxy resin according to Subsection 510.03.02. For expanding grout, mix it according to the manufacturer's instructions. Pour or force the grout into the drilled holes, and apply a coating of at least 0.02 inch of grout to the portions of the bars being inserted into the holes. Slowly insert the coated bars into the full depth of the holes with a twisting motion.

After insertion, look for a light overflow of grout, which indicates complete filling of the drill holes. When this overflow does not occur, immediately remove the bars, place additional grout in the holes, and reinsert the bars. Wipe away all excess grout. After placement and during the hardening of the grout, do not disturb the bars.

511.03.02 Epoxy Bond Coat. Mix the epoxy resin according to Subsection 510.03.02. Mix and apply the epoxy bond coat mixture according to the manufacturer's instructions. Apply the epoxy bond coat only to clean, dry, structurally sound concrete surfaces. Clean surfaces as specified in the Plans or as directed by the Engineer before applying the epoxy mixture.

511.04 MEASUREMENT. The Department will not measure grouting or epoxy bond coat for payment and will consider them incidental to the bid item being grouted or epoxy bond coated.

511.05 PAYMENT. The Department will not make payment for grouting or epoxy bond coat.

SECTION 512 ¾ HOOK BOLTS WITH EXPANSION ANCHORS

512.01 DESCRIPTION. Furnish and install epoxy coated hook bolts with expansion anchors for use in PCC pavement widening or concrete culvert extensions.

512.02 MATERIALS.

512.02.01 Hook Bolts with Expansion Anchors. Conform to Section 811. In addition, ensure that the installed bolts, when tested just before placement of the adjoining concrete, can resist a pull-out load of 9,000 pounds.

512.02.02 Epoxy Coating Material. Conform to Section 811.

512.03 CONSTRUCTION. Epoxy coat and install hook bolts according to the installation requirements for epoxy coated steel reinforcement bars in Subsection 602.03 and the Standard Drawings. Install hook bolts with expansion anchors at the location specified in the Plans or directed by the Engineer according to the manufacturer's instructions.

512.04 MEASUREMENT.

512.04.01 Hook Bolts with Expansion Anchors. The Department will measure the quantity by each individual unit. The Department will not measure epoxy coating for payment and will consider it incidental to this item of work.

512.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2587	Hook Bolt with Expansion Anchor	Each

The Department will consider payment as full compensation for all work required under this section.

DIVISION 600

STRUCTURES AND CONCRETE

SECTION 601 ¾ CONCRETE

601.01 DESCRIPTION. Use concrete consisting of a mixture of cement, fine aggregate, coarse aggregate, and water, with admixtures as specified, combined in the proportions and mixed to the consistency specified, when forming or casting to dimensions specified in the Plans or as the Engineer directs. Provide the materials, material proportions, equipment, and construction methods necessary to ensure that the concrete produced conforms to the Contract. Structural concrete is concrete for structures such as bridges, culverts, and retaining walls. Non-structural concrete is concrete for non-structural items such as sidewalks, entrances, curb and gutter, and roadway median barrier.

601.02 MATERIALS AND EQUIPMENT.

601.02.01 Steel Reinforcement. Conform to Section 811.

601.02.02 Cement. Conform to Section 801. Use Type I cement. The Department will allow the use of Type IA, Type IP, Type IPA, Type II, Type IIA, and Type III when the Engineer approves. The Engineer will condition his approval upon satisfactory means of storage and handling to ensure the ready identification of these cements when used in portions of the work. If obtaining unsatisfactory test results using Types IA, IP, IPA, II, IIA, or III cement, complete the work using Type I cement. Do not intermix cement types in any structural unit. Use Type K cement for Class S concrete.

601.02.03 Admixtures. Conform to Section 802. Use air-entraining and water reducing admixtures in all classes of concrete. Use other admixtures when the Engineer directs or approves.

601.02.04 Water. Conform to Section 803.

601.02.05 Fine Aggregate. Conform to Section 804.

601.02.06 Coarse Aggregate. Conform to Section 805.

601.02.07 Joint Materials. Conform to Section 807.

601.02.08 Structural Steel. Conform to Section 812.

601.02.09 Miscellaneous Metals. Conform to Section 813.

601.02.10 Concrete Curing Materials. Conform to Section 823.

601.02.11 Masonry Coating. Conform to Section 828.

601.02.12 Mineral Admixtures. Conform to Section 844.

601.02.13 Forms. Provide forms that are mortar tight, true to the dimensions, lines, and grades of the structure, and of sufficient strength to prevent appreciable deflection during placing concrete.

A) Form Panels. Form panels are continuous sections of form facing material unbroken by joint marks, against which concrete is placed. For exposed surfaces, use form panels of plywood conforming to U.S. Product Standard PS-1 for Exterior B-B (Concrete Form) Class I plywood or any material other than plywood that will produce an equivalent smooth uniform concrete surface.

B) Plywood Forms. Ensure that plywood forms are at least 3/4 inch thick.

C) Plastic Forms. Conform to the manufacturer's specifications.

D) Plastic Lined Forms. Conform to the manufacturer's specifications.

E) Metal Forms. Use metal forms of such thickness that the forms will remain true to shape. Do not use metal forms that do not present a smooth surface or line up properly.

F) Stay-In-Place Metal Forms. Conform to the following requirements:

1) Forms and Supports. Fabricate permanent steel bridge deck forms and supports from steel conforming to ASTM A 446, Grades A through E, and having a zinc coating class of G 165 according to ASTM A 525. Use forms having a minimum thickness of 22 gage.
2) Fastener Hardware. For miscellaneous fastener hardware (bolts, nuts, metal screws, and washers), provide common stock hardware items with a zinc coating equal to or better than that required by ASTM A 153.
3) Coarse Aggregate. Conform to the requirements of Section 805.04.01 for all coarse aggregate used in concrete for bridge decks and barrier walls when using permanent steel bridge deck forms.
4) Precast Beam Hardware. Provide all deck and overhang support hardware that is cast into precast beam tops with a zinc or epoxy coating of a commercial quality grade.
5) Anchor Legs. To anchor angle weld tabs, use straight anchor legs containing a hole having a 1 1/8-inch minimum diameter. If necessary, incline the anchor leg to vertical.

G) Plank Forms. Use plank forms having a minimum nominal thickness of 1 1/2 inches.

H) Form Oil. Provide a commercial quality form oil or other equivalent coating that allows ready release of the forms and does not discolor the concrete or is detrimental to masonry coating.

I) Form Fasteners. Use Engineer approved form fasteners.

J) Chamfer Strips. Only use chamfer strips that are no less than 3/4 by 3/4 inch.

601.02.14 Scales. For weighing water, aggregates, cement, and mineral admixtures, provide either beam, springless dial, or electronic load cell type scales, designed as an integral unit of the batching plant. When checked under static loads, maintain the accuracy of the scales to within 0.5 percent of the net load on the scales. The net load on the scales is the total weight of the actual test weights used in the accuracy determination. Use enough actual test weights to at least equal the weight necessary to check the cement scales to the net load required for a normal size batch. Check the scales to the capacities specified in the Department's Concrete Manual. Check scales according to the procedures specified in the Department's Concrete Manual. The Department will allow the use of aggregates in combination with test weights to obtain the accuracy determination of aggregate scales in the higher ranges.

Provide dial scales having a minimum of 1,000 graduations with a clear interval between graduation marks of 0.03 inch or more.

Provide beam scales having a graduation interval not greater than 0.1 percent of the scale capacity with a clear interval of 0.03 inch or more.

Provide scales that are sensitive enough to discern movement due to the addition to the scales of a weight equal to 0.1 percent of the scale capacity under load when the scales are not connected for automatic operation, or equal to 0.2 percent when the scales are connected for automatic operation.

Except for small batches of concrete for headwalls, box inlets, finishing up operations, etc., use a batch size that exceeds 30 percent of the capacity of the scales.

Equip each beam scale with an auxiliary dial or "telltale" that will indicate to the operator that the required load in the hopper is being approached. The device shall show a minimum of 4 percent of the net rated capacity of the largest beam for underweight and 3 percent for overweight. Ensure that the indicator registers any movement of the beam.

Provide dial scales with suitable markers capable of being set to indicate the correct position of the dial indicator for predetermined loads. Enclose the dial in a glass-faced case for protection against dust.

Ensure that all weighing and indicating devices are in full view of and readable by the operator while charging the hopper, and provide the operator with convenient access to all controls.

Have all scales inspected and certified before use and whenever the Engineer may deem necessary to confirm the accuracy of the scales. Ensure that an inspection of the scales has been made within the preceding 6 months at any time a plant is supplying concrete to a Department construction project. Have a representative of a commercial scales company certified by the Division of Weights and Measures inspect and certify the scales. After the inspection and certification, only make adjustments or changes in the weighing mechanism at the direction of the Engineer. Keep all exposed fulcrums, clevises, and similar working parts of the scales clean at all times.

Furnish all weights and other equipment necessary for testing and calibrating the scales.

601.02.15 Batching Plant Equipment. Ensure that the plant conforms to all safety, health, and sanitation requirements specified in Subsection 107.01.01. Supply the batching plant with bins, weighing hoppers, and scales for the fine aggregate, each size of coarse aggregate, bulk cement, and mineral admixtures. The Department will allow weighing of cementitous material cumulatively. For the bulk cement, provide scales separate and distinct from those used for aggregate. Install and maintain the batching plant in a manner to provide accurate operations at all times. Only use weatherproof equipment for unloading cement, and protect the storage, weighing, and batching equipment for cement from the weather at all times.

Provide bins with separate compartments of sufficient capacity for each size of fine and coarse aggregate, and for bulk cement. Design each compartment to discharge efficiently and freely into the weighing hopper.

Provide a means of control so that when the quantity desired is being approached, the material may be added slowly and shut off with precision.

Use freely suspended weighing hoppers that do not affect the free movement of the weighing mechanism. Enclose the cement weigh hopper to prevent the loss of cement during weighing, and provide it with an approved device to transfer the cement to the batch trucks or the mixer. Construct all hoppers to eliminate leakage and the accumulation of tare materials, and to discharge completely. Provide any hopper that does not discharge satisfactorily with a vibrator having the frequency and power necessary to effect complete discharge.

601.02.16 Mixers.

A) Batch Mixer. Furnish a batch mixer of an approved size and type specified to positively ensure uniform distribution of materials throughout the mass, and to ensure discharge of the entire batch without segregation. Do not use any mixers having a rated capacity of less than one bag batch. Equip the mixer with adequate water storage and a device for accurately measuring and automatically controlling water discharge into each batch. Provide a mechanical device to control time of mixing for each batch and to automatically prevent discharge of the mixture until materials have been mixed for the specified time. Equip the mixer with a mechanical means for preventing addition of aggregates after mixing has started.

B) Continuous Mixer. Furnish a continuous mixer of an approved size and type specified to ensure uniform distribution of materials throughout the mass and to ensure discharge of the entire batch without segregation. Equip continuous type mixers to fix the proportions of admixture, cement, and fine and coarse aggregates by calibration according to KM 64-312. Provide devices to indicate the proportions of all components being incorporated into the mixture. Equip the water supply portion of the mixer with a readily

accessible cumulative type meter which can be read to the nearest 0.1 gallon. Ensure that the meter is of sufficient size to allow for easy reading. Calibrate the continuous type mixer to the satisfaction of the Engineer before starting work. Recalibrate the mixer thereafter at least once during each 50 cubic yards of production when yield checks indicate recalibration is necessary, and at any other times the Engineer deems necessary.

C) Truck Mixer. Furnish a truck mixer of an approved revolving drum or revolving blade type, constructed to produce a thoroughly mixed concrete mass with a uniform distribution of materials throughout. Keep the interior of the mixer drums free from hardened concrete.

Equip the truck mixer with a discharge mechanism which will ensure discharging of the mixed concrete without segregation. When the Engineer deems it necessary, provide baffle plates in the chute to avoid segregation in the concrete placed in the work. Make satisfactory repairs to any truck mixers that will not discharge concrete within the specified slump and air content ranges before using them.

Attach to each truck mixer a metal plate stating the manufacturer's capacities in terms of volume of mixed concrete for the various uses the equipment is applicable and the manufacturer's recommended speeds of rotation for mixing and agitation. For the mixer drum, apply the rates of rotation used for mixing and agitation as designated on the metal plate by the manufacturer of the equipment.

Do not allow the mixer drum to lose any water or concrete during charging, mixing, and agitation, or during transportation.

Equip the truck mixer with an automatic revolution counter that allows reading of the count at the plant and at the destination. Do not use trucks equipped with defective revolution counters. Keep the interior of the mixer drums free from hardened concrete. Equip tanks containing mixing water on all trucks with a device for accurately determining the quantity of water added at the job site.

Conduct tests to evaluate capability of the truck mixer to produce a uniform mixture according to KM 64-311. The Department will perform random checks of the tests.

D) Central Mixer.

1) Drum Type Mixer. Equip each drum type mixer with a batch counter and an approved timing device that automatically locks the discharge mechanism during the mixing period.
2) Pan Type Mixer. Equip each pan type mixer with a batch counter and an approved timing device that automatically locks the discharge mechanism during the mixing period.

601.02.17 Concrete Transfer Equipment. To transfer concrete from truck mixers or agitators, only use equipment of adequate design and dimension to deposit concrete of the specified slump at the point of placement.

601.02.18 Vibrators. Use a type and design approved by the Engineer that is capable of transmitting vibration to the concrete at frequencies to adequately consolidate the concrete and, when applicable, not damage the epoxy coating on reinforcing steel.

601.02.19 Wooden Float. Use Department approved wooden floats.

601.02.20 Carborundum Brick. Use Department approved carborundum brick.

601.02.21 Tremies. Use tremies consisting of a tube having a diameter of 10 inches or more, constructed in sections having flanged couplings fitted with water tight gaskets.

601.02.22 Wire Brooms. Use Department approved wire brooms.

601.02.23 Slip Form Machine (Extrusion Machine). Use a self-propelled slip form machine designed to consolidate and finish the concrete in one pass without damaging or displacing any steel reinforcement, and that finishes the concrete to a smooth, uniformly textured surface conforming to the required cross section with a minimum of hand finishing.

601.02.24 Curing Compound Sprayer. To apply the membrane forming curing compound, use a sprayer consisting of a container having a capacity of no less than 10 gallons in which a constant pressure can be maintained by mechanical means or by a suitable pumping arrangement in order to maintain a constant pressure at the spray nozzle or nozzles, and to uniformly apply the membrane forming curing compound at the specified rate. Equip the spray unit with mechanical devices providing constant agitation of the membrane forming curing compound or continuous circulation of the compound within the container. Use nozzles designed to deliver a uniform, fine spray and that allow for easy cleaning. Provide a shield or apron to protect the spray from wind. Provide means for cleaning the nozzles as part of the spraying equipment.

601.03 CONSTRUCTION.

601.03.01 Care, Storage, and Handling of Aggregates, Cement, and Mineral Admixtures. Furnish, stock, and handle the fine and coarse aggregates at the job site or at the plant site to maintain uniformity of grading and free moisture contents at the time of batching. For Class S concrete, saturate coarse aggregate stockpiles a minimum of 24 hours before use. The Engineer may direct saturation to continue if necessary. Obtain the Engineer's permission prior to using materials stockpiled at areas remote from the plant site. The Engineer may revoke permission to use materials remote from the plant site any time it is apparent there is not uniformity of grading and free moisture content.

When storing in stockpiles, place each size aggregate in separate stockpiles sufficiently removed from each other to prevent the intermixing of material at edges of piles. Do not use materials which have become mixed with foreign matter, or fine and coarse aggregates which have become mixed with each other. Build stockpiles in layers not exceeding 3 feet in height. Complete each layer before beginning the next layer. Handle aggregates in a manner that ensures the uniformity of the moisture content for each pour. Do not batch directly from washing plants. When handling by hydraulic methods or when washing is involved, stockpile or use bins to drain all aggregates at least 12 hours before batching. Do not remove aggregates from stockpiles within one foot of the ground line until final cleanup of the work.

Protect stored cement from dampness at all times. For cement storage, use weatherproof buildings that have ample space for storing separate shipments readily identified and accessible for sampling. Remove the cement from storage in the order received, as practical, to avoid long storage periods.

Handle cement in a manner to prevent loss, wetting, or contamination.

When using bulk cement, maintain a clean and clear cement feed to the cement batching bin to maintain the correct batch weight at all times. Furnish to the Engineer daily records of the cement shipments to the job batch plant. The Engineer may not require daily records of cement shipments when using commercial concrete plants.

Do not allow the temperature of the cement at the time of its incorporation into the mixture to exceed 170 °F.

Store and handle fly ash and GGBF slag as specified for cement. Provide means, such as double wall separation, to prevent the intermixing of cement with fly ash or GGBF slag.

601.03.02 Concrete Producer Responsibilities. Ensure that the concrete producer complies with the following when the quantity of concrete delivered to the project in a plastic condition is 100 cubic yards or more:

A) General. Design concrete mixtures, and perform quality control and process control testing as needed.

B) Certified Personnel. Employ concrete technicians responsible for the design of the concrete mixtures and for performing quality control and process control testing as necessary. Ensure that concrete technicians are certified as ACI Level I and KRMCA Level II as awarded by the KRMCA.

C) Quality Control. Take full responsibility for the batch weight calculations and quality control of concrete mixtures at the plant. Ensure that the Level II concrete technician is available when work is in progress. A Level II concrete technician is responsible for inspecting trucks, performing aggregate moisture tests, batch weight calculations, monitoring, batching, making mixture adjustments, performing the necessary slump and air content tests, and monitoring the concrete temperature, all to ensure that the concrete arrives at the project conforming to the specifications. A Level I concrete technician is responsible for testing production material for aggregate moisture, slump, entrained air, and temperature of the mixture. A Level II concrete technician is responsible for supervising this testing.

Ensure that Level II concrete technicians cooperate with the Engineer in making minor adjustments to the mixture proportions within the limits of the specifications, that may be desirable due to conditions at the job site.

Ensure that a Level II concrete technician completes and furnishes to the Department a daily summary of batch quantities on a TC 64-305 form within 3 working days after each production day. Show the batch quantities for sand, stone, cement, water, and admixtures; the moisture content of the aggregates; and the air content, slump, and temperature of the mix. Ensure the technician performs all sampling and testing according to the appropriate Kentucky Methods.

D) Producer Testing. Have a Level I concrete technician perform a daily moisture content of coarse and fine aggregate. Perform air content, slump, and temperature tests on the concrete mixture of the first unit and at least every 100 cubic yards thereafter, for each day's production.

E) Trip Tickets. Furnish a trip ticket form TC 63-9 or equivalent for each load of concrete. Include on the trip ticket a statement certifying that the data on the ticket is correct and that the mixture conforms to the approved mix design. The Inspector will insert the required job site information in the spaces provided. Ensure that the plant manager or a Level II concrete technician signs the ticket.

F) Records. Retain all concrete technician records and test results pertaining to concrete produced for a Department project for at least 3 years after formal acceptance of the project. Make records and test results available to the Engineer and the Contractor on the project for review upon request.

G) Mix Designs. Design the mixture for each class of concrete specified. Determine the proportions of materials to be used on an absolute volume basis utilizing the design procedure outlined in the Department's Concrete Manual. Establish quantities to yield as nearly practical, the design volume. Before producing any concrete for the project, submit a proposed mixture design to the Engineer and obtain the Engineer's approval.

Consider any load of concrete delivered to the job site that fails to conform to specification requirements to be subject to rejection. The Engineer may allow the addition of water at the job site. When the Engineer allows the addition of water at the job site, take responsibility for the quantity to be added. Do not allow the total water/cement ratio to exceed that listed in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.05. The Engineer may test remixed loads having additional water added to the mix at the job site.

1) New Mixture Designs. Base the proposed design on standard Department methods unless the Engineer approves otherwise. Include the following with the submitted design:

a) The class of concrete and 28-day compressive strength.
b) The source, specific gravity, percentage, and quantity of fine and coarse aggregate. The Engineer will provide an average value of the specific gravity and aggregate absorption.
c) The cement producer, type, and pounds of cement per cubic yard.
d) The mineral admixture supplier, type, class, percentage of cement reduction and replacement ratio, and total pounds per cubic yard.
e) The source of water, predicted amount of total water per cubic yard, and the maximum allowable water per cubic yard.
f) The brands and predicted dosages of admixtures per cubic yard.
g) If the concrete mixture is a class that the producer has not previously furnished to a Department project, have the producer provide trial batches of at least 4 cubic yards to demonstrate that the mixture will conform to the requirements for slump, air content, water/cement ratio, and compressive strength. Have the producer make the trial batches using the ingredients, proportions, and equipment (including batching, mixing and delivery time) to be used on this project. Have the producer make at least 2 consecutive trial batches conforming to all specified requirements. Department personnel will observe all phases of the trial batches. Have the producer submit a report containing mix proportions and test results for slump, air content, water/cement ratio, and compressive strength for each trial batch for the Engineer's review and approval.

2) Approval. The Engineer will base approval of the mixture design on the following criteria:

a) Provide concrete cylinders molded at the project site to verify that the specified compressive strength will be attained.
b) The quantities of components given for a one cubic yard batch will, on the basis of absolute volumes, produce one cubic yard of concrete mix. Include the volume occupied by entrained air.
c) The cement factor is at least the minimum specified in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03.
d) The water/cement ratio does not exceed the maximum specified in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03.
e) The aggregate sources, the cement supplier, the mineral admixture supplier or producer, and the admixture brands are on the Department's List of Approved Materials.
f) The trial batches, when required, produce acceptable results.

3) Changes in Approved Mixture Designs. Do not change the source of supply of mixture ingredients without the Engineer's written permission. If it is necessary to change the source of aggregates, submit a new design reflecting the new source of aggregate to the Engineer. Upon the Engineer's written approval, the Department will allow the use of aggregate from the new source.

601.03.03 Proportioning and Requirements.

A) Concrete.

INGREDIENT PROPORTIONS AND REQUIREMENTS FOR VARIOUS CLASSES OF CONCRETE							
Class of Concrete	Approximate Percent Fine to Total Aggregate		Maximum Free Water by W/C Ratio (lb/lb)	28-Day Compressive Strength [1] (psi)	Slump [4] (inches)	Minimum Cement Factor (lb/yd^3)	Air Content (%)
	Gravel	Stone					
A[5]	36	40	0.49	3,500	2-4[7]	564	6 ± 2
A Mod	36	40	0.47	3,500	4-7	658	6 ± 2
AA[2]	36	40	0.42	4,000	2-4	620	6 ± 2 [13]
AAA[9]	36	40	0.40	5,500	3-7	686	6 ± 2 [13]
B	40	44	0.66	2,500	3-5	451	6 ± 2
D[3]	35	39	0.44	4,000	3-5[6]	639	6 ± 2
D Mod[3]	35	39	0.42	5,000	3-5[6]	733	6 ± 2
M1[9] w/ Type 1 Cement	36	40	0.33	4,000[11]	7 max.	800	6 ± 2
M2[9] w/ Type III Cement	36	40	0.38	4,000[11]	7 max.	705	6 ± 2
S[8]	36	40	0.53	4,000	6 max.	710	6 ± 2
P[5]	35	38	0.49	3,500	1 1/2-2[10]	564[12]	6 ± 2 [13]

[1] *The Department may direct non-payment, additional construction, or removal and replacement for concrete for which test cylinders indicate low compressive strength and follow-up investigations indicate inadequate strength. The Department may require some classes to attain the required compressive strength in less than 28 days.*

[2] *When the ambient air temperature while placing slab concrete is 71°F or more, add to the concrete a water-reducing and retarding admixture. The Engineer may require or allow, water-reducing and retarding admixture in slab concrete for ambient air temperatures of less than 71°F. Only use one type of admixture for concrete placed during any individual contiguous pour.*

[3] *For prestressed members, the Department will require a strength of 5,000 psi at or before 28 days.*

[4] *The Engineer will allow slumps less than the minimum provided concrete is workable.*

[5] *The Department will allow the use of PCC pavement mixture for non-structural construction.*

[6] *At the option of the prestressed product fabricator, the Department will allow the slump of Class D or Class D Modified concrete to be increased to a maximum of 7 inches. When increasing the slump, add: 8 to 25 ounces per 100 pounds of cement for Class D Modified, 12 to 25 ounces per hundred pounds of cement for Class D, and Type F or Type G High Range Water Reducer in an amount not to exceed the following water/cement ratios:*

Summer mix designs - 0.39
Spring & Fall mix designs - 0.37
Winter mix designs - 0.34

[7] *The precast fabricator may increase the slump of Class A concrete to a*

maximum of 7 inches provided the fabricator uses an adequate amount, 12 to 25 ounces per hundred pounds of cement of Type F or Type G High Range Water Reducer so as to not exceed a water/cement ratio of 0.46.

(8) *Place Class S concrete when maximum daytime temperature is below 80°F. Batch at least 2 cubic yards less than the rated capacity of the truck mixer, when truck mixing.*

(9) *Use a high range water reducer (Type F or G) at a rate of 12 to 25 ounces per hundred pounds of cement.*

(10) *Slump. 2 inches maximum with a nominal slump of 11/2 inches. The Department will allow a maximum of 3 inches when hand finishing or truck mixing.*

(11) *Compressive Strength Testing, Opening to Traffic and Acceptance Requirements for Class M1 and Class M2. Test 2 cylinders at 24 ± 0.5 hours from the time of molding, and allow the resulting average strength to dictate one of the following actions:*

(a) *If the average compressive strength is 3,500 psi or above, open to traffic, and test the remaining pair of cylinders at an age of 7 days or 28 days.*

(b) *If the average compressive strength is between 3,000 and 3,500 psi, open to traffic, and test the remaining pair of cylinders at 48 ± one hour.*

(c) *If the average compressive strength is less than 3,000 psi, protect the item as directed or approved. Test the remaining set of cylinders at 48 ± one hour.*

If the average strength of the cylinders tested at 48 ± one hour is 3,500 psi or above, the Engineer will consider the concrete acceptable. If the average strength is below 3,500 psi, take 2 cores from the concrete and test at an age of 7 days. If the average strength of the cores tested at 7 days is 4,000 psi, the Engineer will consider the concrete acceptable.

When 2 consecutive first sets of cylinders or when 2 first sets out of any 4 first sets of cylinders do not reach 3,500 psi, compressive strength, the Engineer will suspend the work. Resume work when the Engineer approves the adjusted mix design.

Cast four 6 by 12-inch cylinders from the concrete used for each placement.

Cast the cylinders after tests verify that the concrete conforms to slump and air content requirements. Make and cure the cylinders according to the procedures outlined in KM 64-305. Department personnel will test the mixture and cast cylinders.

(12) *611 lb/yd^3 when using coarse aggregate sizes No. 8, 78, or 9-M.*

(13) *7 ± 2% when using coarse aggregate sizes No. 8, 78, or 9-M.*

B) Mortar, Grout, and Flowable Fill. When required, ensure that the air content of mortar or grout is 8 percent ± 2 percent by volume. Do not allow the quantity of fly ash in mortar or grout to exceed 20 percent of the cement quantity.

1) Mortar. Proportion mortar mix with one part cement or cement with fly ash to 2 parts mortar sand, by volume. Add water in an amount not to exceed a water/cement ratio of 0.48.
2) Grout. Proportion grout with water and one part cement or cement with fly ash to 2 parts mortar sand, by volume. Adjust the water to produce a mixture of a consistency suitable for job conditions.
3) Non-Shrink Grout. Use the non-shrink grout on the Department's List of Approved Materials. Use an approved non-shrink, non-staining grout

consisting of either a mixture of hydraulic cement, water, fine aggregate, and an approved non-ferrous expansive admixture, or a packaged commercial product. To be placed on the Department's List of Approved Materials, non-shrink, non-staining grout, must conform to the following requirements:

a) Use an initial set time of at least 45 minutes when tested according to ASTM C 191 or ASTM C 403. The Department will allow the use of a set-retarding admixture compatible with the expansive admixture.
b) Ensure that the grout exhibits expansion of no less than 0.02 percent and no more than 1.50 percent upon setting, when tested according to ASTM C 1090 with the exception that the glass plate shall remain in place during the test period.
c) Use grout that has a minimum 7 day compressive strength of 4,500 psi when tested using applicable portions of ASTM C 109.
d) Use grout that has a minimum durability factor of 85 percent and a maximum expansion of 0.06 percent when tested according to KM 64-626.
e) Keep the water content of the grout as low as possible for proper grouting and do not exceed a water/cement ratio of 0.44. Do not exceed the manufacturer's recommendations for water added to commercial products.
f) Ensure that the grout does not contain chlorides or nitrates.
g) Cure grout mixtures by covering with 2 layers of wet burlap or other approved covering so as to keep the grout continuously moist for at least 3 calendar days, except cure commercial mixtures as recommended by the manufacturer.
h) Ensure that commercial products are non-ferrous and approximately match the color of hardened concrete.
i) When preparing non-commercial grout mixture, submit a proposed mix design and a sample of the expansive admixture to the Engineer for testing and approval before use.
j) When using packaged commercial grout, provide certified test results from the manufacturer showing the material conforms to Subsection 601.02. When the Engineer requests, provide samples of the grout mixture for testing and approval.

4) Latex Grout. Use latex and cement mixture of a paste consistency.
5) Flowable Fill. Use flowable fill consisting of a mixture of cement, sand, Class F fly ash, water, and other materials the Engineer approves.

Proportion flowable fill as follows, per cubic yard batch:

Cement	30 pounds
Fly Ash, Class F	300 pounds
Sand (S.S.D.)	3,000 pounds
Water (Maximum)	550 pounds

Contrary to Section 844, do not allow the loss on ignition for Class F fly ash to exceed 12 percent.

The Department may approve other mixtures. The mixtures may include other proportions of the above materials, Class C fly ash, chemical admixtures, or aggregate not conforming to the Standard Specifications. When deviating from the above specified proportions and materials, make and test a trial batch of at least 4 cubic yards to ensure that the mix will have flow and density characteristics suited for the intended use. Use the ingredients, proportions, and equipment intended for the project, including batching, mixing, and delivery. Provide mixtures that are firm within 3 hours. Refer to the following general guidelines:

a) Require a minimum flow of 8 inches when tested with a 3 by 6-inch opened ended cylinder modified flow test.
b) Mixture bleeds freely within 10 minutes.
c) Require the mixture to support a 150-pound person within 3 hours.

The Department will observe all phases of the trial batching for approval. Submit the proposed mixture proportions and test results for the minimum flow, time of bleeding, and time to achieve firmness to the Engineer for review and approval. When the mixture is proprietary, comply with Subsection 107.05.

The Department will cast test cylinders for each 300 cubic yards of flowable fill in place. Do not rod the cylinders, but lightly tap the sides of the mold. Allow the test cylinders to bleed for about 30 minutes, refill, and then cover with a sheet of tough, durable, impervious plastic or cylinder lid. Secure the plastic in place around the mold, within one inch of the top, with a rubber band or string, and cover the lid with wet burlap. Remove the burlap after 24 hours and cure for 28 days when the ambient shade temperature is 60 to 90 ºF. Obtain an average compressive strength of 50 to 100 psi at 28 days.

C) Mixtures Using Type IP Cement or Mineral Admixtures. The Engineer will not consider any Contract time extension requests for delays due to additional time necessary to attain specified strengths. Seasonal limitations on the use of Type IP cement and fly ash in bridge decks are specified in Subsection 601.03.09 D).

1) Type IP Cement. The Department will allow the use of Type IP cement when substituted for Type I cement, pound for pound.

To produce the necessary workability, strength properties, and expected durability of the concrete, the Department will allow adjustment of the proportioning, air entraining agent, and finishing requirements; and acceptance procedures. Obtain the Engineer's approval for all such adjustments.

Conform to all strength requirements for loading structures or removing falsework before applying loads or removing falsework. If strength requirements are not met, increase the minimum times specified in the Required Time in Calendar Days Before Removing Forms and Falsework table in Subsection 601.03.14 and the Required Time in Calendar Days Before Applying Significant Loads on Concrete Structures table in Subsection 601.03.15 by 33 percent.

Ensure that the mixture contains the specified amount of entrained air.

2) Mineral Admixtures. The use of fly ash, Ground Granulated Blast Furnace (GGBF) slag, or microsilica in concrete is the Contractor's option.

When the ability to use GGBF slag or microsilica has not been demonstrated have the concrete producer provide trail batches in accordance with Subsection 601.03.02 G) 1). Have the producer make the trail batches using the ingredients, proportions, and equipment (including batching, mixing and delivery time) to be used on the project. Furnish all required materials and samples at no cost to the Department.

a) Fly Ash. When added as a separate ingredient, the Department will allow the use of fly ash to reduce the quantity of cement, except do not use fly ash to reduce the quantity of Type IP cement. The Department will allow the use of Class F fly ash to reduce the quantity of cement up to a maximum of 20 percent of the minimum cement content. For each 1.0 pound of cement reduced, add at least

1.0 pound, but no more than 1.25 pounds, of Class F fly ash.

The Department will allow the use of Class C fly ash to reduce the quantity of cement up to a maximum of 30 percent of the minimum cement content. For each 1.0 pound of cement reduced, add 1.0 pound of Class C fly ash.

Incorporate and uniformly distribute the fly ash into the mixture using methods and equipment that the Engineer approves. The Department will allow weighing of fly ash cumulatively in the same weigh hopper with the cement, but weigh the cement first. Weigh fly ash within a tolerance of 1.0 percent of the specified weight.

Conform to all strength requirements for loading structures or removing falsework before applying loads or removing falsework. If strength requirements are not met, increase the required times specified in the Required Time in Calendar Days Before Removing Forms and Falsework table in Subsection 601.03.14 and the Required Time in Calendar Days Before Applying Significant Loads on Concrete Structures table in Subsection 601.03.15 by 33 percent.

To produce the necessary workability, strength properties, and expected durability of the concrete, the Department will allow adjustment of the proportioning, air entraining agent, finishing requirements, and acceptance procedures. Obtain the Engineer's approval for all such adjustments.

Calculate the maximum free water based on the total cementitious material including fly ash. Do not change any of the slump requirements.

Ensure that the mixture contains the specified amount of entrained air.

b) Ground Granulated Blast Furnace Slag (GGBF Slag). When added as a separate ingredient, use Grade 120 GGBF slag to reduce the quantity of cement. The Department will allow the use of GGBF slag to reduce the quantity of cement up to a maximum of 30 percent of the minimum cement content. For every 1.0 pound of cement reduced, add 1.0 pound of GGBF slag. The combined weight of the cement and GGBF slag will determine the minimum cement factor and water cement ratio. Due to the lower specific gravity of GGBF slag, the concrete volume will increase. Unless directed by the Engineer, adjust the increased volume by reducing an equal volume of the fine and coarse aggregate in the mixture.

Use Type I cement unless otherwise specified. Use Type IA and Type II cement only if requested and approved in writing. When additional cements are approved, store and handle the cement so intermixing does not occur. Work done with each cement shall be readily identifiable. If test results are unsatisfactory, complete the work using Type I cement. Use only one brand of cement for each structure unless otherwise permitted by the Engineer.

Weigh the cement first when weighing GGBF slag cumulatively in the same weigh hopper. GGBF slag shall be within a tolerance of 1.0 percent of its specified weight. Incorporate the GGBF slag into the mixture by methods and equipment that ensure uniform distribution throughout the mixture.

c) Microsilica. When added as a separate ingredient, replace cement with microsilica as a percentage by weight specified elsewhere in the contract. When not specified elsewhere, replace 7 percent. The Department will allow the use of microsilica to reduce the quantity of cement up to a maximum of 10 percent of the minimum cement content. The combined weight of the cement and microsilica will determine the minimum cement factor and water cement ratio.

Use a high range water reducer conforming to ASTM C 494, Type F or Type G. Incorporate into the microsilica slurry or add at

the time of batching for dry microsilica.

Use Type I cement unless otherwise specified. Use Type IA and Type II cement only if requested and approved in writing. When additional cement types are approved, store and handle the cement so intermixing does not occur. Work done with each cement shall be readily identifiable. If test results are unsatisfactory, complete the work using Type I cement. Use only on brand of cement for each structure unless otherwise permitted by the Engineer.

Weigh the cement first when weighing microsilica in the dry or pellet form cumulatively in the same hopper. When the microsilica is in a slurry form, verify the dispenser or other means of measurement to the Engineer's satisfaction. The percent of microsilica will be considered in the measurement determinations and in the proportioning calculations.

When the microsilica admixture is in a slurry form, continuously recirculate by pumping. Begin recirculation at least four hours before batching and continue until batching operations cease.

When using a truck mixer, limit the mixer charge to 3/4 of its rated capacity, unless the Engineer approves a larger size.

D) Department Tests. The Department will test the work at the minimum frequencies indicated in the Manual of Field Sampling and Testing Practices or as necessary to determine the quality. The Department will perform the tests according to procedures outlined by the applicable Kentucky Method. The Department will cast and test compressive strength specimens according to KM 64-305 and ASTM C 39, respectively. In cases of failures, the Department will evaluate cylinder results according to KM 64-314 to determine whether in-place investigation may be necessary.

E) Measuring.

1) Cement. Measure cement by weight, considering one bag equal to 94 pounds, or weigh it in bulk on scales. When the weight of an entire shipment of cement in bags varies more than 2 percent from 94 pounds per bag, weigh the cement in bulk on scales. Do not produce batches from fractional bags, unless the entire quantity of cement is batched by weight as required for handling bulk cement.
2) Aggregates. Measure fine and coarse aggregates by weight, making corrections for moisture content. When the fine and coarse aggregates used contain more than the maximum free water stipulated in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03, increase the cement content according to the concrete proportioning requirements, and ensure that the maximum water/cement ratio is not exceeded.
3) Water. Measure water either by weight or by volume. Use an approved visible measuring device for measuring water. Use only water meter systems and other approved volumetric systems that can accurately deliver into the mixer, to within ± 1.0 percent of the required amount of water per batch and are arranged to automatically stop flow of water when the required quantity has been delivered into the mixer. When the water measuring device fails to deliver the quantity of water discharged into the mixer within the limits specified, suspend operation of the mixer until making repairs and proper adjustments. Assume water weighs 8.34 pounds per gallon.

   Each time the scales are checked, check, or obtain an approved scale company to check, water meter systems for accuracy in the presence of the Engineer. Ensure that all calculations are included in the scale company's report. Refer to the requirements of the Department's Concrete Manual for the procedure for checking scales.

Withhold a portion of the water until the last part of the batching process to wash any cement that is sticking to the sides of the mixer into the mix.

4) Measuring Admixtures. Introduce air-entraining admixtures into the concrete along with or as part of the mixing water by means of an approved mechanical dispenser. However, do not introduce air entraining admixtures into the water line when the water is being heated.

When used, introduce water-reducing or water-reducing and retarding admixtures into the concrete along with, or as part of, the mixing water by means of an approved mechanical dispenser separate from one that may be used for introduction of the air-entraining admixture. Add the air-entraining admixture and the water-reducing or water-reducing and retarding admixture to the batch separately. Use a dispenser for the water-reducing or water-reducing and retarding admixture that is equipped with a meter or gage that indicates the quantity of admixture dispensed.

Use a dispenser that is capable of being adjusted to deliver the quantity of admixture required to produce the desired air content at all times, and is capable of delivering quantities of the admixture consistently to successive batches at any setting it is adjusted with satisfactory accuracy.

The Department may allow admixtures to be added to the truck at the project site provided the Engineer's approval is obtained first.

601.03.04 Classes and Primary Uses. Use the following classes of concrete in the types of construction designated.

A) Class A. All reinforced concrete abutments below top of caps including pedestals, retaining walls, box culverts, pipe culvert headwalls, nonstructural concrete, and all items for which the concrete class is not specified.
B) Class A Modified. All concrete deposited under water.
C) Class AA. All reinforced concrete in bridge substructures and superstructures above the tops of caps, excluding pedestals.
D) Class AAA. Bridge decks and other high strength uses.
E) Class B. Gravity retaining walls, and all non-reinforced concrete deposited as fill for cavities or voids and mass footings.
F) Class D. Prestressed I beams, cast-in-place piles, and precast piles.
G) Class D Modified. Prestressed box, slab, and I-beams; and prestressed concrete piles.
H) Class M1. High early strength for bridge joint repair and full depth slab patching. (Type I cement)
I) Class M2. High early strength for bridge joint repair and full depth slab patching. (Type III cement)
J) Class P. PCC pavement.
K) Class S. Bridge slabs or barrier walls when specified in the Contract.
L) Mortar. Concrete pipe joint seals, leveling drainage structure flowlines, and filling around inlets or outlets of drainage structures.
M) Flowable Fill. Backfill for pipe.
N) Grout. Patching, filling spalled areas, or other uses specified in the Contract.
O) Latex Grout. Bond coat between existing bridge surface and new overlays; and joint sealing for centerline and other construction joints and minor cracking on overlays.
P) Non-Shrink Grout. Bonding and sealing for post-tensioning, tie-back rods and bolts, and non-composite box beams.

601.03.05 Admixtures. For all classes of concrete, add at least a water-reducing admixture. The Department will allow the use other admixtures when specified or approved by Engineer. The Department will allow admixtures according to the Ingredient Proportions and Requirements for Various Classes of Concrete table in

Subsection 601.03.03. Follow the manufacturer's recommendations in determining the quantity of admixture to use.

Ensure that the concrete producer establishes the quantity of air-entraining admixture necessary to produce a mixture having the specified air content for the class of concrete being produced. Add air-entraining admixtures separately from other admixtures, and keep them separate until introducing them into the mixing water or concrete mixture. The Engineer will not require air-entraining of mortar or grouts, except when they are exposed to freeze-thaw conditions.

Ensure that any type of admixture is uniform in properties throughout its use in the work. Only dispense of admixtures in liquid form unless the Engineer approves prepackaged powdered water reducing admixtures. When using more than one admixture ensure that the admixtures are compatible. When using fly ash, ensure that the concrete producer uses fly ash compatible admixtures.

Clearly label admixture containers that indicate the exact brand name and type of admixture. Store products in containers with the correct label. Store admixtures in suitable areas to protect them from freezing temperatures or excessive heat.

When using water-reducing and retarding admixtures provide the Engineer with manufacturer's recommendations regarding the quantity of admixture used and expected retardation period for the job mixture and conditions.

601.03.06 Slump. The Department will measure the slump of the concrete as described in KM 64-302. Do not exceed the water/cement ratio, including the free water on the aggregates, according to the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03. In general, use a mixture which contains the minimum quantity of water required by these specifications, and ensure that concrete mixtures are such that:

1) mortar clings to the coarse aggregate;
2) concrete is not sufficiently fluid to segregate when transported to the place of deposit;
3) mortar shows no free water when removed from the mixer;
4) concrete, when transported in metal chutes at an angle of 30 degrees with the horizontal, slides rather than flows into place; and
5) upper layers of the hardened concrete show a cement film on the surface but are free from laitance.

601.03.07 Delivery. Mix the concrete in the quantities required for immediate use. Except for prestressed box beams, do not allow an interval greater than 20 minutes between delivery of batches placed contiguously in the work. When using concrete with a water reducing and retarding admixture, the Engineer will allow a 30-minute intervals between the delivery of batches, except for bridge deck slabs. For prestressed box beams, the Engineer will allow a 45-minute interval for delivery of batches between placement of the bottom slab and the remainder of the box beam when using concrete with a water reducing and retarding admixture.

After adding all water, cement, and aggregates to the mixer, deliver and place concrete in its final position within the time limits listed in the following table. Do not use concrete that has developed initial set, that has become segregated, or that has not been delivered within the time limits listed.

TIME OF DISCHARGE LIMITS [(1)] **(minutes)**					
Normal Concrete [(2)]			Retarded Concrete [(3)]		
Agitated [(4)]	Agitor [(5)]	Non-Agitated	Agitated [(4)]	Agitor [(5)]	Non-Agitated
60	45	30	90[(6)]	60	30

[(1)] *All times begin when cement first enters the mixer.*
[(2)] *Normal concrete is concrete without the addition of a water-reducing and retarding admixture.*

(3) Retarded concrete is concrete to which a water-reducing and retarding admixture has been added at the Engineer's direction or approval.
(4) Agitated is defined as concrete that has been continuously agitated from the time of initial contact between cement and mixing water to the time of placement at the site of work.
(5) An agitor is a truck with paddles.
(6) 120 minutes for Class B concrete placed in miscellaneous work such as fence post footings.

601.03.08 Mixing Concrete.

A) General. The Department will allow mixing of concrete at the site of work or the use of ready-mixed methods. Ready-mixed concrete includes central-mixed and truck-mixed concrete. Site mixing includes batch mixing and continuous mixing. The Engineer may allow hand mixing.

B) Site Mixing. Thoroughly mix concrete in a batch mixer or continuous mixer.

Maintain the mixer, whether batch or continuous type, free of partially dried or hardened materials at all times. Consistently produce concrete to provide a uniform thoroughly blended mixture within the specified air content and slump limits.

1) Batch Mixing. Mix all concrete for a period of no less than 60 seconds after all materials, including water, are in the mixer. During the period of mixing, operate the drum at the manufacturer's recommended drum speed. When necessary, continue mixing until all aggregates are thoroughly coated with mortar.

   Remove the entire contents of the mixer from the drum before adding any materials for the succeeding batch. Deposit materials composing a batch simultaneously into the mixer. Do not operate any mixer above its rated capacity.

2) Continuous Mixing. The Department will allow the use of continuous type mixers for Class A or Class B concrete, except do not use them to place concrete in bridges or box culverts. Notify the Engineer of any proposed changes in the proportioning of any of the ingredients. Maintain the free-moisture content of the fine aggregate within the limits necessary to produce concrete conforming to these specifications.

   Perform slump tests on mixtures produced by continuous type mixers 4 to 5 minutes after depositing the concrete.

C) Ready-Mixed. When electing to use ready-mixed concrete, prevent delays in delivery and placing concrete. Provide a means of direct voice communication between the inspector at the job site and the inspector at the plant.

1) Truck Mixing. Accurately measure and control the entire quantity of mixing water to within ± 1.0 percent accuracy. Mix each batch no less than 70 revolutions at the plant site, at the rate of rotation the manufacturer specifies for a mixing speed. The Department will allow a reduction in mixing to 50 revolutions when the batch is charged so that all ingredients, including water, are uniformly blended during charging to produce a satisfactory mixture. In this case, mix the concrete an additional 10 revolutions at the specified mixing speed at the job site. When the Engineer allows additional water at the job site, mix the concrete an additional 30 revolutions at the specified mixing speed after adding water. Perform any additional mixing at a lower speed as the mixer manufacturer specifies for agitation, and continuously agitate until discharging the batch.

   Replace or repair any truck mixer that does not produce a uniform mixture.

2) Central Plant Mixing. When using a central-mixing plant, mix the concrete in an approved drum type mixer or pan type mixer. For drum type mixers having a rated capacity of 2 cubic yards or less, mix for a minimum of 60 seconds. For mixers having capacities greater than 2 cubic yards, mix for a minimum of 90 seconds. The Department will allow a reduction in the minimum mixing time for drum type mixers from 90 to 75 seconds when the concrete ingredients are uniformly blended during the charging of the mixer. In order to attain uniform blending, charge the batch so that the flows of water, coarse aggregate, fine aggregate, and cement are started, continued, and ended simultaneously or nearly simultaneously.

For pan type mixers having a rated capacity of 3 cubic yards or less, mix for a minimum of 45 seconds. Increase the mixing time for pan type mixers having rated capacities greater than 3 cubic yards by 15 seconds for each 3 cubic yards, over that allowed for the 3-cubic yard mixer. Any fraction of 3 cubic yards is considered to be 3 cubic yards.

The Engineer may increase the minimum mixing time for any type of mixer if the mixer does not produce the desirable quality with respect to uniformity of mixture, slump, and air content, or upon proof by tests that concrete of an undesirable quality with regard to compressive strength would be prevented by additional mixing. Measure the mixing time from the time all cement and aggregates are charged into the mixer until the mixer is ready for discharging.

Deliver concrete for use at points other than the central plant site in approved truck mixers. Start agitating immediately after introducing the batch into the mixer and continue without interruption until discharging the batch. Completely discharge each batch before introducing the succeeding batch.

The Department will allow the delivery of central-mixed concrete without agitation to a structural unit having a volume not exceeding 10 cubic yards, provided the time of delivery does not exceed the 30-minute limit listed in the Time of Discharge Limits table in Subsection 601.03.07 and the interval between delivery of batches does not exceed 20 minutes.

601.03.09 Placing Concrete.

A) General. Deliver concrete to its final position of placement within the time required for delivery after mixing and within the required time interval between delivery of batches as specified for the method of mixing and handling employed. Moisten forms and reinforcement with water immediately before placing the concrete.

Ensure that all equipment used for handling or placing concrete accommodates concrete of the proportions and consistencies as specified. The Engineer will make no adjustments in mixture proportions to accommodate equipment incapable of handling concrete of specified proportions and consistencies.

Whenever possible, completely remove water from all foundation excavations before depositing concrete. When it is necessary to deposit concrete under water, place concrete according to the requirements specified.

Employ methods and manners of placing concrete that avoid segregation or separation of aggregates or displacement of reinforcement. The Department will allow the use of long chutes, troughs, belts, and pipes for conveying concrete from the mixing plant or point of delivery to the forms only with the Engineer's written permission. When the Engineer allows such conveyers and the quality of concrete or methods of placing or working it are not satisfactory, discontinue their use and re-equip his plant or conveyance to place concrete in a satisfactory manner. Arrange and use troughs, pipes, or chutes used as aids in placing concrete so that ingredients of the concrete are not separated. Where steep slopes are required, equip the chutes with

baffle boards or provide the chutes in short lengths that change the direction of movement. Maintain all chutes, troughs, and pipes clean and free from coating of hardened concrete by thoroughly flushing with water after each run or when out of operation for more than 30 minutes. Discharge water used for flushing clear of in-place concrete. Use troughs, pipes, and chutes that are either metal or metal lined and extend as near as possible to the point of deposit. Do not use aluminum or aluminum alloy troughs, pipes, or chutes.

Do not drop concrete in excess of 5 feet without using pipe or tremies, and do not deposit a large quantity at any point and run or work it along the forms. Maintain the discharge end of the pipe as close to the point of deposit as feasible. Place concrete to entirely fill but not bulge or distort the forms or to disturb their alignment. Fill each part of the forms by depositing concrete as near its final position as possible, to work the coarser aggregate back from the face, and to force concrete under and around reinforcing bars without displacing them. After concrete has taken its initial set, avoid jarring the forms or placing any strain on ends of projecting reinforcement.

Consolidate concrete in all bridges and box culverts with a mechanical vibrator operated within the mass of concrete. Consolidate concrete in all other concrete construction, exclusive of pavement, either by vibration as described herein or with approved spading tools. When vibrating concrete, the Engineer will require spading in addition to vibrating to prevent formation of honeycomb, voids, and air pockets against the forms, except for concrete placed in pavements, bridge slabs, footings, and culvert slabs.

Provide vibration of sufficient intensity and duration to cause flow or settlement of the concrete and complete consolidation, but ensure that vibration is not used to cause concrete to flow over long distances in the forms or is unduly prolonged to cause segregation or undesirable laitance at the surface of the lift being consolidated. Use plastic coated vibrators, when necessary, to prevent damage to the epoxy coating of the steel. Provide and use a sufficient number of mechanical vibrators to ensure that consolidation can be started immediately after concrete has been deposited in the forms. Do not attach the mechanical vibrator to the forms or reinforcing steel or apply to the surface of the concrete. Apply the vibrator to the concrete immediately after depositing the concrete and move it throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into angles and corners of the forms. Design forms to provide for requirements of vibration.

Place concrete in continuous horizontal layers not exceeding a thickness of one foot, unless otherwise specified for different types of structures. In any given layer, place and consolidate consecutive batches before the preceding batch has taken its initial set. Ensure that each layer of concrete retains a rough surface to secure efficient bonding with the next layer. Consolidate a succeeding layer placed before the underlying layer has set in a manner that will entirely break up and eliminate the tendency to produce a cold joint between layers.

Construct the bridge seats comprising the area of that portion of the pier or abutment tops receiving steel bridge bearings to an elevation of 1/8 inch greater than that specified in the Plans for an area in excess of the bearing area occupied by masonry bearing plates. Construct this excess material for the bearing area with mortar of the same proportions as that in the concrete and cast it monolithic with the pier or abutment. Prevent the coarse aggregate from being placed within 1/4 inch of finished elevation specified in the Plans. Immediately after depositing the mortar, strike the surface off by means of a wooden float. When the concrete has thoroughly hardened, finish it to the true, correct elevation specified in the Plans by tooling and polishing with a carborundum brick. Test the finished surface with a spirit level, and ensure that there is no variation in excess of 1/32 inch above or below a true level plane.

When temporarily discontinuing placing, clean the concrete, after it

becomes firm enough to retain its form, of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, make construction joints according to Subsection 601.03.10.

Regulate the method and manner of placing concrete so as to place all construction joints across regions of low shearing stress and in locations that will be hidden from view the greatest possible extent. Use methods and sequences of placing concrete for various types of concrete bridge construction as specified for the particular type of construction involved.

Deposit and consolidate concrete to form a compact, dense, and impervious mass of uniform texture having smooth faces on exposed surfaces. When any section of concrete is defective, remove and satisfactorily replace or repair it as directed.

B) Placing Concrete Under Water. Do not expose concrete to the action of water before setting, or deposit it in water, except upon the Engineer's written permission. Mix all concrete deposited under water in proportions specified for Class A Modified. Place concrete deposited under water in its final position by means of a tremie or by other approved methods. Do not disturb it after depositing. Provide a sufficient number of tremies or other approved devices to ensure proper distribution of concrete to all portions of the seal. Maintain calm water at the point of deposit. Do not place any concrete in flowing water. Ensure that all form work, such as interlocking sheeting, designed to retain concrete under water is water-tight.

Regulate the consistency of the concrete to prevent segregation of materials. Maintain the surface of the concrete as nearly horizontal as practical at all times. To ensure thorough bonding, place each succeeding layer before the preceding layer has taken its initial set.

Close the discharge end at the start of work to prevent water from entering the tube. Induce the flow of concrete by slightly raising the tremie, but always keeping the discharge end in the deposited concrete. Stop the flow by lowering the tremie. Provide a continuous flow and, unless unavoidable, do not interrupt it until completing the work.

The Department will allow dewatering when the concrete is sufficiently strong to withstand hydrostatic pressure, but in no case in less than 3 calendar days after placing, or such additional length of time as the Engineer may direct. Remove all laitance or other unsatisfactory material from the exposed surfaces by scraping, chipping, or other means which will not injure the concrete surface, as the Engineer directs.

When it is necessary to use a concrete seal in construction of a foundation, construct it as hereinafter described. A concrete seal in a foundation is that volume of concrete placed under water by means of a tremie or other approved means for sealing the entire bottom area of the excavated pit within the cofferdam against hydrostatic pressure, to dewater the excavation and construct the remainder of the foundation in dewatered forms. Use Class A Modified concrete for the seal, and in general make the thickness of the seal course 0.43 times the hydrostatic head exerting pressure on the bottom of the foundation, or of a thickness as specified in the Plans. Place the corners of the seal to an elevation lower than the remaining surface of the seal course for the purpose of dewatering. In such cases, do not exceed an elevation difference between the corners and the remaining surface of 6 inches.

C) Placing Flowable Fill. To place flowable fill requires a minimum trench width of 6 inches clearance on each side of the pipe. The Engineer will allow standing water to be in the trench when backfilling with flowable fill. Deep trenches may require bleeder trenches or placement in layers to drain excess water.

Because certain types of pipe may float, backfill in lifts or anchor the pipe when necessary. Backfilling in lifts is more applicable to long lines of pipe, allowing time for a substantial amount of the water to dissipate before

applying the next lift. The Department will allow the use of adequately spaced anchors made of small lumber or metal straps to anchor the pipe. For larger diameter pipe, it may be possible to maintain a surge of flowable fill on top of the pipe to prevent floating. Floating usually does not occur after the level of the backfill is above the springline of the pipe. Ensure that the pipe remains in the correct horizontal position and elevation.

Place flowable fill by discharging directly from truck chutes into the trench or place by means of conveyors, buckets or pumps. When pumping, fill the voids adequately with solid particles to provide cohesion during the transport through the pump line under pressure to prevent segregation and line blockage. Maintain continuous flow through the pump line to prevent segregation and line blockage.

Place the flowable fill from the top of the compacted bedding to the bottom of the pavement structure. Unless the Engineer directs otherwise, allow a minimum of 2 hours before adding and compacting any material above the flowable fill.

To expedite settling and hardening in cool weather, drain or pump the bleed water from the surface or overfill the trench to allow bleed water to flow out. When overfilling, remove all excess material after hardening.

The flowable fill will bleed water within 5 to 10 minutes after placement. The release of water by bleeding causes the solid particles to realign and become firm. A delay in bleeding indicates there are too many fines in the mixture or insufficient water. If the maximum water was added, reduce the fly ash quantity in increments of 50 pounds until the mixture bleeds freely. Add approximately 60 pounds of sand to replace each 50-pound increment of fly ash to maintain the original yield. When 2 increment reductions, 100 pounds total, do not promote free bleeding of the mixture, evaluate other possible remedies. The flowable fill is too dry when cracks develop as it flows into place.

D) Weather Limitations and Protection. Maintain concrete at a minimum temperature of 45 °F for 3 calendar days after placement and at a minimum temperature of 40 °F for an additional 4 calendar days. When the Engineer requires, submit a written outline of the method to be used for protecting concrete. Designate an employee for the Engineer to contact in case of unexpected situations. The Department reserves the right to discontinue concrete placement when the means of protection or method of placement does not produce satisfactory results. Do not place concrete during times of the year that temperatures may be expected to drop below the 45 °F or 40 °F limits, unless there are adequate provisions at the job site for maintaining concrete at the specified temperature. When performing cold weather concrete work, supply a maximum/minimum reading thermometer.

In hot weather, make efforts to maintain the temperature of the mixture below 90 °F. Ensure that the temperature of the concrete mixture immediately before placing in bridges or box culverts is between 50 and 90 °F. When the ambient air temperature is above 90 °F, cool the temperature of the forms, reinforcing steel, steel beam flanges, and other surfaces that will come in contact with the mixture to below 90 °F by means of a water spray or other approved methods. Allow excess water to drain, or remove it from the forms before placing concrete. Do not place concrete in box culverts or bridges if the ambient temperature exceeds 100 °F. Do not place Class S concrete when the ambient daytime temperature exceeds 80 °F.

In cold weather, heat all water and/or aggregate so the temperature of the mixed concrete is no less than 50 °F or more than 90 °F at the time of placement. To avoid the possibility of flash set when water or aggregate is heated to above 100 °F, mix the water and aggregate before adding the cement, and do not exceed a temperature of 90 °F for the mixture of water and aggregate when adding the cement.

When using artificial heat, provide a means to maintain adequate moisture in the air within the enclosure. Maintain surfaces of all concrete in a

moist condition as specified for curing during the entire curing period. When using artificial heat, do not exceed a temperature of 90 °F for concrete near the source of heat, and maintain the temperature of concrete remote from the source of heat higher than the designated 45 °F or 40 °F for the time of curing after placement. When using stoves or salamanders, make adequate provisions for fire protection.

Assume all risk connected with placing concrete under these conditions, and even with the Engineer's permission to do the work, take responsibility for proper results. Should concrete placed under such conditions prove unsatisfactory, remove and replace it with satisfactory concrete.

Do not use fly ash or Type 1P cement in bridge decks, PCC pavement, PCC base, or PCC shoulders between November 1 and March 1 if the item is to be opened to public traffic and exposed to deicing salts. If the item will remain closed to public traffic until the following spring or later, the Department will allow the use of fly ash or Type 1P cement during this period.

601.03.10 Construction Joints.

A) General Requirements for Structures. When work of placing concrete is delayed until the concrete attains its initial set, deem the point of stopping to be a construction joint. Locate construction joints in the structure as specified in the Contract for the different types of structures; but, when the volume of concrete is too great to be placed without the use of additional construction joints, locate and construct the additional construction joints without impairing the strength or appearance of the structure as the Engineer approves. Avoid construction joints through paneled wingwalls or other surfaces to be treated architecturally. To avoid visible joints as far as possible upon exposed faces, finish the top surface of concrete adjacent to the forms by smoothing with a mason's plastering trowel. Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wingwall, use an inset form work to produce a blocked out portion in the preceding layer that produces an edge thickness of 6 inches or more in the succeeding layer. Do not stop or temporarily discontinue work on any section or layer within 18 inches below the top of any face unless details of the work provide for a coping having a thickness less than 18 inches. When the details provide for a coping having a thickness less than 18 inches, the Engineer may allow placement of the construction joint at the underside of the coping.

Whenever construction joints are required and in the opinion of the Engineer an insufficient quantity of reinforcement is projecting to secure satisfactory bond, accomplish bonding as specified in B) below.

B) Bonding Construction Joints for Structures. In joining fresh concrete to concrete that has already set, or to preceding layers, thoroughly clean the surface of work already in place of all laitance, loose, and foreign material. Then, wash and scrub this surface with wire brooms and thoroughly drench with water until saturated. Keep the surface saturated until placing new concrete. Immediately before placing new concrete, draw all forms tight against concrete already in place.

After interrupting concrete placement and forming a construction joint, interlock with the succeeding concrete by forming suitable keys in the concrete. Form these keys by inserting and subsequently removing beveled wood strips. Thoroughly saturate the wood strips with water before inserting them. The Department may allow the use of steel dowels instead of keys. The Engineer will determine the size and placement of keys and dowels.

C) Non-Structural Concrete Items. When non-structural concrete items are constructed on top of rigid pavement, ensure that construction joints in the non-structural items coincide with the pavement joints. Install expansion joint material 1/2 inch thick and cut it to conform to the cross section of the non-structural item at all construction joints. When a construction joint is

within 100 feet of a break in alignment or a drainage structure; treat the construction joint as a contraction joint.

601.03.11 Falsework. Design and construct falsework that provides the necessary rigidity, supports the loads imposed, and produces, in the finished structure, the lines and grades specified in the Plans. Have a Registered Professional Engineer design all falsework that is not a Department standard design for structures with clear span lengths of 20 feet or more and all falsework where traffic openings are specified.

Furnish the Engineer detailed working drawings in triplicate and design calculations for falsework. Do not begin any falsework construction until the Engineer has reviewed the falsework drawings. Take full responsibility for any falsework constructed prior to the Engineer's review of falsework drawings. Do not place any concrete until the Engineer has completed the review of the falsework drawings. Provide time for the Engineer to complete this review that is proportionate to the complexity of the falsework design; however always provide at least 3 weeks. For falsework over railroads or navigable streams, the Engineer’s review of the falsework drawings will be contingent upon the drawings being satisfactory to the railroad company involved, US Coast Guard, Army Corps of Engineers, or other agency having jurisdiction, as applicable.

The Department will allow the revision of falsework drawings at any time. When requesting a revision, allow sufficient time for the Engineer’s review before starting construction on the revised portion.

When using footing type falsework foundations, decide the bearing value of the soil, and show the values assumed in the design of the falsework on the falsework drawings. Show assumed values for both wet and dry soil conditions.

Construct slab forms between girders with no allowance for settlement relative to the girders.

Ensure that the design load for falsework consists of the sum of dead and live vertical loads. Include the weight of concrete, reinforcing steel, forms, and falsework in the dead loads. Assume the weight of concrete, reinforcing steel, and forms to be no less than 160 pounds per cubic foot of concrete. In addition to the full dead load, assume a live load of 50 pounds per square foot for horizontal surfaces and finishing machine weight, if necessary, in the design of falsework and centering.

Design the falsework so that horizontal loads are resisted in any direction by diagonal bracing, blocking, ties, or other means the Engineer approves, to be no less than 2 percent of the total dead load.

Design falsework footings to carry the load imposed upon them without exceeding the estimated soil bearing values and all anticipated settlements. When post-tensioning the concrete, design the falsework to support any increased or readjusted loads caused by the post-tensioning.

Ensure that the design of all plywood form panels and studs supporting them is as specified for forms. Design all joists supporting slabs and overhangs as falsework.

When falsework is over or adjacent to roadways or railways, install all details of the falsework system which contribute to horizontal stability and resistance to impact at the time each element of the falsework is erected and leave them in place until removing the falsework.

Construct falsework to reasonably conform to falsework drawings. Use materials in the falsework construction of the quality necessary to sustain stresses required by the falsework design. Use workmanship in falsework construction of such quality that the falsework will support the loads imposed without excessive settlement or deformation. Use suitable jacks or oak wedges in connection with falsework to set the forms to the required grade and to take up any excessive settlement in the falsework, either before or while placing concrete.

If unanticipated events occur, including undue settlements, which in the opinion of the Engineer would prevent obtaining a structure conforming to the Contract, discontinue placing concrete and provide corrective measures satisfactory to the Engineer. In the event satisfactory measures are not provided before initial set of the concrete in the affected area, discontinue placing concrete at a location the Engineer

determines. Remove all unacceptable concrete.

Do not place temporary supports or shoring under prestressed concrete or structural steel girders when paving bridge slabs or when taking top of beam elevations.

When placing falsework installations over or adjacent to an open public road, include design considerations and protection to ensure that the falsework system is not disturbed by errant highway vehicles or from vibration forces caused by passing vehicles. Include provisions to protect traffic from falling objects.

601.03.12 Forming.

A) Forms for Structures. Clean the inside surfaces of forms of all dirt, mortar, and foreign material. Thoroughly coat forms which will later be removed with form oil before use.

Do not deposit concrete in forms until completing all work connected with constructing the forms, placing all materials required to be embedded in the concrete for the unit to be poured, and the Engineer has inspected forms and materials.

Control the rate of depositing concrete in forms to prevent over stressing the forms due to fluid pressure.

Provide forms for all concrete surfaces not completely enclosed or hidden below the permanent ground surface that conform to the requirements herein for forms for exposed surfaces. The Engineer will consider interior surfaces of underground drainage structures the same as to be completely enclosed surfaces.

Prior to using the forming system for exposed surfaces and when the Engineer requests, furnish the Engineer the form design and materials data so the Engineer may verify compliance with this section.

Design and construct forms for exposed concrete surfaces so the formed surfaces of concrete do not deflect excessively in any direction between studs, joists, form stiffeners, form fasteners, or wales. Place plywood with the face grain perpendicular to the studs or joists. If placement of the plywood with the grain parallel to the studs or joists is desired, furnish the Engineer calculations showing that excessive deflection or stresses will not occur. Provide a clear span between supporting studs or joists that is no more than 20 times the thickness of the form facing and that does not deflect more than 1/360 of the clear span. Should any form or forming system, even though previously reviewed before use, produce a surface with excessive bulges, discontinue its use until making modifications satisfactory to the Engineer.

Form all exposed surfaces of each element in a concrete structure with the same forming material or with materials which produce similar surface textures, color, and appearance.

Face forms for exposed surfaces with form panels. Only use form panels in good condition free of defects, such as scars, dents, or delaminations, for exposed surfaces.

In general, furnish and place form panels for exposed surfaces in uniform widths of 3 feet or more and in uniform lengths of 5 feet or more, except where the dimensions of the member formed are less than these dimensions. Arrange panels in symmetrical patterns conforming to the general lines of the structure. Precisely align form panels on each side of the panel joint using supports or fasteners common to both panels, to obtain a continuous, unbroken concrete plane surface.

Construct forms for exposed surfaces with 3/4 inch chamfer strips attached to prevent mortar runs and to produce smooth, straight chamfers at all sharp edges of the concrete.

Use form fasteners consisting of form bolts, clamps, or other devices as necessary to prevent spreading of the forms during concrete placement. Do not use twisted wire loop ties to hold forms in position.

The Department will allow casting of anchor devices into the concrete for

later use in supporting forms or for lifting precast members when the Engineer allows. Do not use driven types of anchorages for fastening forms or form supports to concrete on bridge decks.

Construct all forms to allow removal without damaging the concrete. Frame forms for copings, offsets, railings, and all ornamental work so there will be no damage to or marring of the concrete when removing the forms.

Leave openings in forms at intervals no greater than 10 feet vertically. Ensure that the openings are adequate to allow free access to the forms for the purpose of inspection, working, and vibrating the concrete.

Set and maintain all forms true to lines and grades designated until the concrete has hardened. After placing concrete, remove the forms according to Subsection 601.03.14.

For narrow walls where access to the bottom of forms is not readily attainable otherwise, leave the lower form boards loose so they may be removed to remove all chips, dirt, sawdust, or other extraneous material from inside the forms immediately before placing concrete.

Construct metal ties or anchorages within the forms to allow their removal to a depth of at least one inch from the face without injury to the concrete. Design all fittings or metal ties such that upon their removal the cavities that remain will be the smallest possible size. Regardless of their position in the completed construction, ram and fill cavities with mortar, and ensure that the surface is sound, smooth, even, and uniform in color.

When using ordinary tie wires within the forms for areas where concrete will be exposed and will receive surface finish, cut back all wires at least 1/4 inch from the face of the concrete with chisels or nippers. Fill the resulting cavities with mortar, and ensure that the surface is sound, smooth, even, and uniform in color. Use nippers for cutting wires in fresh concrete. Cut the wires that are not included within the areas where the concrete will receive surface finish flush with the concrete surface. The Engineer will not require grouting unless concrete is damaged in cutting wires.

Maintain forms that are intended for reuse in good condition to ensure accuracy of shape, strength, rigidity, watertightness, and surface smoothness. Do not use forms that are unsatisfactory in any respect in the opinion of the Engineer and remove them immediately from the job site.

Use forms for circular section concrete columns that are plastic, plastic lined, metal, or other approved material in order to provide a smooth and true surface free from fins, joints, and other irregularities.

Apply the above wooden form specifications relative to design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse, and oiling to metal forms, also. Countersink all bolt heads. Design clamps, pins, or other connecting devices to hold the forms rigidly together and to allow removal without injury to the concrete. Keep metal forms free from rust, grease, or other foreign matter that may discolor the concrete.

B) Forms for Non-Structural Construction. Provide wood or metal side forms used for non-structural construction, free from warps, of sufficient strength to resist warping during construction, and of a height approximately equal to the depth of the section to be constructed. Thoroughly clean, oil well, and securely stake, brace, and hold forms to the required line and grade before depositing any concrete. Use approved flexible forms for construction of circular sections where the radius is 100 feet or less.

C) Slip Forming for Non-Structural Construction. The Department will allow the use of slip form or extruding machines for non-structural concrete items whose design is compatible with the slip form or extrusion process. For concrete placed by the slip form or extrusion process, the Engineer may waive the minimum slump requirements for the concrete being placed. Control the slump so that during each continuous run the maximum range of slump between the various batches or loads does not exceed one inch.

Produce items by the slip form or extrusion process that are comparable in quality to those produced by use of side form methods. When work is not

satisfactory, the Engineer may require the use of side forms instead of the slip form or extrusion process, as well as corrective work.

D) Slip Forming for Bridge Barrier Wall. The Department will allow slip form construction of bridge barrier wall when the Engineer approves test sections. The Engineer will approve a test section by periodic coring or slicing the wall to ensure concrete consolidation around the horizontal steel reinforcement. When concrete is not consolidated around the steel or the quality is not comparable to the side form methods, the Engineer may require the use of side forms and corrective work. The Engineer may waive the minimum slump requirements. Control the slump so that during each continuous run, the maximum range of slump between the various batches of loads does not exceed one inch. Conform to the alignment tolerance requirements of Subsection 601.03.18. Construct joints and bevels according to the Plans. Construct barrier wall to the dimensions specified on the Plans.

601.03.13 Camber. Set falsework and forms to provide structural camber indicated or as directed.

601.03.14 Removal of Falsework and Forms. In determination of time for removal of falsework and forms, consider the location and character of the structure, weather, and other conditions influencing hardening of the concrete and materials used in the mixture.

Do not remove falsework centering and falsework supporting any concrete work or loosen any wedges without obtaining the Engineer's permission. Even with the Engineer's permission, take full responsibility for the safety of the work.

The Department will allow the removal of forms for ornamental work, railing, parapets, columns, and vertical surfaces that do not carry loads after 18 hours, unless otherwise directed or approved.

1) The Department will allow the removal of supporting forms and falsework for structural units subjected to bending stresses, 3 days after placing the last concrete in the unit upon conformance to the following conditions:

   a) Advise the Engineer in writing at least 24 hours in advance of placing concrete that early removal is necessary or desirable, and request that additional cylinders for the required testing be made.
   b) Submit, for approval, a written request for the intended use of any special procedures or modifications to the mixture such as increased cement content, use of Type III cement, use of high range water reducing admixture. If supplying a high range water reducing admixture, subject to the Engineer's approval, the Department will allow the use of a higher than specified slump.
   c) Ensure that results of the compressive strength tests demonstrate a minimum of 80% the required 28-day compressive strength for the class of concrete specified. The Engineer will sample for compressive strength at the minimum frequencies indicated in the Manual of Field Sampling and Testing Practices. The Department will cast and test compressive strength cylinders according to KM 64-305 and ASTM C 39, respectively. Cure cylinders to be tested for early removal of forms and falsework as nearly as possible in the identical manner that the concrete in the structural unit is cured. The Engineer will allow early removal of forms and falsework when all of the cylinders achieve the specified minimum compressive strength.

      Upon conforming to the above conditions, the Department will allow the removal of supporting forms and falsework for structural units subjected to bending stresses to begin 3 days after placing the last concrete in the unit.

2) If early release cylinders are not requested or have failed strength

requirements, do not remove the falsework, centering, and forms supporting any girder, slab, beam, arch, or member subject to direct bending stress, or forms inside concrete barrels, until the minimum curing time has elapsed as shown in the following table. The Engineer will take air temperature readings at 7:00 AM and 3:00 PM each day during the curing period and determine the average temperature from those readings. The curing time will start after placing the last concrete in the member considered.

The Engineer will add one day to the following calendar days shown in the table for each day the average ambient air temperature falls below 40 °F.

REQUIRED TIME IN CALENDAR DAYS BEFORE REMOVING FORMS AND FALSEWORK[1]

Item	Average Ambient Temperature During Curing Period		
	41 to 54 °F	55 to 69 °F	70 °F or more
Box Culverts, spans 10 feet or less	18	11	7
Box Culverts, spans 10 to 20 feet inclusive	18	12	8
Slab and Girder Spans, 10 feet or less, including Slab Spans between Steel Girders	18	11	7
Slab and Girder Spans, 10 to 20 feet inclusive, including Slab Spans between Steel Girders	18	12	8
Slab and Girder Spans, over 20 feet, including Slab Spans between Steel Girders	21	15	12
Caps of Concrete Pile Bents, and Open Column Abutments and Piers	18	11	7
Caps of Piers with Copings extending 3 feet or less beyond Web Walls	7	5	3
Curbs or Slabs Overhanging 2 feet or less, and Rails in Open Handrails	7	5	3
Falsework under Web Walls	7	5	3
Curbs or Slabs Overhanging more than 2 feet	18	11	7
Walls, Columns, and Vertical Sides of Beams and Girders	18 hours min. as the Engineer directs		

[1]*For mixtures using Type IP cement or fly ash, see Subsection 601.03.03*

3) Remove falsework and centering in such a manner and sequence that allows concrete to uniformly and gradually take the stresses due to its own weight.

Remove forms without defacing the structure. Always remove forms from the sides of columns and piers before removing falsework or centering beneath girders, beams, or other members that they will support, so the Engineer may inspect the quality of concrete.

The Engineer will not grant any extension of time to complete work due to falsework remaining in place during curing.

4) Box culvert top slab forms may be removed earlier than 3 days. Submit special mix design and early release cylinder plan to the Engineer for approval if removal of forms earlier than 3 days is desired.

601.03.15 Opening to Traffic. Conform to the following requirements for the time of opening a completed structure to traffic or application of significant loads. The Engineer will consider construction equipment passing over a structure to be traffic.

1) The Engineer will allow early opening to traffic or application of significant loads under the same criteria as early removal for forms and falsework with the following additional requirements:

   a) Ensure that results of the compressive strength tests demonstrate a minimum of 100% the required 28 days compressive strength, for the class of concrete specified.
   b) When possible, continue to cure concrete for the time specified in the following table even when the specified strength requirements have been met.

2) If early release cylinders are not requested or have failed strength requirements, do not open the structure to traffic or subject it to significant loads until the minimum time has elapsed as specified in the Required Time in Calendar Days Before Removing Forms and Falsework table in Subsection 601.03.14 and the Required Time in Calendar Days Before Applying Significant Loads on Concrete Structures table in this subsection. The curing time will start after placing the last concrete in the structure, with the exception of handrails not designed as load supporting members. The Engineer will add one day to the following calendar days shown in the table for each day the average ambient air temperature falls below 40 °F.

   The Engineer will take air temperature readings at 7:00 AM and 3:00 PM each day during the curing period and will determine the average temperature from those readings.

REQUIRED TIME IN CALENDAR DAYS BEFORE APPLYING SIGNIFICANT LOADS ON CONCRETE STRUCTURES			
Item	Average Ambient Temperature During Curing Period		
	40 to 54 °F	55 to 69 °F	70 °F or more
Box Culverts, spans 10 feet or less	21	13	10
Box Culverts, 10 to 20 feet inclusive	22	14	11
Slab and Girder Spans, 10 feet or less, including Slab Spans between Steel Girders	21	13	10
Slab and Girder Spans, 10 to 20 feet inclusive, including Slab Spans Steel Girders	22	14	11
Slab and Girder Spans, over 20 feet, including Slab Spans between Steel Girders	23	18	14
Overhanging Slabs, age before barrier walls are placed[(2)(3)]	23	18	14
Caps on Concrete Pile Bents, and Open Column Abutments and Piers			
Concentrated Loads, as produced by steel superstructures or precast concrete	18	11	7
Distributed Loads, as produced by poured-in-place concrete deck girder superstructures	3	2	1[(2)]
Class "D" Piles, Moved or Driven[(1)]	28	21	21
Class "D" (HES) Piles, Moved or Driven[(1)]	7	5	3
Class "D" Modified Piles, Moved or Driven[(1)]	14	10	7
Backfill against Abutments or Retaining Walls	14	10	7

[(1)] *See Subsection 604.03.*
[(2)] *No strength requirements apply.*
[(3)] *The Engineer will not apply time limits when falsework is designed to support barrier wall.*

601.03.16 Joints.

A) Expansion and Contraction Joints for Structures. Construct expansion joints to allow absolute freedom of movement. After completing all work, use a fine chisel to carefully remove all loose or thin shells or mortar likely to spall under movement from expansion joints.

Provide and place expansion joints at locations specified in the Plans and Standard Drawings as follows:

1) Friction or Sliding Joints. Friction or sliding joints may be either metal, neoprene, rubber, or premolded filler type as specified.
2) Open Joints. Place at locations designated and form by insertion and subsequent removal of a template of timber, metal, or other suitable and approved material. Use a method of insertion and removal of joint templates that avoids the possibility of chipping or breaking the edges and construct the templates so removal is readily accomplished without injury to the work. Do not extend reinforcement across an open joint unless specified in the Plans. Carefully set structural steel angles, channels, plates, or other shapes used in connection with open joints to conform to the crown and grade of the bridge deck. Construct the joint with a uniform opening and to dimensions specified in the Plans.
3) Special Types. Use special types other than those listed when specified in the Plans or when the Engineer so orders in writing. Furnish special details for such joints.

B) Expansion Joints for Non-Structural Items. Install expansion joints at all breaks in alignment and at all locations where one concrete construction abuts another concrete or other type construction. Install expansion joints at each 1,000 feet of continuous construction. The Engineer will not require steel reinforcement in expansion joints.

When another concrete item crosses an expansion joint in PCC pavements, construct the expansion joint for the structural or non-structural concrete item one inch wide and construct all other expansion joints 1/2 inch wide. The Engineer will not require expansion joints in paved ditches except at locations where the paved ditch abuts another structure. Cut the one-inch thick expansion joint material to conform to the cross section of the concrete.

C) Contraction Joints for Non-Structural Concrete Items. Either form 1/8-inch wide contraction joints for non-structural concrete items or construct them according to requirements of this subsection at intervals not to exceed 30 feet, except when items are constructed on or adjacent to a rigid pavement or shoulder. For these exceptions, make the joint spacing coincide with that of the pavement or shoulder. Space contraction joints for sidewalks as specified in Section 505. The Engineer will not require the sealing of contraction joints in non-structural items.

The Engineer will not require contraction joints for paved ditches. Construct sawed contraction joints to a minimum depth of 2 inches, except that the Engineer will allow one inch of depth for header curbs and integral curbs.

601.03.17 Curing Concrete. Cure reinforced concrete bridge slabs according to Subsection 609.03. Contrary to Subsection 609.03, wet cure all Class S concrete. Wet cure all surfaces that are to receive a masonry coating finish, unless using combination material. When using combination material, cure as specified in B) below. Either wet cure all other concrete, except pipe culvert headwalls, as specified in A) below or cure it by application of membrane forming compound as specified in B) below. The Engineer will not require curing for cast-in-place pipe culvert headwalls.

At any time the Engineer determines concrete on the project is not being properly cured, the Engineer may suspend all or any concreting operations on the project.

At any time during the curing period when the atmospheric temperature is 45 °F or less, protect the concrete to satisfy the temperature requirements according to Subsection 601.03.09 D).

A) Wet Curing. Cure concrete for a period of at least 7 calendar days, beginning immediately after placement and finishing, by frequently applying water to all surfaces to keep them continuously damp during the full 7-calendar day curing period or until the required strength is attained. Protect exposed concrete surfaces from drying by application of a double thickness

of wet burlap or similar approved material and keep the burlap or other approved material continuously wet for a period of 7 or more calendar days. Soak new burlap in water for at least 12 hours before the first use.

When the structure or any portion thereof is enclosed and artificial heat is provided for protection, the Engineer will not waive the moist curing requirement. When using steamlines for heating, leave the pipe loose so sufficient steam escapes into the housing to maintain a moist atmosphere at all times. When using stoves or salamanders, maintain vessels containing water on each stove or salamander to maintain a moist atmosphere at all times. The Department will allow the curing of flat horizontal surfaces with curing blankets.

B) Membrane Curing. Do not dilute or alter the membrane forming curing compound. Thoroughly agitate the compound immediately before using it. When the compound is too viscous to apply, warm it in a water bath to approximately 100 °F before applying.

Uniformly apply the compound to a surface by use of an approved pressure sprayer. The Department will allow the placement of curing compound in one application. When placing in one application, achieve uniform and satisfactory coverage. If the Engineer directs that 2 applications are required because one application is not satisfactory, then make each application at the rate of one gallon per 300 or less square feet. Start the first application as soon as practical after the final finish and as the Engineer directs, and start the second application after finishing the first application. Use a total actual application rate of at least one gallon per 150 square feet or less actual coverage.

Do not apply curing compound to construction joints, reinforcing steel, or surfaces to receive a masonry coating, except:

1) The Department will allow the use of materials conforming to the water retention requirements of AASHTO M 148 for liquid membrane forming curing compound, and also conforming to Section 828 for masonry coating, on areas designated to receive masonry coating.
2) When using combination materials, follow wet curing procedures until completing all patching or other surface corrections and applying the compound. Keep the surface covered with wet burlap or other approved material and alternately expose small sections for surface corrections, to avoid drying. Conform to surface preparation requirements for masonry coating in all respects.

   When inadvertently applying curing compound to surfaces upon which the compound is not allowed for use, remove it by sandblasting.

   Protect the curing compound and maintain it in an acceptable condition for a period of at least 7 calendar days. Moisten and respray curing compound on surfaces on which the curing compound is damaged before the end of the 7-calendar day curing period. Cover surfaces upon which curing compound has been applied and that will be used as work surfaces or otherwise subject to damage to the curing compound with planks, boards, or other protective material to protect the curing compound from damage.

C) Curing Blankets. Only use curing blankets for curing bridge deck slabs and other flat horizontal surfaces.

Keep the concrete continuously damp for the period of time specified for the item being constructed, beginning immediately after placing and finishing. As soon as possible, without damaging the concrete surface, moisten the concrete by applying water, and immediately cover the surface with the curing blankets.

Place the blankets so that adjoining blankets overlap at least 18 inches. Weight all laps and outside edges to prevent displacement of the blankets before completing curing. Ensure intimate contact between the blankets and

the concrete surface.

If the blankets are disturbed before the curing time expires, immediately replace them. Apply water at any time drying of the concrete is evident.

Immediately repair torn places in the blankets by cementing an additional thickness of the same material over the torn area. At the end of each curing period, inspect the blankets; repair all tears or holes before reusing the blankets.

601.03.18 Surface Finish. Apply the following surface finishes to various parts of concrete structures:

1) Ordinary Surface Finish,
2) Masonry Coating Finish, or
3) Floated Surface Finish.

Apply ordinary surface finish to all concrete surfaces not required to have masonry coating finish or a floated surface finish. Consider ordinary surface finish as a final finish on all surfaces not required to have masonry coating.

Ensure that exposed finished concrete surfaces do not vary more than 1/4 inch in 10 feet as measured from a straightedge.

A) Ordinary Surface Finish. Immediately following removal of forms, remove all fins and irregular projections from all surfaces except those not to be exposed in the completed work. On all surfaces, that have cavities and depressions resulting from removal of form ties, and all other holes, honeycomb spots, broken corners or edges, and other defects, thoroughly clean the defects, saturate them with water, and carefully point them. Use a mortar of the same cement and fine aggregates mixed in the same proportions as used in the class of concrete being finished. Do not use a mortar that is more than 30 minutes old, and cure the mortar patches as specified for the structures. After the mortar has thoroughly hardened, finish it with a carborundum brick to obtain a uniform and smooth surface that is the same color and texture as in the surrounding concrete. When required, chip out honeycomb areas before pointing. Carefully tool all open and filled contraction and expansion joints in the completed work and keep them free of all mortar and concrete. Expose the joint filler for its full length with clean true edges.

Obtain smooth and even surfaces of uniform color and texture without unsightly bulges, patched areas, depressions, and other imperfections.

The Engineer will consider individual surfaces satisfactory and in compliance with requirements for ordinary surface finish when the surfaces have been formed and finished as specified and the Engineer has approved the resultant surface as to uniformity, color, texture, and smoothness.

The Engineer will consider each face of a column, wing, girder, or parapet separately in determining if the finish is satisfactory.

Protect all exposed surfaces from subsequent construction operations and from drip and disfigurement. Clean and finish any surface disfigured as a result of construction or other operations as the Engineer may require to give a satisfactory surface finish.

B) Masonry Coating Finish. After the Engineer has inspected and accepted the concrete surfaces of bridges and median barriers as having a satisfactory ordinary surface finish, clean the concrete surfaces specified hereinafter of all dust, foreign matter, and form oil, and apply a Department approved masonry coating finish. Coat the following surfaces, including all beveled edges:

1) Bridge End Bents, Abutments, Retaining Walls, and Headwalls for box or long span underpasses - every exposed surface including wingwalls, above a point 6 inches below ground or fill line.
2) Bridge Pier Caps - the tops (including exposed surfaces of pads, pedestals, and keys), sides and ends. Do not apply the coating to

bearing areas.

3) Bridge Superstructure - the tops, inside and outside faces, and ends of all barrier walls, parapets, curbs, and plinths that will be exposed. Do not apply the coating to the riding surface of the bridge deck.
4) Median Barriers - all exposed surfaces of concrete median barriers and concrete terminal sections appurtenant to the barriers.
5) Exposed Surfaces of Substructure and the Superstructure of Highway, Railway, and Pedestrian Bridges Over a Highway - all surfaces identified in 1), 2), and 3) above and the underneath surfaces of slab overhangs that are outside of exterior girders and the exterior side and bottom of exterior beams, girders and box beams and all exposed surfaces of piers, abutments and walls that are within 200 feet of a public road or street. Extend the masonry coating from a point 6 inches below ground line to the top of the exposed surface.

Thoroughly clean all surfaces to receive a masonry coating and keep them free of oil, form oil, grease, dust, dirt, mud, curing compound, release agents, loose patching mortar, or any other substance that may prevent bonding. Before applying the masonry coating material, fill all air holes flush with the surface with the masonry coating material or an approved mortar to provide a uniform surface.

Check all surfaces to receive a masonry coating for the presence of dust by wiping a dark cloth across the surface of the concrete. If a white powder can be seen on the dark cloth, clean the concrete by wire brushing, grinding, or water blasting and then allow it to thoroughly dry before applying the masonry coating. The Engineer will recheck the surface for the presence of dust after cleaning.

Check all surfaces to receive a masonry coating for the presence of oily conditions by sprinkling or fogging water on the surface of the concrete. If the water stands in droplets without spreading out immediately, this indicates the surface is contaminated with an oily substance, and the Engineer will require cleaning using a detergent and water followed by thorough rinsing with water. The Engineer will recheck the surface for the presence of oily conditions after cleaning.

Thoroughly dry all surfaces to receive a masonry coating before applying the coating, unless the coating manufacturer specifically recommends the surface to be wet. The Department's List of Approved Materials contains each manufacturer's recommendation. The Engineer will not consider surfaces to be dry unless an absorbent paper pressed tightly against the surface does not show any trace of moisture.

Suspend coating application any time the ambient temperature or the temperature of the concrete does not comply with the coating manufacturer's recommendations.

Prior to application of the materials, furnish the Engineer with copies of the coating material manufacturer's brochures or booklets. Apply masonry coating materials in strict conformity with the manufacturer's written instructions and apply the material at a uniform rate of at least 50 ± 10 square feet per gallon.

Satisfactorily repair or remove any portions of the coating that are not clean, uniform in color, texture, thickness, tightly bonded, or that are damaged before final acceptance of the project and replace them with an acceptable finish and coating.

Provide a neat uniform appearance, and prevent the coating from being dripped, sprayed, or otherwise deposited upon concrete or steel surfaces not designated to receive the coating. Remove any objectionable deposits or material and repair the surfaces to the Engineer's satisfaction.

C) Floated Surface Finish. Finish horizontal surfaces not subject to wear, and those that do not receive the Masonry Coating Finish, such as back walls, and headwalls, by placing an excess of materials in the form and removing or

striking off such excess with a wooden template, forcing coarse aggregate below the mortar surface. Do not use mortar topping for surfaces falling under this classification. After striking-off the concrete as described, thoroughly work the surface and float it by hand with a wooden float leaving a fine grained, smooth-sanded surface.

Finish concrete bridge floors as specified in Section 609.

Finish sidewalks on structures as specified in Section 505.

601.03.19 Construction Date and Identification. On all concrete bridges and box culverts, stencil the year the Contract was executed and the structure drawing number on the concrete at the locations designated. Make the figures on the stencil according to details specified in the Plans. For bridges having a clear span of 20 feet or more, stencil the year the Contract was executed and load capacity of the structure on the outside face of the plinth or barrier wall as shown on the Standard Drawing or as directed. On all box culverts, place stenciled figures giving the year in which the Contract is executed on the inlet end of the culvert on the outside face and center of the parapet or headwall. Do not use permanent plates or markers of any kind, other than those shown, on any structure. On all bridges, imprint the name(s) of the prime contractor, and the subcontractor when applicable, in the concrete at the location shown or designated. Furnish stencils, all equipment, tools, labor, materials, and other incidentals necessary.

601.04 MEASUREMENT.

601.04.01 Concrete. The Department will measure the quantity in cubic yards according to the dimensions specified in the Plans. The Department will not measure the volume of concrete displaced by pile heads (except when using concrete piles) for payment and will consider it incidental to this item of work. The Department will measure the volume of concrete displaced by concrete pile heads in cubic yards. The Department will not measure forming, including permanent steel forms, for payment and will consider it incidental to this item of work. The Department will measure the average core strength in psi by testing cores. The Department will not measure the average core strength as a separate pay unit, but will use it to calculate an adjusted Contract unit price for Concrete, Class M1 or M2.

601.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

601.04.03 Masonry Coating. The Department will measure the quantity in square yards.

601.04.04 Mass Concrete. The Department will measure the quantity in cubic yards actually placed.

601.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8100-8106, 2555	Concrete, Class[(1)]	Cubic Yard
8150	Steel Reinforcement	See Subsection 602.05
2998	Masonry Coating	Square Yard
----	Mass Concrete[(2)]	Cubic Yard

[(1)] *The Department will adjust the Contract unit price for Concrete, Class M1 and Concrete, Class M2 by the Schedule for Adjusted Payment for Strength Deficiency. The adjusted quantity is equal to the plan quantity of Concrete, Class M1 or Concrete, Class M2 multiplied by the Contract unit price for the Concrete, Class M1 or Concrete, Class M2 and the Price Adjustment. The Department will not make additional payment for*

average core strengths in excess of the specified strength.

(2) *The Department will pay for Mass Concrete at a unit price of 2 times the delivered cost of the concrete. When mixing concrete on site, the Department will pay for Mass Concrete at one-half the contract unit price for that class concrete.*

SCHEDULE FOR ADJUSTED PAYMENT FOR CLASS M STRENGTH DEFICIENCY	
Average Core Strength psi	Percent of Contract Unit Price
3,800 – 3,999	90
3,600 – 3,799	80
3,400 – 3,599	70
3,200 – 3,399	(1)
Below 3,200	(2)

(1) *Acceptable at no pay.*

(2) *Remove and replace these areas with concrete of the specified strength at no expense to the Department when directed by the Engineer.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 602 ¾ STEEL REINFORCEMENT

602.01 DESCRIPTION. Furnish and place steel for reinforcement of concrete. Furnish bars, spirals, welded wire fabric, bar mat, or other specified reinforcement, of the quality, type, size, and quantity designated by the Contract.

602.02 MATERIALS.

602.02.01 Steel Reinforcement. Conform to Section 811.

602.02.02 Epoxy Coating Material. Conform to Section 811.

602.02.03 Welded Steel Wire Fabric (WWF). Conform to Section 811.

602.03 CONSTRUCTION.

602.03.01 Protection of Material. Handle and store steel reinforcement to prevent bending, excessive rusting, or contamination with objectionable substances.

602.03.02 Straightening. Before placing in the work, straighten reinforcement bent during shipment or handling without injuring the steel. Do not heat the steel, or use steel with sharp kinks.

602.03.03 Bending. Bend reinforcement cold to the dimensions and shapes specified in the Plans and to within tolerances designated in the CRSI Manual of Standard Practice. In bending, do not injure the steel. Bend bars in the shop before shipment, not in the field.

602.03.04 Placing and Fastening. Accurately place all steel reinforcement as shown, and firmly hold in position while placing and during hardening of concrete. Hold in position to within a tolerance of ± 1/2 inch, and place to within a tolerance of ± 1/4 inch of specified clearance from the face of concrete, except for bridge deck reinforcement steel. Place steel reinforcement for bridge slabs to within the tolerances specified in Subsection 609.03.03. Dimensions shown from the face of concrete to bars are clear distances. Bar spacings are from center to center of bars. Tie bars at all intersections, except where spacing is less than one foot in both directions, then tie alternate intersections. Always pass vertical stirrups around the main tension members and securely attach them to the members.

Use Engineer approved supports to maintain distances from forms. Use precast blocks composed of mortar or Engineer approved metal chairs as supports for holding reinforcement from contact with the forms. Ensure that the tips of metal chair supports in contact with the surface of the concrete are plastic coated steel. When using plastic coated steel supports, provide a minimum of 1/8 inch thickness of the plastic material between the metal tips and the exposed surface of the concrete. The Engineer will accept metal supports as specified for epoxy coated bars. Securely tie down the steel placed in reinforced concrete slabs to prevent any possibility of steel rising above the specified elevation during placing, vibrating, and finishing the concrete as required by Subsection 609.03. Ensure that metal supports have a shape that will be easily enveloped by the concrete.

Separate the top and bottom mats of bars with precast mortar blocks or by other equally suitable devices. Do not use pebbles, pieces of broken stone or brick, metal pipe, and wooden blocks as separators. Securely place reinforcement in any member, and then obtain the Engineer's approval before placing concrete. The Engineer may reject concrete placed in violation of this provision.

When using grout to install steel bars into existing concrete, conform to Section 511.

602.03.05 Special Requirements for the Installation of Epoxy Coated Bars. Either coat all tie wires, clips, chair and bar supports, and other metallic materials used for the installation of the epoxy coated reinforcing bars with fusion bonded epoxy resin or with an approved vinyl type material, or make them of an approved non-metallic material.

Use an epoxy material that provides a uniform continuous coating having a film thickness of 12 ± 7 mils. Use vinyl-type material that is pliable and provides a uniform continuous coating having a thickness of 30 ± 10 mils. Test installation devices coated with either material according to KM 64-106.

Allow the Engineer to check the installation devices for flaking, chipping, or any other defects during the pre-pour inspection of the epoxy coated reinforcing bars, and repair or replace the devices as the Engineer deems necessary.

Coat tie wires with a flexible plastic or vinyl material to a thickness of 12 ± 7 mils. The Engineer will test the coating according to KM 64-106.

Provide all systems for handling coated bars with padded contact areas for the bars whenever possible. Pad all bundling bands, and lift all bundles with a strong back, multiple supports, or a platform bridge so as to prevent bar-to-bar abrasion from sags in the bar bundle. Use nylon slings for direct epoxy bar contact. Use loading and unloading procedures and equipment that does not damage the coating.

Unload and store the epoxy coated steel bars on the project site in a manner to avoid damage or contamination. Avoid extended outdoor storage of coated bars of over 2 months. If expecting the outdoor storage to exceed 2 months, cover the bars for protection against the elements and to prevent condensation from forming on the bars. Install the bars in the bridge deck according to applicable requirements of Section 609, except as provided in this section and as the Engineer deems necessary in order to protect and preserve the epoxy coating.

Repair all cuts, nicks, and abrasions that exceed 0.25 percent of the surface area and the bar end with the epoxy repair material supplied by the powdered epoxy resin manufacturer. If the areas damaged during transportation, handling, and placing exceed 2 percent per foot of the coated area, remove and replace them with acceptable bars. Also, repair any damaged metallic accessories with a suitable material.

Make every reasonable effort to repair all damaged areas of the reinforcing steel and accessories before any rusting occurs. If infrequent and small damaged areas do rust, thoroughly remove the rust by sandblasting or other Engineer approved methods before repairing the areas. Ensure that the coated bars, when incorporated into the work, are reasonably free from dirt, paint, oil, grease, or other foreign substance, and, when deemed necessary, clean the bars to the satisfaction of the Engineer.

Place concrete in the deck using methods and equipment that will not damage the coated materials.

Since the epoxy coating is flammable, do not expose the coated bars to any fire or flame. Do not cut coated bars by burning.

602.03.06 Splicing. Do not splice any reinforcement that is not of the type and at the locations specified in the Plans without the Engineer's written permission. The Department will allow the use of lapped splices, welded splices, mechanical couplers, or other positive connection splices specified in the Plans or designated by Engineer. Do not weld rail steel bar reinforcement used for bridges, cast-in-place culverts, and cast-in-place walls.

Make all splices added in the field and not specified in the Plans as far from the point of maximum tensile stress in the member as practical, and stagger splice points 3 feet or more in adjacent bars, when possible. Do not use any splices which reduce the clear distance between the splice and the closest bar to less than the minimum clear distance required by the design specifications. Do not use mechanical couplers having a diameter of greater than 125 percent of the nominal diameter of the reinforcing bar in the top bars in beams, slabs, or girders in which the concrete under the top bars is 12 inches or more in depth.

Make all splices with clean, sound materials properly affixed to the members being spliced and free of any substances that would weaken or contaminate the splice or concrete surrounding the splice.

Provide lapped splices that have a length no less than that specified in the Plans. When using lapped splices in areas not specified in the Plans, obtain the Engineer's approval. Splice bars by rigidly clamping or to otherwise wire together in a manner the Engineer approves. Make splices for spirals, where necessary, with a minimum lap of 1.5 turns of spiral.

When welding splices, conform to the AWS Reinforcing Steel Welding Code. Butt together and weld bars to develop, in tension, at least 125 percent of the specified yield strength of the bars. Do not use welded splices unless specified in the Plans or as the Engineer approves.

Use mechanical couplers primarily for bars required for compression only. Use only mechanical couplers or bars designed to carry critical tension or compression that are equivalent in strength to approved welded splices (125 percent of the specified bar yield strength).

When the Engineer allows welded splices or mechanical couplers, prepare 2 test specimens of the spliced reinforcement for submittal to the Division of Materials for testing before incorporating the splices into the work, and submit one additional test specimen for each 100 splices made. Ensure that only personnel who are qualified in conformance with the AWS Reinforcing Steel Welding Code make the welded splices.

602.03.07 Welded Steel Wire Fabric (WWF). Overlap sheets of WWF by 40 or more times the nominal diameter of the longitudinal wires to maintain a uniform strength, and securely fasten the sheets at the ends and edges.

602.04 MEASUREMENT.

602.04.01 Steel Reinforcement. The Department will measure the quantity, including bars used to replace test specimens, by the pound in the final work based on the theoretical number of pounds. The Department will not measure clips, wire, chairs, or other material used for fastening reinforcement in place for payment and will consider them incidental to this item of work. The Department will not measure welded splicing for payment and will consider it incidental to this item of work.

The Department will base quantities of materials furnished and placed on the calculated weights of the reinforcing steel actually placed. The Department will calculate the weights based upon the following table:

ASTM STANDARD REINFORCING BARS

Bar Size English and (metric)	Nominal Mass pounds per foot	Nominal Dimensions - Round Sections		
		Diameter inches	Cross Section Area, sq. inches	Perimeter inches
#3 (10)	0.376	0.375	0.11	1.178
#4 (13)	0.668	0.500	0.20	1.571
#5 (16)	1.043	0.625	0.31	1.963
#6 (19)	1.502	0.750	0.44	2.356
#7 (22)	2.044	0.875	0.60	2.749
#8 (25)	2.670	1.000	0.79	3.142
#9 (29)	3.400	1.128	1.00	3.544
#10 (32)	4.303	1.270	1.27	3.990
#11 (36)	5.313	1.410	1.56	4.430
#14 (43)	7.650	1.693	2.25	5.320
#18 (57)	13.600	2.257	4.00	7.090

602.04.02 Steel Reinforcement, Epoxy Coated. The Department will measure the quantity according to Subsection 602.04.01. The Department will not measure the epoxy coating or its application for payment and will consider it incidental to this item of work.

602.04.03 Mechanical Couplers. The Department will measure the quantity by each individual unit.

602.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8150	Steel Reinforcement	Pound
8151	Steel Reinforcement, Epoxy Coated	Pound
----	Mechanical Couplers, Size	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 603 ¾ FOUNDATION PREPARATION AND BACKFILL

603.01 DESCRIPTION. Excavate and backfill or dispose of all materials required for the construction of bridges, box culverts, and other structures for which excavation is not otherwise provided.

603.02 MATERIALS AND EQUIPMENT. Use fabric wrapped backfill drains conforming to Section 845.

603.03 CONSTRUCTION. Remove and dispose of all materials excavated for the construction of the foundations for all structures, including the removal of existing structures. Place backfill to the original ground level and perform final cleaning up.

603.03.01 Classification. Perform structure excavation necessary for all bridge foundations and culverts, except pipe culverts, as Structure Excavation Solid Rock or Structure Excavation Common. Perform structure excavation necessary in the construction of cribwalls and retaining walls as Structure Excavation Unclassified.

A. Structure Excavation Solid Rock. The Department considers all of the following Structure Excavation Solid Rock:

1) All rock in solid beds, detached masses, or ledge formations which cannot be removed without blasting or quarrying. Hoerams and jackhammers may be required for solid rock removal.
2) Detached rocks or boulders having a volume of 0.5 cubic yards or more each.
3) Shale, slate, or coal which cannot be removed without blasting or quarrying.
4) Rock layers interspersed with strata of earth, or all conglomerate boulder formations, when rock strata or boulders constitute 60 percent or more of the volume to be removed.

B. Structure Excavation Common. The Department considers Structure Excavation Common as all material not classified as Solid Rock Structure Excavation.

C. Structure Excavation Unclassified. The Department considers Structure Excavation Unclassified as all excavation regardless of the materials encountered.

603.03.02 Channel Preservation. When any excavation or dredging is done at the site of the structure, do not excavate outside of caissons, cofferdams, steel piling, or sheeting, and do not disturb the natural stream bed adjacent to the structure without the Engineer's written permission.

603.03.03 Footing Excavation. Notify the Engineer at least 48 hours in advance of beginning structure excavation.

Excavate the foundation pits to allow placing of the full width and length of footings specified in the Plans with full horizontal beds. Do not use rounded or undercut corners and edges of footings. Ensure that all rock and other hard foundation material is free from all loose material, cleaned, and cut to a firm surface, either level, stepped, or roughened, as directed. Clean all seams and fill with concrete, mortar, crushed stone, or sand. When masonry is to rest on an excavated surface other than durable rock or durable shale (SDI equal to or greater than 95 according to KM 64-513), do not disturb the bottom of the excavation, and do not make the final removal of the foundation material to grade until just before the masonry is to be placed. When unsuitable foundation material is encountered, excavate and replace with acceptable material as the Engineer directs. Maintain the excavation free of

standing water, insofar as is practical.

When the Plans require the foundation for a bridge or culvert to be solid rock or shale, drill into the foundation material to confirm its suitability. Drill according to the Division of Construction's Guidance Manual.

603.03.04 Backfilling. Use only approved materials that will provide a dense well-compacted backfill. Ensure that the backfill material is free of frozen lumps, vegetation, debris, and rock fragments larger than 4 inches in any dimension. Before starting backfill, clear the excavated pits of all form material and rubbish, and, when practical dewater the pits.

For backfill that will be beneath, or within a proposed embankment, backfill according to Subsection 206.03.03.

When backfilling piers constructed in a stream bed or flood plain, the Department will allow material removed from the excavation as backfill material provided no large rock or broken concrete fragments are placed in contact with the structure, and provided no logs, stumps or rubbish are used. Backfill below normal low water elevation will not require compaction.

Shape the backfilled areas lying outside the limits of roadway embankment to a uniform finish.

As a precaution against introducing unbalanced stresses in masonry walls or columns, place and compact the backfill to the same elevation on both sides of culverts, wingwalls, piers, and abutments before proceeding to the next layer.

For structures over which rock fills will be constructed, first cover the structures to a minimum depth of 2 feet with materials placed and compacted as required for backfill.

Obtain the Engineer's permission before backfilling against any concrete masonry structure.

603.03.05 Drainage. At locations where depth to weep hole flowline is 30 feet or less, drain backfill by installing a fabric-wrapped drain.

Center a fabric-wrapped drain over the inlet end of each weep hole with a wide side against the concrete, and glue the drain in place. Use a glue recommended by the drain manufacturer. Ensure that glue is not placed over the portion of the drain covering the weep hole. Place drains vertically at each weep hole.

Extend the drain from top of footing or from 6 inches below the inlet end of weep holes to 6 inches below subgrade elevation or, in the case of box culverts, to the top of the top slab. Avoid damaging or compressing the drain during backfilling.

When splices are required, provide a 6-inch lap of fabric to be glued to the adjacent piece so the spliced drain is completely covered by fabric.

Provide flaps or separate pieces of fabric to cover the top and bottom of the drain, and overlap the fabric on all sides of the drain at least 6 inches.

At the weep hole, if necessary, puncture the plastic core to provide free drainage from the drain to the weep hole. If puncturing of the core is necessary do not puncture the geotextile fabric on the outside face of the drain. Place a piece of plastic, at least 8 inches by 8 inches by 3/16 inches on the outside face of the drain over the weep hole, as reinforcement.

When depth to weep hole flow line is greater than 30 feet, cover the inlet ends of weep holes with at least 0.05 cubic yard of No. 57 coarse aggregate. Place the aggregate to allow free drainage but at the same time prevent the fill from washing. From approximately 6 inches below the bottom of the inlet ends of the weep holes, place a column of clean crushed stone or gravel, at least 0.01 square yard, up against the back of the wall to the upper limits of the backfill. At the time of placing the remainder of embankment adjacent to the structure, continue placing the column of stone up to subgrade elevation, or, in the case of box culverts, to the top of the top slab.

603.03.06 Cofferdams. For foundation construction, drive sheet piles for cofferdams to an elevation well below the bottom of the footings. Brace walls to ensure against collapse. Provide interior dimensions that allow sufficient clearance for

the construction of forms and the inspection of their exteriors, and to permit pumping outside the forms. Right, reset, or enlarge cofferdams that are tilted or moved laterally during the process of sinking to provide the necessary clearance. Construct cofferdams sufficiently watertight to prevent water from coming in contact with fresh concrete. Do not allow bracing to extend into the substructure masonry unless the Engineer permits in writing. Submit drawings prepared by a Registered Professional Engineer showing the design and construction methods of proposed cofferdams. Include in the drawings all necessary details and design calculations. The type and clearance of cofferdams, details that affect the character of the finished work and the safety of the installation are subject to Department approval. The Department will review design details of cofferdams, bracing, shoring, or other work.

Remove all cofferdams, including all sheeting and bracing, after completion of the substructure without disturbing or causing damage to the finished masonry.

603.03.07 Foundation Seals. When conditions are encountered which, in the judgement of the Engineer, render it impracticable to remove water from the cofferdam before placing masonry, the Engineer may require construction of a concrete foundation seal according to Subsection 601.03.09 B).

Do not dewater cofferdam until the concrete seal has set sufficiently to withstand the hydrostatic pressure and in no case less than 72 hours after placement.

The Engineer may require longer than 72 hours.

603.04 MEASUREMENT. The Department will not measure the removal of existing structures, or portions thereof, in structure excavation when listed in the Contract as a bid item.

The Department will measure removing masonry necessary in the building of extensions to or the rebuilding of an existing structure according to Section 203.

The Department will consider removal of existing pipe incidental to structure excavation and will deduct the interior volume of the pipe from the structure excavation quantity.

When the Plans require the foundation to be solid rock or shale, drilling to confirm suitability is incidental to the structure excavation.

603.04.01 All Structures. When it is necessary to backfill in excess of the material excavated, the Department will measure the quantity of the additional material necessary for such backfill in cubic yards in its original position under Borrow Excavation or Roadway Excavation, unless it is paid for as Extra Work.

The Department will not measure dewatering excavated pits and placing and compacting backfill for payment and will consider them incidental to the structure excavation bid items.

When not listed as a bid item, the Department will not measure furnishing and placing fabric wrapped drains or coarse aggregate at weep holes for payment and will consider them incidental to the structure excavation bid items.

When it is necessary to construct any footing more than 5 feet below the elevation specified in the Plans for structures, except pipe culverts, sewers, and underdrains, the Department will pay for all excavation below plan elevation as Extra Work.

The Department will not measure excavation or backfill in excess of the limits described in this section for payment.

603.04.02 Bridges and Culverts. The Department will measure the quantity of all excavation in its original position as that actually excavated within the limits bounded by vertical planes 18 inches outside the footings and parallel thereto except as follows. The Department will measure between the original ground surface and the bottom of the excavated pit, except in cuts where the finished cross section will govern, and except when structures are removed, the bottom of the excavation for removal shall govern. The Department will not include in the quantity the volume of the waterway of existing culverts and bridges, the volume of materials removed as Remove Existing Structure, nor materials removed as incidental. The Department will not measure

structure excavation for pipe culverts and pipe culvert headwalls, sewer pipe, or combination sewer and storm pipe.

Where tie beams, struts, web walls, overhangs, or similar construction are required on the substructure above the bottom of the footings and extend beyond the area bounded by vertical planes 18 inches outside the footings, the Department will measure the excavation, except that the Department will measure the area bounded by vertical planes 18 inches outside the footings and 18 inches outside the neat lines of the tie beams, struts, web walls, and other similar construction. The Department will measure between the original ground surface and a plane 18 inches below the bottom of the tie beams, struts, web walls, and other similar construction.

The Department will not measure excavation necessary to construct concrete encasement for an individual steel pile for payment and will consider it incidental to the pile. The Department will not measure Structure Excavation in the construction of timber bents or backing planks, or for excavation incidental to splicing piling for payment.

603.04.03 Foundation Preparation. When listed as a bid item, the Department will measure all work performed as part of Foundation Preparation as a lump sum for each structure. The Department will not measure cofferdams, shoring, dewatering, common excavation, or backfill for payment, and will consider them incidental to this bid item. The Department will measure Structure Excavation Solid Rock and removal of unsuitable foundation material and refill separately for payment.

603.04.04 Structure Excavation Common. When Foundation Preparation is not listed as a bid item, the Department will measure the quantity, in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.05 Structure Excavation Solid Rock. The Department will measure the quantity in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.06 Structure Excavation Unclassified. The Department will measure the quantity in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.07 Foundation Undercut. When Foundation Preparation is not a bid item and the Engineer directs that unsuitable foundation material is be excavated and replaced, the Department will measure the quantity of excavation as Structure Excavation Common, Structure Excavation Solid Rock, or Structure Excavation Unclassified in cubic yards, as applicable, which will be complete compensation for all excavation, disposal, backfill, and all other incidentals necessary to prepare a suitable foundation.

When Foundation Preparation is a bid item, the Department will pay for Foundation Undercut as Extra Work.

603.04.08 Cofferdams. The Department will not measure the quantity unless it is listed as a separate bid item and will consider it incidental to the bid item Structure Excavation or Foundation Preparation.

603.04.09 Foundation Seals. The Department will not measure the quantity unless it is listed as a separate bid item or the work is directed by the Engineer.

603.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8002	Structure Excavation Solid Rock	Cubic Yard
8001	Structure Excavation Common	Cubic Yard

2203	Structure Excavation Unclassified	Cubic Yard
2210	Borrow Excavation	See Section 205.05
2200	Roadway Excavation	See Section 204.05
8003	Foundation Preparation	Lump Sum

The Department will consider payment as full compensation for all work required under this section.

SECTION 604 ¾ BEARING PILES

604.01 DESCRIPTION. Furnish and drive prestressed concrete, precast concrete, cast-in-place concrete, or HP shape structural steel bearing piles.

604.02 MATERIALS AND EQUIPMENT.

604.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

604.02.02 Structural Steel. Conform to Section 812.

604.02.03 Welded Steel Pipe Piles (Cast-In-Place Pile Shells). Conform to ASTM A 252, Grade 3.

604.02.04 Miscellaneous Metals. Conform to Section 813.

604.02.05 Polypropylene Sleeves. Conform to the manufacturer's recommendations.

604.02.06 Pile Points. Conform to AASHTO M 103, Grade 65/35 or ASTM A 148. Furnish pile points from a supplier on the Department's List of Approved Materials.

604.02.07 Equipment for Driving.

A) Hammers. Provide hammers for driving precast or prestressed concrete piles that develop a minimum energy per blow at each full stroke of the piston of more than one foot-pound per each pound weight of pile being driven. Use 150 pounds per cubic foot as the weight of concrete in the pile being driven. Use a hammer that develops a total energy of 12,000 or more foot-pounds per blow.

Provide hammers for driving steel piles or steel shells for cast-in-place piles that develop a minimum energy of 5,000 foot-pound for each ton of steel in the pile or shell being driven and in no case develop less than 10,000 foot-pounds of total energy.

Use diesel powered pile hammers with a ram weighing at least 2,000 pounds to drive steel piles, concrete piles, and steel shells for cast-in-place piles. For hammers that do not restrict the rebound of the ram use a ram 2,000 pounds or more.

If hammers with an enclosed ram are used, they will have a rated equivalent energy of no less than 250 foot-pounds per blow per ton of the required bearing. For driving concrete piles, use hammers that have a rated equivalent energy of 15,000 foot-pounds or more per blow. Equip hammers of this type with a gage and charts that will evaluate the equivalent energy actually produced under any driving conditions.

When the Engineer determines the size of the hammer to be unsatisfactory, correct or replace it to produce satisfactory results. Provide the Engineer with the manufacturer's specifications regarding hammers on request.

B) Leads. Use pile driver leads that allow freedom of movement to the hammer and ensure proper distribution of hammer blows on the head of piles. Hold leads in position with guys, stiff braces, templates, or other Engineer approved means for supporting the pile during driving.

C) Followers. Avoid driving piles with followers if possible. Use followers only with the Engineer's written permission or when driving piles through water. If using followers, drive one long pile from every group of 10 without a follower, and use this pile to determine the average bearing power of the group.

D) Water Jets. The Department will allow the use of water jets alone or in combination with a hammer. Provide sufficient water volume and pressure at the jet nozzles and number of jets to freely erode materials adjacent to the pile. When using water jets and a hammer for driving, withdraw external jets or stop jetting, and drive the piles with the hammer to secure final penetration. Consider the difficulties encountered in driving when determining the time of withdrawal of jets. Vary this procedure until obtaining the desired results.

604.03 CONSTRUCTION.

604.03.01 General.

A) Precast and Prestressed Concrete Piles. Construct according to Section 605.

B) Cast-In-Place Piles. Construct according to Section 601. Use Class D or D Modified concrete, according to the Contract. Use welded steel pipe pile shells of the design and dimensions specified in the Plans. Select a wall thickness for steel shells that is sufficient to withstand driving without injury and to resist harmful distortion and buckling due to soil pressure after driving. Use only watertight shells to exclude water during the placement of the concrete. For pile shells with a fluted or corrugated section, measure the diameter of the shells from crest to crest of flutes or corrugations. Use only shells equipped with heavy steel ends and with welded joints.

C) Steel Piles. Use HP shape piles.

604.03.02 Limitations of Use. Penetrate 10 feet or more into original ground and 10 feet or more below stream bed, or to rock. In all cases, develop the required bearing value with the pile penetration.

For foundation work, do not penetrate a very soft upper stratum overlying a hard stratum unless the piles penetrate the hard material a sufficient distance to rigidly fix the ends.

The Department will allow the driving of precast concrete piles and prestressed concrete piles 3 calendar days after casting or any time thereafter provided that samples of concrete taken from the respective mixture indicate a compressive strength of at least 4,000 psi for Class D concrete or 5,000 psi for Class D Modified concrete.

604.03.03 Storage and Handling. Store and handle piles in a manner that avoids injury to the piles.

604.03.04 Preparation for Driving.

A) Excavation. Do not drive piles until after completing excavation, except for test piles and for piles that extend above the ground in the completed structure. Sufficiently excavate the area in the vicinity of the test piles before driving them to ensure that the test piles are driven only through material that will not be excavated later in constructing the footing. Ensure that the Department allows driving test piles before excavating for the entire footing. Remove all material forced up between the piles to the correct elevation before placing concrete for the foundation.

B) Caps. Protect the heads of all precast concrete piles and prestressed concrete piles with caps of approved design having suitable cushion next to the pile head and fitting into a casting which in turn supports a timber shock block.

Cut the heads of steel piles squarely. Provide a driving cap or head that has been properly grooved or made in some manner to fit and hold firmly the head of the pile being driven so that the axis of the pile is in line with the axis of the hammer.

Protect tops of steel shells for cast-in-place piles with driving heads,

mandrels, or other devices properly sized for the hammer according to the hammer manufacturer's recommendations to properly distribute the hammer blow and to prevent damage to the shell during driving.

C) Pointing. For steel piles, provide cast steel points when specified or directed in order to obtain penetration. Use pile points of the type specified in the Contract or by the Engineer. Weld pile points to the pile with a minimum 5/16 inch groove weld along the full outside width of each flange on the pile. Install pile points in the shop or in the field. Furnish a mill test report according to Subsection 607.03.13 C). Furnish the Engineer with the manufacturer's specifications.

D) Extensions, Build-Ups, and Splices. The Engineer may allow extensions, splices, or build ups when necessary as follows:

1) Precast and Prestressed Concrete Piles. Perform extension or build-ups according to the Standard Drawings. If alternate methods for extensions or build-up is desired submit proposal to the Engineer for consideration.
2) Cast-in-Place Piles. Make extensions, splices, or build-ups on steel shells as specified in the Plans or as directed.
3) Steel Piles. Make extensions or splices according to the standard drawings or the Division of Construction's Guidance Manual. Weld according to Subsection 607.03.07.

604.03.05 Methods of Driving and Placing. With the Engineer's written permission, water jet or core holes for prestressed, precast, or cast-in-place concrete piles, and then place piles in the holes and drive them to secure the last few feet of their penetration. Do not jet or core holes for steel piles unless the Engineer directs. Unless otherwise specified in the Plans or directed, prepare jetted or cored holes in compacted fills as necessary to secure the required penetration. Core holes to a maximum diameter equal to the least cross sectional dimension of the piles driven. Fill all voids that occur around a driven pile with free flowing sand.

Do not drive piles in the vicinity of recently placed concrete until the concrete is sufficiently cured to prevent damage, in the judgment of the Engineer.

For cast-in-place piles, drive the shells using steel heads having a projecting ring fitting inside the shell. Provide a 1/4 inch clearance between the ring and the shell. The Department will allow the use of other types of driving heads if the Engineer approves. The Department will not require painting the steel shells. Provide an inspection light before and during the shell filling operation. Remove and replace improperly driven, broken, or otherwise defective shells, or otherwise correct them to the Engineer's satisfaction by driving an additional pile. The Engineer will inspect all driven shells. When the Engineer approves the driven shells, cut them off to a horizontal plane at the required elevation.

Before placing concrete, remove all water or debris from the shell. Place concrete in an approved manner that will ensure against segregation. Do not place concrete until completely driving all piles within a radius of 16 feet of the shell to be filled or until completely driving all the shells for any one bent or foundation. Continuously place the concrete in each pile, and exercise proper care to fill every part of the shell and to ensure a dense, homogeneous mixture.

The Engineer will not require steel reinforcement in cast-in-place piles unless specified in the Plans. When specified, use the type and design of reinforcement specified in the Plans.

Ensure that the finished tops of piles are at the elevation specified in the Contract or directed by the Engineer and that they project no less than 6 inches into pier footings and no less than 3 feet into end bents.

604.03.06 Test Piles. Drive test piles of a length and at the location designated on the plans or determined by the Engineer. These piles shall be of greater length than the length assumed in the design in order to provide for any variation in soil conditions.

Test Piles are for the Engineer's use in determining capability of the Contractor's

equipment and adequacy of design. The Engineer will determine when an adequate bearing value has been obtained. The Contractor shall be responsible for determining pile lengths that may be necessary to obtain the required bearing values. No claim shall be made against the Department for costs of construction delays, or any materials, labor, or equipment, that may be necessary due to the Contractor's failure to furnish piles of a length sufficient to obtain the required bearing values, or for variations in length due to subsurface conditions that may be encountered.

The same model and size pile hammer shall be used to drive the remaining piles in the structure as the one used to drive the test pile. The same type of piles shall be used in the remainder of the group as the type tested for the group.

Soundings, boring logs, soil profiles, or other subsurface data included in the Contract documents are used by the Department for making preliminary estimates of quantities and should not be used for determining equipment, materials, or labor necessary for driving piles as required by the contract. All test piles shall be accurately located so they may be used in the finished structure.

604.03.07 Determination of Bearing Values. The Engineer will determine when each pile in the structure has obtained an adequate bearing value. Determine the pile lengths necessary to obtain the required bearing values. The Department will determine bearing values by the specified formulas. When specified in the Contract or directed by the Engineer, the Department will determine the bearing values by static load test. Drive piles to develop a bearing value of no less than that specified in the Plans, directed by the Engineer, or determined by static load testing. When using water jets or cored holes in connection with driving, withdraw the jets or drive the piles in the cored holes, then the Department will determine the bearing value.

A) Static Load Tests. When specified in the Contract or required by the Engineer, the Department will determine the size, number, and bearing value of piles by actual loading tests. Perform load test according to plans or proposal notes.

B) Formula. In the absence of load tests, the Department will determine the allowable bearing values for piles by the following formulas:

$$P = \frac{2\,WH}{S + 1.0}$$ for gravity hammers

$$P = \frac{2\,WH}{S + 0.1}$$ for single acting steam-air hammers

$$P = \frac{2\,E}{S + 0.1}$$ for double acting steam-air hammers

$$P = \frac{2\,WH}{S + 0.1}$$ for diesel hammers (having unrestricted rebound of ram)

$$P = \frac{2\,E}{S + 0.1}$$ for diesel hammers (having enclosed ram)

Where:

P = allowable bearing capacity in pounds;
W = weight in pounds, of striking parts of hammer;
H = height of fall in feet;
S = the penetration in inches per blow for the last 5 to 10 blows for gravity hammers and the last 10 to 20 blows for steam, air, or diesel hammers; and
E = 90 percent of the average equivalent energy in foot-pounds as determined by gage attached to pile hammer and recorded during the period when the penetration per blow is being observed.

The Department will use the preceding formulas 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, and
4) there is no observed appreciable bounce after the blow.

604.03.08 Allowable Variation in Driving. Use templates when specified or directed.

A) Exposed Piles. The Engineer will not accept exposed piles in the finished structure when:

1) during driving, the pile varies more than 1/4 inch per foot from vertical or the batter position specified in the Plans;
2) the driven pile varies more than 4 inches from plan position at the pile cut-off elevation; or
3) the driven pile varies more than 2 inches from a stringline stretched between exterior piles in the exposed portion of the pile bent or group.

B) Unexposed Piles. The Engineer will not accept unexposed piles in the finished structure when:

1) during driving, the pile varies more than 1/4 inch per foot from vertical or the batter position specified in the Plans; or
2) the driven pile varies more than 6 inches from plan position at the pile cut-off elevation.

For either case, the Engineer will reference the plan position of the pile cut-off elevation to determine the variation of 1/4 inch per foot. For all piling that is unacceptable because of variations, remove and replace or redrive them in an acceptable position or correct them in a manner the Engineer directs. Furnish and place all additional concrete and steel reinforcement required to meet plan clearance and dimensions in footings, caps, or bridge seats due to variations in driving, even when variations are within allowable tolerances.

604.03.09 Design Modifications. When it is not possible to obtain the capacity required by the Plans, the Department will redesign the structure based on the actual bearings obtained by test piles or pile load tests.

604.03.10 Ordering Piles. Order piles of the number and lengths necessary to complete the work.

604.03.11 Pile Protection. When specified in the Contract, provide protection from negative skin friction as the Contract specifies.

604.03.12 Unused Pile Lengths. Take ownership of unused lengths of piles and pile cutoffs, and remove such lengths and cutoffs from the project.

604.04 MEASUREMENT.

604.04.01 Piles. The Department will measure the quantity in linear feet for the total lengths of the various types and sizes. Splices are incidental to this item of work.

For precast or prestressed concrete piles having concrete removed in order to expose the reinforcing steel, the Department will consider the end of the exposed reinforcing steel as the pile end for purposes of measurement.

The Department will not measure unused lengths of piles or pile cutoffs for

payment.

The Department will not measure corrective work or redriven piles.

The Department will not measure any additional concrete or steel reinforcement required to meet plan clearance and dimensions in footings, caps, or bridge seats due to variations in driving, even when variations are within allowable tolerances.

604.04.02 Pile Points. When included as a bid item, the Department will measure the quantity by each individual unit.

604.04.03 Test Piles. For test piles actually used as a pile in the structure, the Department will measure the quantity according to Subsection 604.04.01 except that the minimum measured length for test piles will be the length specified in the Plans or directed by the Engineer. The Department will not measure unsatisfactory test piles that are not used as a pile in the structure.

Length of test piles specified in the Plans are approximate only. The Department will not measure necessary splices for payment and will consider them incidental to this item of work.

604.04.04 Loading Tests. The Department will measure the quantity by each individual unit. The Department will not measure for payment load tests made at the option of the Contractor.

604.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8080, 8082, 8086, 8096	Piles, Prestressed Concrete, Size	Linear Foot
8072	Piles, Cast-in-Place, Size	Linear Foot
8042-8056	Piles Steel, Size	Linear Foot
8093-8095	Pile Points	Each
8033	Test Piles	Linear Foot
8040	Loading Tests	Each
8060-8066	Piles-Precast Concrete, Size	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 605 ¾ PRESTRESSED AND PRECAST CONCRETE PRODUCTS

605.01 DESCRIPTION. Construct precast prestressed concrete members.

Provide complete members, including all steel and other materials. Members include I-beams, box beams, barrier walls, deck units (box beams and slab), box culverts, and piling and other structural items.

Fabricate according to the Department's Precast and Prestressed Concrete Products Inspector's Manual.

605.02 MATERIALS AND EQUIPMENT.

605.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

605.02.02 Steel Reinforcement. Conform to Section 811.

605.02.03 Prestressing Strands. Conform to Section 811.

605.02.04 Non-Shrink Grout. Conform to Subsection 601.03.

605.02.05 Forms. Conform to Subsection 601.02. Only use metal forms for prestressed sections, except that wooden bulkheads are acceptable. Ensure that all forms are accessible for vibrating, tamping, and consolidating the concrete. Only use non-petroleum based form release compounds.

605.02.06 Styrofoam. Use material the Engineer approves.

605.02.07 Cardboard. Use material the Engineer approves.

605.02.08 Batching Plant Equipment. Conform to Subsection 601.02.

605.02.09 Plant Certification. Ensure that all prestressed and precast concrete products supplied to Department of Highways' projects are manufactured in a Certified Plant.

A) Requirements. For a plant to become a Certified Plant, ensure that the producer has the following:

1) A production facility and other necessary equipment that conform to the Contract requirements.
2) A quality control program conforming to Division 100 of the Department's Precast and Prestressed Concrete Products Inspectors Manual.
3) An acceptable record of production of quality products.
4) Concrete technicians responsible for design of the concrete mixture and for performing quality control and process control testing, as required in Subsection 605.02.09 and Division 300 of the Department's Precast and Prestressed Concrete Products Inspectors Manual. Ensure that the concrete technicians are certified as ACI Level I and KRMCA Level II as awarded by the KRMCA.

   A Level I concrete technician is responsible for quality control tests such as air content, slump, and molding cylinders. A Level II concrete technician is responsible for supervising this testing.

   The Engineer may require retesting or re-certification as deemed necessary.

B) Application for Certification. Each year, ensure that the plant submits a written application for plant certification before January 1 to the Division of

Materials. Ensure that the plant submits an application for re-certification when transferring plant ownership.

Ensure that the plant includes the following items with the application:

1) Company name, plant address, the principle officers of the company, plant manager, production superintendent, and quality control supervisor.
2) The names and certification levels of the concrete technicians responsible for design of the concrete mixture and for performing the required quality control and process control testing.

The Department will place any plant that has not previously manufactured products for the Department on a one-year probationary period before qualifying it as a Certified Plant.

C) Additional Prestressed Concrete Certification. Ensure that all prestressed concrete members supplied to the Department are manufactured in a plant that is certified under the appropriate Prestressed Concrete Institute quality control program and is designated as a PCI Certified Plant.

605.02.10 Concrete Production. During production of concrete products, ensure that the producer conforms to all requirements of the Contract, and ensure that the concrete technicians perform all quality control and process control testing required by the Precast and Prestressed Concrete Products Inspectors Manual.

The Inspector will perform the inspection duties established by the Department for the item being produced, including but not limited to the duties in the Department's Precast and Prestressed Concrete Products Inspectors Manual. If, at any time, the producer is not abiding by the certification requirements, the Inspector will reject or accept those products not manufactured according to the Contract requirements as specified in Subsection 105.04. If a plant consistently produces products not conforming to the requirements as set forth in this agreement, the Department will revoke its certification, and the plant may not longer produce products for Department projects until the plant corrects all deficiencies and regains certification.

605.03 CONSTRUCTION. For prestressed concrete deck units, use Class D Modified concrete of either Type I or Type III cement, except do not allow the cement factor to exceed 800 pounds per cubic yard. Construct prestressed members other than concrete deck units of Class D concrete that uses either Type I or Type III cement, except do not allow the cement content to exceed 800 pounds per cubic yard.

When the ambient temperature is 71 °F or higher, add a water reducing and retarding admixture to the concrete mixture for prestressed concrete products. The Engineer may direct or allow the use of water reducing and retarding or water-reducing admixture.

605.03.01 Mixing and Batching. Conform to Subsection 601.03.

605.03.02 Forming. Construct formwork according to Subsection 601.03.

When the ambient temperature is above 80 °F, fog spray forms exposed to direct sunlight with water in order to cool the forms before placing the concrete mixture. When the ambient temperature is below 41 °F, heat forms left unprotected from the weather with steam or other Engineer approved methods, unless the temperature of the concrete mixture to be placed is maintained at 60 °F or greater.

Fabricate voids of styrofoam or from cardboard that has been treated with a waterproofing agent. Glue and band all voids made by stacking more than one piece of material to prevent separation during concreting operations. The Engineer will regard any evidence of separation as cause for rejection.

605.03.03 Casting. Cast all members in the horizontal position. Accurately place all steel, when required, as shown or directed. Dimensions shown from the face of concrete to steel are clear distances. Spacings are from center to center of steel. Place

and securely tie all steel reinforcement before placing concrete, unless the Engineer requires or allows otherwise.

For concrete batching equipment and procedures, conform to Section 601. Do not begin concreting operations when the wind chill factor at the site is consistently 0 °F or less.

Place concrete continuously in each section, vibrating internally or externally or both to consolidate the concrete. Overfill the forms, screed off the surplus concrete, and finish the top surfaces to a uniform, even texture comparable to the finish produced by the forms.

Give the top surfaces to be bonded to other concrete a rough finish. Initially, float finish the surfaces. Perform further finishing before the concrete takes its initial set, by scoring the tops of the members transversely at approximately 3-inch centers with a pointed tool. Remove any laitance present during the finishing operations.

Vibrate in a manner that avoids displacement of any steel or enclosures and segregation of the concrete. Properly embed steel and enclosures in the concrete.

The Department will allow casting of members at the job site or at any location away from the job site. The Engineer will inspect members at the site of the casting, but will make final acceptance according to Subsection 105.12.

Determine the compressive strength of the concrete from cylinders cast from concrete placed in the members and cured in the same manner as the concrete represented by the cylinders. Cast and test cylinders according to KM 64-305 and ASTM C 39, respectively.

Imprint the name or trademark of the fabricator of I beams, box beams, or deck units in the concrete near the abutment end of the right fascia beam or deck unit, on the beginning end of each bridge. Cast the name or trademark into the concrete according to Subsection 601.03.19 for the plate used to imprint the construction date.

The Department will inspect, sample, and test precast units to determine their acceptability. The fabricator is responsible for providing quality control personnel as necessary to ensure the work performed complies with all requirements of the Contract.

Ensure that fabricators of prestressed concrete members furnish, as part of their quality control equipment, a pachometer for determining the depth of concrete cover over steel reinforcement. Furnish a meter that is acceptable to the Engineer. Make the pachometer available for use by both the fabricator's quality control personnel and by the Inspectors. Instead of tying, the Department will allow tack welding steel reinforcement in prestressed or precast concrete members, except for prestressing steel.

605.03.04 Tack Welding. If tack welding steel reinforcement, conform to the following conditions.

1) Indicate any proposed tack welding of steel reinforcement in prestressed members on the shop drawings.
2) Do not tack weld on the portion of hairpin stirrups in the web area of I beams, or on any steel reinforcement located in the top 5 1/2 inches of box beams.
3) Tack weld only at intersections of bars. Do not splice bars by tack welding. Although there are no numerical strength requirements for the completed tack welds, ensure that they adequately hold the crossing bars in their true position while placing concrete. Use as low a current as possible to preclude notching or undercutting and still provide a weld of the intended strength. The Department will reject notched or undercut damaged bars. Replace rejected bars as the Engineer directs.
4) Tack weld either by the shielded metal-arc process using only electrodes with low hydrogen classifications E7015, E7016, E7018, E7028, E9015, E9016, E9018, or E9028 according to AWS A5.1 or A5.5 as applicable; or by the gas metal arc process using electrode classification ER70S according to AWS A5.18. Only tack weld when the base metal temperature is above 35 °F. Either purchase electrodes having low hydrogen coverings in hermetically sealed containers or dry them for at least 2 hours at a temperature between 450 and

500 °F before using them. For those that conform to AWS A5.5, dry for at least one hour at temperatures between 700 and 800 °F before using them. Immediately after drying, store electrodes in a storage oven held at a temperature of at least 250 °F. Before using, re-dry any E70 electrodes that are not used within 4 hours or E90 electrodes not used within one hour after removal from sealed storage or drying oven. Do not use any electrodes that have been wet.

5) Only use tack welding procedures and employ tack welders that are qualified biennially by the Division of Materials by tests as prescribed below. Use the same bar stock and type of tack welding equipment that is required for fabrication of the steel in qualifying tack welding procedures and tack welders. To qualify tack welding procedures, prepare and test 2 sample tack welds of the following sequence: #3 to #6T, #6 to #3T, #4 Epoxy to #5T, and #5 Epoxy #4T, to where T is the short bar of the welded intersection. Subject each sample to a tensile test across the point of the tack weld. Each sample must meet the minimum requirement for tensile and yield strength of the bar stock.

6) To qualify tack welders, prepare and test samples in the same manner as specified above for qualification of tack welding procedures. Prepare tack welds for qualifying procedures and tack welders in the presence of the Engineer. Request that the Engineer conduct such inspection at least 5 days in advance of welding the bar reinforcement with the welders being qualified. Assemble all necessary equipment, personnel, and materials, and perform any experimental work to qualify tack welders and tack welding procedures in a reasonably short and continuous period of time. The Department will not disqualify the tack welding procedure or the tack welder for failure to conform to the percentage of elongation specified for the steel bars used.

7) Tack weld hair-pin stirrups and longitudinal bars according to ANSI/AWS D1.4, Table 5.2 as follows:

MINIMUM PREHEAT AND INTERPASS TEMPERATURE [(1),(2)]		
Carbon Equivalent[(3),(4)] Range, %	Size of Reinforcing Bar	Shielded Metal Arc Welding with Low Hydrogen Electrodes, Gas Metal Welding, or Flux Cored Arc Welding Minimum Temperature °F
Up to 0.40	Up to 11 Inclusive	none[(5)]
	14, 18	50
Over 0.40 to 0.45 Inclusive	Up to 11 Inclusive	none[(5)]
	14, 18	100
Over 0.45 to 0.55 Inclusive	Up to 6 Inclusive	none[(5)]
	7 to 11 Inclusive	50
	14, 18	200
Over 0.55 to 0.65 Inclusive	Up to 6 Inclusive	100
	7 to 11 Inclusive	200
	14, 18	300
Over 0.65 to 0.75	Up to 6 Inclusive	300
	7 to 18 Inclusive	400
Over 0.75	7 to 18 Inclusive	500

[(1)] *When reinforcing steel is to be welded to main structural steel, conform to ANSI/AASHTO/AWS D1.5-88, Table 4.4, "Minimum Preheat and Interpass Temperature" for preheat requirements of the structural steel. Conform to the higher minimum preheat requirement of the 2 tables. Exercise extreme*

caution when welding reinforcing steel to quenched and tempered steels, satisfy the preheat requirements for both. If not possible, do not use welding to join the two base metals.

(2) *Do not weld when the ambient temperature is lower than 0 °F. When the base metal is below the temperature listed for the welding process being used and the size and carbon equivalent range of the bar being welded, preheat so the cross section of the bar for not less than 6 inches on each side of the joint is at or above the specified minimum temperature. Ensure preheat and interpass temperatures are sufficient to prevent crack formation.*

(3) *After welding is complete, allow bars to cool naturally to ambient temperature. Do not accelerate cooling.*

(4) *Determine the carbon equivalent of as follows:*

(a) *Where it is impractical to obtain chemical analysis, assume the carbon equivalent to be above 0.75%. Ensure certified prestressed plant furnishes on the mill test report, the carbon equivalent for each heat of reinforcing steel intended to be tack welded.*

(b) *For all steel bars, except those designated as ASTM A706, calculate the carbon equivalent using the chemical composition, as reported in the mill test report, using the following formula:*

$$C.E. = \%C + \%Mn/6 \qquad \text{(Eq. 1)}$$

(c) *For steel bars designated ASTM A706, calculate the carbon equivalent using the following formula:*

$$C.E. = \%C + \%Mn/6 + \%Cu/40 + \%Ni/20 + \%Cr/10 - \%Mo/50 - \%V/10 \qquad \text{(Eq. 2)}$$

Ensure the carbon equivalent does not exceed 0.55% (for ASTM A706 bars only).

(d) *When the base metal is below 32 °F, preheat it to at least 68 °F and maintain at this temperature during welding.*

605.03.05 Special Requirements for Prestress Plants.

A) Hot Weather Production. In addition to the requirements of Subsection 605.03, ensure that the producer applies the following requirements to outdoor prestress operations:

1) When the ambient temperature is above 80 °F sprinkle or fog spray coarse aggregates.
2) Discontinue concreting operations when ambient temperatures are between 90 and 100 °F if the producer cannot effectively maintain form and concrete temperatures below 90 °F.
3) Discontinue concreting operations when ambient temperatures are above 100 °F.

B) Drawings. Have the producer submit drawings conforming to applicable requirements of Subsection 607.03 for prestressed girders. Include with the shop drawings a detailed drawing, including the total number of stirrups, for each different mark number and a diagram of the detensioning procedure. The Department will not require reproducible drawings. Obtain the Department's completed drawing review prior to releasing fabrication.

C) Safety Measures. Ensure that the producer takes effective safety measures to prevent injuries to personnel due to the breakage of strands or failure of anchorage devices during the tensioning operations. Ensure that the

producer provides adequate protection that allows the Inspector to perform his normal duties. The Inspector will report any safety precautions deemed inadequate to the Division of Materials. The Inspector will abide by the safety rules established by the producer, provided that they do not interfere with his normal duties.

D) Prestressing. Ensure that the producer performs prestressing by pretensioning and provides a skilled technician knowledgeable of the pretensioning system used.

Ensure that the producer conforms to the following:

1) Uses approved jacking equipment to perform prestressing.
2) When using hydraulic jacks, equips them with calibrated pressure gages. Calibrates the combination of jack and gage to an accuracy of ± 2 percent, and furnishes a graph or table showing the calibration to the Engineer. If using other types of jacks, furnishes calibrated proving rings or other devices to accurately determine jacking forces.
3) Accurately holds prestressing elements in position to stress by jacks.
4) Applies an initial force to each strand in beams or girders such as to develop a stress of 189,000 psi or such other stress as specified in the Plans.
5) Maintains a record of the jacking force and elongations produced thereby.
6) If desired, cast several units for precast sections in one continuous line, but stress them one at a time.
7) Does not transfer prestressing forces to any member or release end anchors before the concrete has attained a minimum compressive strength of 4,000 psi, as determined by tests of standard cylinders cured identically as the member. The Department may require a higher strength.
8) Removes forms and detensions prestressed members immediately after discontinuing steam curing or heat curing while the concrete is still warm and moist, when using either of these methods for curing.
9) Cuts or releases the elements in an order that minimizes the lateral eccentricity of the prestressing.
10) The Engineer will reject beams or girders having honeycomb of such extent to affect their strength or resistance to deterioration.
11) Makes an allowance of 0.0005 times the length for shortening of beams and girders as a result of shrinkage and elastic change.

E) Curing. Cure according to Subsection 605.03.06 except the producer may discontinue curing after the concrete reaches the detensioning strength.

F) Removal From Forms. The producer may remove and store precast, prestressed members from the casting beds after the prestress force has been applied, provided the Engineer approves arrangements for curing and protecting. Ensure that the producer conforms to the following:

1) Fills all air voids in the inclined surfaces of all I beams with grout.
2) Ensures that strand hold-down devices that remain in place are either a minimum of 1/2 inch from the surface of the concrete or are galvanized.
3) Patches all cavities.
4) The producer may use other type devices when the Engineer approves them. Complete all finishing operations on prestressed bridge beams within 48 hours of detensioning, except masonry coating, curbs, and damage repair as the Engineer directs.

605.03.06 Curing. Cure members either by water curing according to Subsection 601.03.17 or by rapid curing with low pressure steam or radiant heat.

Perform low pressure steam curing or radiant heat curing under an enclosure capable of adequately containing the live steam or radiant heat. Use enclosures that

allow free circulation of steam or heat about the sides, ends, and tops of members and are constructed to contain the live steam with a minimum moisture loss. The Department will allow the use of tarpaulins or similar flexible covers that remain in good repair. Secure the tarpaulins in a manner that prevents the loss of significant steam and moisture. Allow concrete to attain its initial set before applying the steam or heat. After placing the concrete, allow an initial set period of not less than 2 hours before applying the steam or heat. When using water reducing and retarding admixtures, increase the initial set period to 4 hours. The Department will allow determination of the time of initial set using ASTM C 403 and waive the time limits specified herein when the initial set has been reached as determined by the referenced test. Prevent surface drying during the period between placing the concrete and applying the steam or heat by covering the members after casting or by keeping the exposed surfaces wet with a fog spray or a double layer of wet burlap. During the waiting period, do not allow the temperature within the curing chamber to fall below 50 °F. Use live steam or radiant heat to maintain the curing chamber at the proper minimum temperature.

During the initial application of live steam or radiant heat, allow the ambient temperature within the curing enclosure to increase at an average rate not exceeding 40 °F per hour until reaching the curing temperature within the enclosure. Do not allow the maximum curing temperature within the enclosure to exceed 160 °F.

Apply live steam on the concrete forms in a manner that does not cause localized high temperatures.

Apply radiant heat using pipes circulating steam, hot oil, or hot water. Perform radiant heat curing under a suitable enclosure to contain the heat, and minimize moisture loss by covering all exposed concrete surfaces with a plastic sheeting. Provide a method of maintaining moisture satisfactory to the Engineer.

Water cure precast, non-prestressed, non-post-tensioned items for 3 days or rapid cure them with steam or heat overnight. The Department will allow curing to cease when the acceptance strength is reached as shown by test cylinders.

605.03.07 Removal of Forms and Surface Finish. The Department will allow the removal of side forms at any time when no distortion, slump, or misalignment of the concrete will result. Ensure that all surfaces are free from rough, open, or honeycombed areas, and appreciable depressions or projections. Finish or chamfer edges as directed. When removing the forms, avoid spalling or otherwise damaging the concrete. Finish members that will be exposed in the finished work according to Subsection 601.03.18. Repair vents opened to relieve air pressure in box beams during curing using non-shrink grout.

605.03.08 Dimensional Tolerances. Ensure that the producer furnishes members within the tolerances of the following tables. The Engineer will condition final acceptance upon satisfactory placement of the units in the structure.

I-BEAMS, BOX BEAMS WITH CAST-IN-PLACE SLAB, AND PRECAST BARRIER UNITS	
Depth (flanges, web, and fillets)	± 1/4 inch
Depth (overall)	+ 1/2 inch to – 1/4 inch
Width (flanges and fillets)	+ 3/8 inch to – 1/4 inch
Width (web)	+ 3/8 inch to – 1/4 inch
Length of Beam	± 1/8 inch per 10 feet or 3/4 inch, whichever is greater
Exposed Beam Ends (deviation from square or designated skew)	Horizontal ± 1/4 inch; Vertical ± 1/8 inch per foot of beam height
Side Inserts (spacing between centers of inserts and from the centers of inserts to the ends of the beams)	± 1/2 inch
Bearing Plate (spacing between the centers of bearing plates)	± 1/8 inch per 10 feet or 1/2 inch, whichever is greater
Bearing Plate (spacing from the centers of bearing plates to the ends of the beams)	± 1/4 inch
Bearing Plate or Bearing Area (deviation from a level plane)	± 1/8 inch
Stirrup Bars (projection above top of beam when design projection is more than 3 inches)	± 3/4 inch
Stirrup Bars (projection above top of beam when design projection is 3 inches or less)	± 1/2 inch
Stirrup Bars (long, spacing, anchorage zone)	± 1/2 inch
Stirrup Bars (long, spacing)	± 1 inch
End Stirrup Bars	Not more than 2 inches from the end of the beam
Horizontal Alignment (deviation from a straight line parallel to the centerline of beam)	1/8 inch per 10 feet
Camber of precast barrier units	± 1/4 inch per 10 feet
Camber differential between adjacent beams	1/8 inch per 10 feet of span to 1 inch max.
Center of gravity of strand group	± 1/4 inch
Strand positioning	± 1/4 inch
Center of gravity of depressed stand group at the end of beam	± 1/2 inch
Position of hold-down points for depressed stands-longitudinal	± 6 inches
Position of handling devices-longitudinal	± 6 inches
Position of material for debonding of strands	± 1 inch

DECK UNITS (Box Beams and Slabs)	
Depth (top slab, box beam)	± 1/2 inch
Depth (bottom slab, box beam)	± 1/2 inch
Depth (overall)	± 1/4 inch
Width (web, box beam)	± 3/8 inch
Width (overall)	± 1/4 inch
Length	± 1/8 inch per 10 feet or 3/4 inch, whichever is greater
Void position-longitudinal (flat slab)	± 1/2 inch from end of void to center tie hole; ± 1 inch adjacent to end block
Void position-transverse and vertical (flat slab)	± 1/2 inch
Square ends (deviation from square)	± 1/4 inch
Skew ends (deviation from designated skew) Skew angle equal to or less than 30° Skew angle greater than 30°	± 1/2 inch
Bearing plate or bearing area plane (deviation from level plane) (Bearing plate or bearing area plane must be an evenly distributed 80 percent of true plane, when tested with a straightedge.)	± 1/8 inch
Horizontal alignment (deviation from a line parallel to the centerline of member)	1/4 inch, up to 40 feet length; 3/8 inch, over 40 feet and up to 60 feet in length; 1/2 inch, over 60 feet in length
Dowel tubes (spacing between the centers of tubes and from the centers of tubes to the ends and sides of the member)	± 1/2 inch
Tie rod tubes (spacing between the centers of tubes and from the centers of tubes to the ends of the member)	± 1/2 inch
Tie rod tubes (spacing between the centers of tubes to the bottom of the beam)	± 1/2 inch
Total width of deck	Theoretical width + 1/2 inch per joint
Camber differential between adjacent units	± 1/4 inch per 10 feet, 3/4 inch max.
Camber differential between high and low members in the same span	1 inch max.
Side inserts positioning	± 1/2 inch
Stirrup bar positioning	± 1 inch
Stirrup bar (long, spacing, anchorage zone)	± 1/2 inch
Strand positioning	± 1/4 inch
Handling device positioning	± 6 inches
Center of gravity of stand group	± 1/4 inch
Curbs placed separately on prestressed box beams (Applies to any portion 10 feet in length over the entire length of the beam)	± 1/4 inch per 10 feet
Position of material for debonding of strands	± 1 inch

PILING	
Width or diameter	- 1/4 + 3/8 inch
Head out of square	1/8 inch per 12 inches of width
Length of pile	± 1 1/2 inch
Horizontal alignment (deviation from a straight line parallel to the centerline of the pile)	1/8 inch per 10 feet
Void position-longitudinal	± 2 inches
Void position-transverse	± 1/2 inch
Void position-vertical	± 1/2 inch
Stirrup bars or spiral position	± 1 inch
Tendon positioning	± 1/4 inch
Center of gravity of strand group	± 1/4 inch
Handling device positioning	± 6 inches

605.03.09 Transportation, Storage, Handling, and Erection. Transport precast girders in an upright position, and keep the points of support and directions of the reactions with respect to the girder approximately the same during transportation and storage as when the girder is in its final position.

Prevent cracking or damage during storage, hoisting, and handling of precast units. Replace units damaged by improper storing or handling. Do not ship precast units to the Project prior to attaining the specified acceptance strength.

During erection of members, keep the bridge seats and tops of bearing devices free of foreign materials. While shifting members, lift members completely away from bearings.

Temporarily brace and tie each prestressed concrete I-beam, after erection, in a manner that will prevent sliding, tipping, or other movement that may result from high winds, creeping down grade, or other causes, until casting the diaphragms. Erect and brace at least 2 adjacent members in any one span before suspending operations for any one day.

Begin erecting deck units at the location designated or approved by the Engineer and proceed, one member at a time, across the roadway. After placing and fastening the units by transverse tie assemblies, fill longitudinal keys between the units with non-shrink grout and seal as specified in the Plans. Cure the non-shrink grout keys with 2 layers of wet burlap, or other approved covering, placed on the slab. Keep the non-shrink grout continuously moist for 3 or more calendar days, except cure commercial mixtures according to the manufacturer's instructions.

Do not place equipment used to lift deck units into place on a portion of the bridge which has been erected without obtaining the Engineer's approval.

605.04 MEASUREMENT. The Department will not measure the work required to qualify the tack welders and tack welding procedures for payment and will consider it incidental to the pay item for prestressed or precast members, except the Department will test the specimens at no expense to the fabricator.

605.04.01 Precast I-Beams. The Department will measure the quantity in linear feet. The Department will not measure bearing devices for payment and will consider them incidental to this item of work.

605.04.02 Precast Panels. The Department will measure the quantity according to Subsection 613.04.

605.04.03 Precast Box Beams. The Department will measure the quantity in linear feet. The Department will not measure bearing devices for payment and will

consider them incidental to this item of work.

605.04.04 Precast Concrete Median Barrier. The Department will measure the quantity according to Subsection 508.04.

605.04.05 Precast Piles. The Department will measure the quantity according to Subsection 604.04.

605.04.06 Prestressed Piles. The Department will measure the quantity according to Subsection 604.04.

605.04.07 Masonry Coating. The Department will measure the quantity according to Subsection 601.04.

605.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8631-8634, 8639	Precast PC I-Beam, Type	Linear Foot
8635-8638	Precast PC I-Beam Modified, Size	Linear Foot
8628	Precast PC Panels	See Subsection 613.05
8651-8672	Precast PC Box Beam, Designation	Linear Foot
1951-1955, 1958-1978, 1986-1999	Precast Concrete Median Barrier	See Subsection 508.05
8060-8066	Piles-Precast Concrete, Size	See Subsection 604.05
8080, 8082, 8086, 8096	Piles-Prestressed Concrete, Size	See Subsection 604.05
2998	Masonry Coating	See Subsection 601.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 606 ¾ BRIDGE RESTORATION AND WATERPROOFING WITH CONCRETE OVERLAYS

606.01 DESCRIPTION. This work shall consist of bridge deck restoration and waterproofing with latex concrete or low slump concrete overlays.

606.02 MATERIALS AND EQUIPMENT.

606.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

606.02.02 Latex Admixture. Conform to Subsection 841.

606.02.03 Epoxy for Epoxy-Sand Slurry. Conform to Section 826.

606.02.04 Sand for Epoxy-Sand Slurry. Conform to Subsection 804.

606.02.05 Mortar Sand. Conform to Subsection 804 (for Grout-Bond Coat).

606.02.06 Latex Grout. Conform to Section 601.02.

606.02.07 Joint Materials. Conform to Section 807.

A) Filler. Use preformed expansion joint filler, Type II (cork).
B) Sealers. Use rapid cure silicone with closed-cell polyethylene foam back-up rod compatible with silicone sealant.

606.02.08 Concrete Curing Material. Conform to Section 823.

606.02.09 Structural Steel. Conform to Subsection 811 (for expansion dams and joint build up).

606.02.10 Equipment. Conform to Subsection 601.02 with the following exceptions and additions:

A) Mechanical Scarifiers or Grinders. Furnish mechanical scarifiers or grinders designed specifically for scarifying bridge decks that the Engineer approves. Ensure that the scarifier or grinder is capable of producing a surface matching the existing slab cross section and that each pass of the machine matches the previous pass in elevation.
B) Hammers. Provide hammers weighing 40 pounds or less.
C) Mixers. In addition to the requirements of Subsection 601.02, furnish continuous mixers having a latex admixture supply portion equipped with a cumulative-type meter that can be read to the nearest 0.1 gallon. Furnish continuous mixers having a water supply portion equipped with a flow meter or other suitable device for calibrating the water supply, and a cumulative type water meter that can be read to the nearest 0.1 gallon. Ensure that the latex and water meters are readily accessible, accurate to within ± one percent, and legible.
D) Hand Tools. In addition to the requirements of Subsection 601.02, furnish sufficient hand tools for placement of stiff, plastic concrete capable of working the concrete down to approximately the correct elevation for striking off with a screed.
E) Finishing Machine.

1) Low Slump Concrete Overlays. Ensure that the design of the finishing machine and the appurtenant equipment is capable of positive machine screeding of the plastic concrete to within one inch of the face of the existing curbs, is of sufficient length to extend at least 6 inches beyond

an intended longitudinal joint, and is of sufficient length to extend at least 6 inches beyond the longitudinal edge of a previously placed overlay. Furnish a finishing machine that is capable of forward and reverse motion under positive control. Furnish a machine capable of raising the screeds to clear the screeded surface when traveling in reverse.

a) Support Rails. Furnish a finishing machine having support rails upon which the machine travels that is capable of being placed outside the area to be surfaced and capable of extending beyond each end of the bridge.
b) Strike off. Furnish a finishing machine equipped with a strike off to provide a uniform thickness of concrete in front of the screeds and with 2 oscillating screeds to provide the specified crown.
c) Anchorage. Furnish anchorage for the supporting rails that is substantial enough to provide for rigid horizontal and vertical stability of the rails.
d) Screeds. Ensure that the front oscillating screed is designed to thoroughly consolidate the concrete by vibration to the required density. Install identical vibrators along the length of the front oscillating screed at 5 feet intervals. Furnish a front oscillating screed with a bottom width of at least 5 inches and a turned up or rounded leading edge to minimize tearing of the surface of the plastic concrete. Furnish screeds with an effective weight of at least 75 pounds for each square foot of bottom surface area. Provide each screed with positive control of the vertical position, the angle of tilt, and the slope of the crown. Ensure that the final screed oscillates and finishes without vibration.

2) Latex Concrete Overlays. Furnish a Department approved machine.

F) Brooms. Furnish brooms having bristles of sufficient stiffness to treat the surface after finishing.

G) Air Compressors. Furnish air compressors equipped with separators and traps.

606.03 CONSTRUCTION.

606.03.01 Scheduling. Notify the Engineer at least 12 hours before placing concrete for the overlay. The Department will not grant a time extension for delay in placing concrete resulting from the Engineer receiving less than the 12-hour notice.

606.03.02 Weather Limitations. Construct the overlay during the night time hours when the ambient temperature will remain below 85 °F, the wind velocity is low, and hot conditions or rain are not expected. During hot weather, place the concrete when the ambient temperature falls to 85 °F or below. Complete placement of concrete before the ambient air temperature reaches 85 °F. Do not place concrete when the ambient temperature away from artificial heat is less that 45 °F and falling, except when using Type III cement. Keep all concrete at a temperature above 45 °F for at least 96 hours after placing. Make provisions for the uniform distribution of heat, and do not allow any area of the concrete surface to be heated to a temperature above 85 °F. To accomplish uniform distribution of heat during cold weather, provide housing, heating, or insulation methods that the Engineer approves. Do not place concrete during rain or drizzle. If it begins to rain or drizzle during placement, cease placement and finish and protect the material already in place.

606.03.03 Removal of Concrete, Restoration of Reinforcement and Cleaning. Treat the entire area of the deck between the curbs (roadway) and the ends of the structure (100 percent of the deck area) by machine preparation consisting of removal of concrete to a depth of at least 1/4 inch below the existing concrete surface.

Machine prepare with mechanical scarifiers or grinders. If satisfactory results are not achieved, the Engineer may direct that the work be performed with other equipment. The Department will not require machine preparation on endwalls.

Remove epoxy, asphalt, foreign surfaces, and unsound patches in a manner approved by the Engineer. Sound concrete patches are to be left in place as determined by the Engineer. Do not use equipment that may cause damage to the underlying concrete.

Remove all other concrete that the Engineer deems unsound. Remove concrete within areas where the depth of removal exceeds 1/4 inch with hammers or other small equipment. Do not damage any steel reinforcement. Remove concrete to a depth of 3/4 inch below any reinforcing bar which is more than 50 percent exposed or that appears not to be bonded to the existing concrete. Protect any underlying sound concrete and steel reinforcement. Ensure that the periphery of routed areas is as nearly vertical as possible. If the removal of unsound concrete extends through two thirds of the concrete slab or more, remove and replace the remaining sound concrete for full depth patching. Ensure that all exposed steel reinforcement is tied according to Subsection 602.03.04.

Remove all inferior concrete in the deteriorated and spalled areas near joints and all joint filler. Reform the joints to exact width and true alignment according to Subsection 609.03.04 for open joints except when a timber template is used, cover it with polyethylene sheeting.

Blast clean all exposed steel reinforcement and structural steel according to Subsection 606.03.04 to remove scale, rust, grease, oil and other material that would prevent adhesion of the concrete. Before placing concrete, replace or supplement deteriorated or damaged reinforcement as the Engineer directs. Remove all dust and chips of asphalt materials, concrete, or other debris and clean the entire area with compressed air. Ensure that the compressed air is free of detrimental quantities of water, oil, grease, or any other injurious substances. Do not allow leakage of oil, grease, gasoline, or other substances from the compressor or other equipment on the deck. Suspend protective sheeting such as plastic or tarpaulins under all equipment that leaks.

Remove all spalled or deteriorated concrete in curbs, sidewalks, and plinths to a minimum depth of one inch. Blast clean, coat with a grout-bond coat, and restore to the original section with overlay material. Seal with epoxy-sand slurry.

Partial and/or full depth removal of concrete may be accomplished using hydrodemolition. Calibrate the hydrodemolition machine to remove only unsound concrete. Test the machine on an area of concrete as directed by the Engineer. Use potable water with a rust inhibitor. Collect and strain all waste water from the hydrodemolition operation. After hydrodemolition operation, sound deck to ensure that all unsound concrete has been removed. Protect all traffic under or adjacent to work area. Protect structural steel paint. Prior to any hydrodemolition operation, submit a hydrodemolition plan, in writing, for approval by the Engineer. In the hydrodemolition plan state type of machine, water pressure settings and methods to collect and strain waste water and protect traffic and structural steel.

606.03.04 Blast Cleaning. Blast clean the entire area of the deck surface and vertical faces of curbs, barrier walls, and plinths up to a height of one inch above the top elevation of the overlay, and areas to receive epoxy-sand slurry to a bright, clean appearance that is free from curing compound, laitance, dust, dirt, oil, grease, asphalt material, paint, and all foreign matter. Perform blast cleaning of an area of the deck within the 24-hour period preceding placement of the overlay on the area. If the project is done under traffic, perform all blast cleaning within 12 hours prior to placement of the overlay. Perform blast cleaning according to the regulations specified in Subsection 107.01.04.

Protect the blast cleaned areas with white plastic before placement of the overlay. Blast clean contaminated areas and areas exposed more than 24 hours (12 hours when under traffic) again as the Engineer directs. Remove or roll the white plastic between the mixer truck rear wheels and the overlay placement.

Hydro blasting may be used in lieu blast cleaning. Use hand held high pressure

wands with potable water. Water blast the entire area of the deck. Use rush inhibiter in water. Prevent steel reinforcement from rusting.

606.03.05 Full Depth Patching. Fill full depth holes with Class M1 or M2 Concrete. Immediately before placing concrete, dampen and surface dry the contact surface. Then apply a grout-bond coat by vigorously scrubbing or brushing into the vertical surface of full depth routed areas. Proportion the grout mixture according to Subsection 601.03 using Type I cement. Carefully place the Class M1 or M2 concrete and tamp or vibrate into place. Rough-finish the full depth patched areas to an elevation corresponding to the scarified grade and cure for a period of no less than 7 calendar days, or until the overlay is placed, by means of a double layer of wetted burlap or similar material. If the full depth patch area is encompassed by an area of partial depth patching, finish the full depth concrete patch to an elevation corresponding to the bottom of the partial depth routed areas instead of the elevation of the scarified deck.

After the concrete has hardened sufficiently to maintain the proper shape, remove all joint templates. Avoid chipping or breaking down the edges of the repaired joint. Remove all forming material before completion of the project.

Provide temporary support for existing concrete handrails while removing and replacing full depth concrete. Submit the proposed method of supporting the handrails to the Engineer for approval before beginning work.

Blast clean the surfaces of all patched areas and remove sand before constructing the overlay. Complete all full depth patching in each lane before beginning overlay operations on that lane.

Place latex concrete overlays only when full depth patches have been placed for 24 hours or longer. Place low slump concrete overlays only after the full depth patches attain a compressive strength of 3,000 psi. Do not allow construction equipment on the full depth patches until they have attained a compressive strength of 4,000 psi.

606.03.06 Partial-Depth Patching. Fill areas in where concrete is routed to partial depths to the level of reinforcement or below with overlay material and prefill when a low slump concrete overlay is being used. Cure these areas as the overlay is cured until such time as the overlay is placed over the patch or the cure time expires. When latex concrete is used for the overlay, the Department may allow monolithic placement of the partial depth patches with the overlay.

606.03.07 Prohibited Field Welding. Do not perform welding on load carrying members of the bridge without the Engineer's written consent, and then only in the manner and at the locations designated.

606.03.08 Mixing and Placing. Mix concrete at the site by either batch or continuous mixers as the Engineer approves. Do not use truck mixers on low slump concrete overlays. Mix and deliver according to Subsections 601.03.07 and 601.03.08 except discharge within 20 minutes.

Submit to the Engineer for approval proposed methods for anchoring the finishing machine supporting rails to the deck.

Hold the formation of longitudinal joints and transverse joints to a minimum. When constructing longitudinal or transverse joints, thoroughly blast clean and coat with grout-bond coat material before placing plastic concrete against the hardened sides of the joints. Form longitudinal joints using a longitudinal header secured to the deck, 1/4 inch less in thickness than the overlay. Locate longitudinal joints along lane lines. After removal of the header, saw the overlay longitudinally 3 inches or more inside the formed edge and remove the portion of the overlay outside the saw cut before placing the adjacent portion of the overlay. The Department may allow alternate methods of constructing joints on latex overlays.

Produce the mixture at a uniform rate and perform finishing immediately after mixing.

606.03.09 Brooming. Immediately after finishing, broom the surface of the overlay transversely across the bridge deck from curb to curb. Texture the surface according to Subsection 609.03.10 immediately after finishing on new structure overlays, when specified in the Contract, and on Federal Aid projects.

606.03.10 Epoxy-Sand Slurry. After the overlay has been completed and cured, apply a thin coat (approximately 1/16 inch) of an epoxy-sand slurry to the 12 inches of the overlay adjacent to the curbs, concrete barrier walls, or other vertical walls. Extend the epoxy-sand slurry up the faces of the curbs and walls or other vertical walls and extend the epoxy-sand slurry up the faces and tops of the curbs and plinth according to the Standard Drawings. Thoroughly blast clean to a bright appearance and dry the areas to receive the epoxy-sand slurry before applying the slurry. Apply the slurry only after the deck has been dry for 24 hours. Place strips of masking tape along the joints to prevent the slurry from entering the joints and to ensure a straight line of slurry. Proportion the slurry as follows:

One Gallon of Component A
One Gallon of Component B
2 Gallons of dry, silica sand

The Engineer may allow minor adjustments in the quantity of sand in order to produce a more workable mixture. Thoroughly mix the ingredient materials for 3 to 5 minutes. Then spread the slurry and use a squeegee to completely fill the blast cleaned pitted areas, cracks, and rough surfaces. Finish the slurry to a thickness of no more than 1/16 inch. Sprinkle silica sand very lightly over the slurry to provide skid resistance.

The Department will allow placement of thoroughly mixed neat epoxy according to Subsection 510.03.

606.03.11 Cleaning and Sealing Joints. Rework each joint according to the Standard Drawings and as follows:

A) Joint Preparation. Remove any old sealant and joint filler. Use tools and techniques as approved by the Engineer.

When joint is dry, sandblast to remove all contaminants. Sandblast each joint a minimum of 2 passes, one for each face, with nozzle held at an angle to the joint face and within 1 to 2 inches of the pavement. After sandblasting, air blast each joint to remove sand and other contaminants. Air blast in only one direction to prevent recontamination of the joint. Compressed air used for air blasting will be at a pressure of at least 90 psi. The air compressor used will be equipped with traps capable of removing moisture, and oil from the air. Apply primer as recommended by the sealant's manufacturer.

B) Sealant Filler and Installation. Seal joints on same day that preparation occurs. When joints are prepared, but not sealed on the same day, sandblasting, removal of sand and debris, and primer application will be repeated as directed by the Engineer. Also any joint that has become contaminated will be recleaned as directed by the Engineer.

Prior to installation of sealant, each joint will be inspected by the Engineer for proper depth, width, alignment, and cleanliness. Install sealant at a minimum of 1/2 inch below the pavement face and in accordance with the manufacturers' recommendations.

606.03.12 Bridge End Transitions. Overlay the end sections of the bridge and finish as follows:

A) Rigid Approach. Set the finishing machine rails to provide a 50-foot transition on the ends of the bridge to match the finished grade of the overlay with the existing grade of the adjacent pavement. Remove the existing concrete as necessary to maintain the minimum specified thickness of the

overlay.

B) Non-Rigid Approach or a Rigid Approach with Asphalt Overlay. The Department will not require a transition.

606.03.13 Expansion Dam Treatment. Treat the existing expansion dams according to the Standard Drawings. The Department will not require painting of structural steel.

606.03.14 Material Hauling. Haul all material for latex concrete or low slump concrete overlays with vehicles which do not exceed the regulation for either the legal axle weights or axle spacing contained in 603 KAR 5-066. Prior to doing any overlay work on a structure, furnish to the Engineer a certified statement listing the empty weight of each hauling vehicle, axle weights when empty, axle weights when fully loaded, gross weight of each vehicle when loaded with a specific number of cubic yards, and the spacing of axles. The Engineer will use this information for the purpose of determining the allowable quantity of materials to be hauled. The Engineer will determine the allowable quantity of materials to be hauled based on the capacity and condition of the bridge after the removal of unsound concrete and prior to the placement of the overlay. Under no circumstances will the Department allow loads which exceed legal gross or axle load limits.

606.03.15 Damage to Structures. Take responsibility for all damage to the structure during construction until all work is completed, including the replacement of entire spans that fail as a result of this construction.

606.03.16 Unacceptable Work. When the Engineer deems necessary, the Department will core any areas of the overlay that display extensive cracking or other characteristics indicating the waterproofing effectiveness or expected life of the overlay may be reduced, or that the overlay may not be intimately bonded to the underlying deck.-Remove and replace with acceptable concrete all areas shown by the cores to either have cracks exceeding a depth of 1/4 inch or to not be intimately bonded to the underlying deck The Engineer may require removal and replacement without coring when significant cracking or lack of bond are apparent. Seal all cracks that are not significant enough to require removal of the overlay with a latex grout as the Engineer directs.

Correct all individual areas of hardened grooved concrete of 25 square feet or larger in which the texture is unsatisfactory using methods the Engineer approves.

606.03.17 Special Requirements for Latex Concrete Overlays.

A) Existing Bridges and New Structures.

1) Prewetting and Grout-Bond Coat. Thoroughly and continuously wet the blast cleaned areas to receive the overlay with water at least one hour before placing the overlay is started. Keep the areas wet and cooled with water until placing the overlay.

   Disperse or remove all accumulations of water before applying the grout-bond coat. Immediately ahead of placing the overlay mixture, thoroughly brush and scrub a thin coating of the latex concrete mixture to be used for the overlay onto the wetted surface as a grout-bond coat. Do not allow accumulations of coarser particles of the mixture which cannot be scrubbed into intimate contact with the surface.

   Apply the grout-bond coat only for a short distance in advance of placing the overlay. Do not allow the grout-bond coat to show any signs of drying before placing the overlay. Thoroughly recoat all areas showing signs of drying with fresh grout.

2) Proportioning and Requirements. Proportion as follows:

   When adjusting, ensure the mixture contains no less than 658 pounds per cubic yard of cement nor less than 24.5 gallons per cubic

yard of latex admixture.

Material	Quantity
Type I or Type III Cement	94 lbs
Latex Admixture	3.5 gal
Fine Aggregate	215 to 245 lbs[1]
Coarse Aggregate	165 to 195 lbs[1]
Water[2]	22 lbs[1]

[1] *Determine actual quantities and submit to the Engineer for approval.*
[2] *Includes free moisture on the fine and coarse aggregates.*

Furnish latex concrete with the following properties:

Property	Value
Slump[1]	4 – 6 in (KM 64-302)
Maximum Air Content	7% (KM 64-603)
Maximum W/C ratio[2]	0.40
7 - day compressive strength[3]	3,000 psi

[1] *The Department will perform the slump test 4 to 5 minutes after discharging from continuous type mixers.*
[2] *Consider all the non-solids in the latex admixture as part of the total water.*
[3] *Attain a 28-day compressive strength of 4,000 psi when compressive strength is tested at 28 days or later due to unusual circumstances.*

3) Placing, Consolidating, and Finishing the Overlay. Place the latex concrete overlay on the blast cleaned and prewetted deck immediately after applying the grout-bond coat. The Department will require a minimum latex concrete overlay thickness of one inch except on textured finishes. On textured finishes, the Department will require a minimum latex concrete overlay thickness of 1 1/4 inches. Ensure that the surface of the overlay conforms to the existing deck section while maintaining the minimum thickness. The Engineer will determine the deck section in the field, including the cross slope or crown. Pass the finishing machine over the existing deck prior to placing the overlay so that the Engineer can make measurements to ensure the proper cross slope and thickness.

Construct a transverse construction joint whenever placing is interrupted for any reason for 20 minutes or longer.

Ensure that the top surface of the overlay is uniform, smooth, and even-textured after finishing with a finishing machine. Thoroughly consolidate the concrete by vibration during the finishing operations. Ensure that the finished surface does not vary more than 1/8 inch in 10 feet as measured from a straightedge.

4) Curing. Immediately following the brooming operation or texturing, when texturing is required, cover the overlay with a thoroughly wetted layer of burlap immediately followed by a layer of polyethylene film 4 mils or more in thickness. Place sections or strips of burlap transversely, so that the overlay can be covered immediately after finishing or texturing. Leave the burlap and polyethylene film in place for at least 24 hours, and rewet the burlap if any signs of drying appear. Soak new burlap in water for at least 12 hours before the first use.

After the 24-hour period has ended, remove the burlap and polyethylene and allow the overlay to air-cure. Continue the air-cure for an additional 48 hours when using Type I cement or an additional 24

hours when using Type III cement at an ambient air temperature of 50 °F or more.

When the overlay has cured, give the tops of all longitudinal and transverse construction joints a thorough coating of grout of the same proportions as the latex concrete mixture used for the grout-bond coat material. Neatly and uniformly apply a 2-inch wide or wider coating to seal any minute cracks at these locations. Do not use epoxy -sand slurry to seal construction joints in lieu of grout.

The Department will allow the overlay to be opened to traffic as soon as curing is completed, all full depth patches are at least 7 days old or have attained a compressive strength of 4,000 psi, all construction joints are sealed, and gutterline and curb slurry is applied.

B) Special Requirements for New Structures. Construct according to A) above with the following exceptions and additions:

1) The Department will not require machine preparation of the top 1/4 inch of the deck.
2) Construct an overlay having a thickness of 1 1/2 inch.
3) Texture the overlay surface according to Subsection 609.03.10.
4) Perform operations in the following sequence: blast clean the existing deck; apply the grout-bond coat; mix, place, and consolidate the overlay mixture; finish; texture; cure; seal joints and cracks; then apply the epoxy-sand slurry.
5) Do not overlay the deck until it is at least 14 calendar days old.
6) When longitudinal construction joints are necessary, completely cure each section of the overlay before placing the adjacent section of the overlay.

606.03.18 Special Requirements for Low Slump Concrete Overlays.

A) Existing Bridges and New Structures.

1) Grout-Bond Coat. After the concrete surface has been blast cleaned and immediately before placing the concrete overlay mixture on the deck, vigorously scrub a thin coating of bonding grout into the dry, clean surface areas. Do no wet the surface areas before applying the grout. When the bridge deck is exposed to rain before the application of grout, delay the application until the bridge deck has dried a minimum of 4 hours and to the satisfaction of the Engineer. Proportion the grout with water and one part cement to one part mortar sand. Adjust the water to produce a wet slurry mixture to a consistency that is suitable to apply with a stiff brush or broom in a thin, even coating that will not run or puddle in low spots. Ensure that all areas of the blast cleaned deck receive a thorough, even coat of grout and that no excess grout collects in any areas. Apply the grout-bond coat only for a short distance in advance of placing the overlay. Do not allow the grout-bond coat to show any signs of drying before placing the overlay. Thoroughly recoat all areas showing signs of drying with fresh grout.
2) Proportioning and Requirements. Proportion low slump concrete to contain 8.75 bags of cement and no more than 35 gallons per cubic yard of water, including free moisture on the aggregates. Use enough water to maintain the required slump except do no use more than 35 gallons per cubic yard. Attain a 7-day compressive strength of 5,000 psi.

   Use an approximate percent fine to total aggregate of 50 as the Engineer approves. Incorporate the aggregate into the mixture as the Engineer directs.

   Add water-reducing admixture according to the manufacturer's recommendations.

Use the amount of air-entraining admixture necessary to achieve 5.5 ± 1.5 percent as determined according to KM 64-302.

Maintain a slump as determined according to KM 64-302 of 3/4 inch. The Department will perform the slump test 4 to 5 minutes after discharge from the mixer. The Department may allow a slump tolerance of ± 1/4 inch. The Department will not accept concrete having a slump of more than 1 inch. The Department may accept concrete having a slump less than 1/2 inch when the finishing machine can finish and consolidate the concrete according to the requirements of this section. Meet slump requirements at both the site of mixing and at the time of placing.

3) Placing, Consolidating, and Finishing the Overlay. Construct a low slump overlay having a minimum thickness of 1 1/2 inch. For overlays requiring-texturing, construct an overlay having a minimum thickness of 1 3/4 inch. The Engineer will determine the deck section in the field, including the cross slope or crown. Pass the finishing machine over the existing deck before placing the overlay so that the Engineer can make measurements to ensure the proper cross slope and thickness.

Promptly after applying the grout-bond coat, deposit the concrete on the deck. Then strike off and consolidated with the finishing machine.

The Department may require consolidation using hand-held vibrators when placing the mixture around steel reinforcement or structural steel members. Construct a transverse construction joint whenever placing is interrupted for 20 minutes or longer, for any reason.

First strike off the concrete at 1/4 inch or more above the specified final thickness, and then consolidated by vigorous mechanical vibration. The Department will determine the in-place density of the consolidated mixture by nuclear gages immediately following the screeding operation; the Department will adjust the determined in-place density using the following formula:

$$\text{Adjusted Density} = \frac{\text{in-place density} \times 0.945}{1.00 - \text{actual air content}^{(1)}}$$

(1) Express actual air content as a decimal.

Provide concrete with an adjusted density equal to or exceeding the target density of 99 percent of the maximum theoretical density calculated assuming an entrained air content of 5.5 percent. Immediately correct areas of concrete of deficient density by additional passes of the finishing machine. When any concrete cannot be consolidated to the specified density, remove it and replace with acceptable concrete. The Engineer may require hand finishing of the consolidated concrete with a float in order to produce a tight uniform surface.

4) Curing. Cure the overlay immediately after texturing or brooming. Cure with a double layer of wetted burlap. Place sections or strips of burlap transversely so that the overlay can be covered immediately after texturing. Continuously and thoroughly wet the burlap by automatic fogging or sprinkling equipment for at least 96 hours after the curing is started. Soak new burlap in water for at least 12 hours before the first use. Do not use membrane curing compound.

When the overlay has cured, give the tops of all longitudinal and transverse construction joints a thorough coating of grout of the same proportion and consistency as the grout-bond coat material. Neatly and uniformly apply a minimum 2-inch wide or wider coating to seal any minute cracks at these locations. Do not use epoxy-sand slurry to seal construction joints in lieu of grout. The Department will allow the overlay to be opened to traffic as soon as the curing is complete.

B) Special Requirements for New Structures. Construct according to Subsection A) above except for the following exceptions and additions:

1) The Department will not require machine preparation of the top 1/4 inch of the deck.
2) Construct an overlay of Contract specified thickness.
3) Texture the overlay surface according to Subsection 609.03.10.
4) Perform operations in the following sequence: blast clean the existing deck; apply the grout-bond coat; mix, place, and consolidate the overlay mixture; finish; texture; cure; seal joints and cracks; then apply the epoxy-sand slurry.
5) Do not overlay the deck until it is at least 14 calendar days old.
6) When longitudinal construction joints are necessary, completely cure each section of the overlay before placing the adjacent section of the overlay.

606.04 MEASUREMENT.

606.04.01 Removal of Epoxy, Asphalt, and Foreign Overlay. When listed as a bid item, the Department will measure the quantity in square yards.

606.04.02 Machine Preparation of Existing Slab. The Department will measure the quantity in square yards. The Department will not deduct parts of the deck that are not concrete such as deck drains, castings, expansion dams, and patches of foreign material for payment.

606.04.03 Concrete, Class M for Full-Depth Patching. The Department will measure the quantity in cubic yards. The Department will not measure removal of epoxy, asphalt, or foreign overlays for payment, unless listed as a bid item, and will consider it incidental to this item of work.

606.04.04 Structural Steel. The Department will measure the quantity according to Subsection 607.04.

606.04.05 Blast Cleaning. The Department will measure the quantity in square yards. Before placement of the overlay the Department will measure the area of the deck and the vertical part of the curb which will be in direct contact with the overlay (distance equal to the thickness of the overlay) plus one inch for payment. After placement of the overlay and before placement of the epoxy-sand slurry, the Department will measure the 12-inch width of the overlay and the sides and tops of curbs that are to receive the epoxy-sand slurry for payment. The Department will not measure any repeated blast cleaning for payment and will consider it incidental to this item of work.

606.04.06 Latex Concrete Overlay or Low Slump Concrete Overlay. The Department will measure the quantity in cubic yards as metered from an accurately calibrated mixing unit. The Department will measure the overlay partial depth patches and material used to patch spalled or deteriorated sections of curbs, sidewalks or plinths for payment. The Department will not measure the volume of material wasted or not incorporated in the work; grout used for the bond coat; crack sealing; or sand blast cleaning of reinforcing steel, longitudinal or transverse construction joints, areas of curbs, sidewalks, plinths, and other areas to be patched; or temporary supports for existing concrete handrails while removing and replacing full depth concrete for payment and will consider them incidental to this item of work.

606.04.07 Epoxy-Sand Slurry. The Department will measure the quantity in square yards. The Department will measure the entire area covered, including the 12-inch width of the overlay and the sides and tops of curbs, barrier walls, and plinths for payment.

606.04.08 Joint Sealing. The Department will measure the quantity in linear feet.

606.04.09 Hydrodemolition. When listed as a bid item, the Department will measure the quantity in square yards. Otherwise, the Department will not measure Hyrodemolition for payment and will consider it incidental to the overlay.

606.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8510	Removal of Epoxy, Asphalt, or Foreign Overlay	Square Yard
8551	Machine Preparation of Existing Slab	Square Yard
8526	Concrete, Class M for Full Depth Patching[(1)(3)]	Cubic Yard
8160	Structural Steel	See Subsection 607.05
8549	Blast Cleaning	Square Yard
8534	Concrete Overlay, Latex[(1)(2)(3)]	Cubic Yard
8535	Concrete Overlay, Low Slump[(1)(2)(3)]	Cubic Yard
8504	Epoxy-Sand Slurry	Square Yard
8540	Joint Sealing	Linear Foot
8550	Hydrodemolition	Square Yard

[(1)] *The Department will establish an adjusted unit price according to the supplemental formulas established for excessive overruns and underruns in Subsection 104.02.02 when this pay item is a major item and either an overrun or an underrun of more than 25 percent occurs.*

[(2)] *The Department will adjust the Contract unit price of overlays on new structures by the Schedule for Adjusted Payment for Thickness Deficiency. The adjusted quantity is equal to the measured quantity of the pay item multiplied by the Contract unit price for the pay item and the Price Adjustment. As an option, remove and replace overlays with an average defiency in thickness of no more than 1/2 inch with an overlay of the specified thickness at no cost to the Department. The Department will not make additional payment for average thicknesses of overlay in excess of the specified thickness.*

Schedule for Adjusted Payment for Thickness Deficiency

Average Thickness Deficiency (inches)	Price Adjustment (Percent of Contract Unit Bid Price)
0	100.0
1/16	95.0
1/8	90.0
3/16	80.0
1/4	70.0
5/16	57.5
3/8	45.0
7/16	25.0
1/2	0.0
Greater than 1/2	[(a)]

[(a)] *Remove and replace with an overlay of the specified thickness at no expense to the Department.*

[(3)] *When placing concrete on overlays is not begun within 2 hours after the scheduled time, the Department will deduct all engineering costs from the scheduled time until the time placing begins or is canceled from the Contract amount. The Department will not deduct engineering costs for uncontrollable*

circumstances such as inclement weather or equipment failure after placing begins.

The Department will consider payment as full compensation for all work required under this section.

SECTION 607 ¾ STRUCTURAL STEEL BRIDGES

607.01 DESCRIPTION. Build steel bridges, and perform other structural steel and miscellaneous metal construction.

The dimensions specified in the Plans are for a normal temperature of 60° F with dead load on the structure.

607.02 MATERIALS AND EQUIPMENT.

607.02.01 Paint. Conform to Section 821.

607.02.02 Structural Steels. Conform to Section 812.

607.02.03 Miscellaneous Metals. Conform to Section 813 for pins and rollers; bearing and expansion plates (rockers and expansion dams); aluminum; high-strength steel bolts, nuts, and washers; and welding. Use flat and smooth circular washers and square or rectangular beveled washers.

Ensure that bolt dimensions conform to the heavy hexagon structural bolt requirements of ANSI B18.2.1 and Section 813.

Ensure that nut dimensions conform to the heavy hexagon nut requirements of ANSI B18.2.2 and Section 813.

Identify heavy hexagonal structural bolts, manufactured according to ASTM A 325, on the top of the head by 3 radial lines, the legend "A 325", and the manufacturer's mark.

Identify Grade 2H nuts on at least one face by the marking "2H" or "2HB", and Grade DH by the marking "DH". Ensure that all nuts bear the manufacturer's identification mark.

Heavy hexagonal structural bolts have shorter thread lengths than other standard bolts. Depending on the amount of bolt length added to adjust for incremental stock lengths, the full thread may extend into the grip as much as 3/8 inch for the following bolt sizes; 1/2 inch, 5/8 inch, 3/4 inch, 7/8 inch, 1 1/4 inch and 1 1/2 inch, and as much as 1/2 inch for the following bolt sizes; one inch, 1 1/8 inch, and 1 3/8 inch. The fabricator may include some of the thread run-out into the plane of the shear. When the thickness of an outside part adjacent to the nut is less than these values, the fabricator may use the next increment of bolt length together with a sufficient number of flat circular washers to ensure full seating of the nut.

607.02.04 Wrenches. Use manual or power torque wrenches. Use power wrenches of adequate capacity and of sufficient air supply to perform the required tightening of bolts in approximately 10 seconds.

607.02.05 Direct Tension Indicators. When specified on the plans, use direct tension indicators consisting of a hardened washer with protrusions on one face that flatten under bolt tension. Determine correct bolt tension by examining the gap between the washer and bolt head remaining after tightening.

Include with each shipment of direct tension indicators, reports of actual tests showing the bolt tension achieved when the indicators are loaded. Ensure that the bolt tension is ± 20 percent greater than the tension specified in the Bolt Tension table in Subsection 607.03.05. Furnish test reports for representative samples of each lot or heat and each size tension indicator in the shipment, and provide packaging that easily identifies individual lots or heats. The Department may perform any additional sampling or testing the Engineer deems necessary.

Mark the tension indicators with the correct grade (A 325 or A 490) to ensure ready verification on the job.

607.02.06 Tapes. Use only tapes that are correctly calibrated with NIST to ensure correct fit of the work.

607.03 CONSTRUCTION.

607.03.01 Shop Drawings and Welding Procedures. Submit to the Division of Bridge Design detailed shop drawings and welding procedures. The Department will furnish plans showing sufficient details to prepare detailed shop drawings. Include welding procedures and details, when required, as part of the shop drawings. The Department will not consider the shop drawing review process to be complete without the submittal of welding procedures. Make all drawings on sheets of 0003 inch minimum thickness mylar film, 22 inches or 24 inches wide by 36 inches in length. Ensure that final drawings provide clear, sharp lines on prints. If applicable, use photo reproductions on photo sensitive film. Submit to the Division of Bridge Design 3 full or half size sets (6 for railroad bridges) of prints of the detailed shop drawings and welding procedures. The Division of Bridge Design will return one set of reviewed shop drawings with all required corrections noted. When corrections are necessary, submit 3 full or half size sets of prints of the corrected drawings. After final review, furnish to the Division of Bridge Design 10 full or half size sets of correct shop drawing prints. After fabrication is complete and the Engineer has approved the structural steel for shipment, furnish to the Engineer one full-size set of the reviewed shop drawings, including the welding procedures, which will produce clear prints and microfilms.

Do not make any changes to any drawing after the Engineer has reviewed it without the Engineer's written approval or written direction.

Only make substitutions of sections different from those shown on the drawings when the Engineer approves in writing.

Although the drawings may have been reviewed, take responsibility for the correctness of the drawings and for shop fits and field connections.

Take responsibility for any material ordered or work done before the Engineer reviews the drawings and welding procedures.

When design drawings differ from the shop drawings, the design drawings govern. When the requirements of this section differs from the shop drawings, the requirements of this section govern.

When the design drawings differ from the requirements of this section, the design drawings govern.

607.03.02 Workmanship.

A) Quality of Workmanship. Ensure that workmanship and finish are equal to the AISC best general practices in modern bridge shops.

B) Storage of Materials. Store structural material, either plain or fabricated, at the fabricating shop above ground upon platforms, skids, or other supports. Keep it free from dirt, grease, and other foreign matter and protect it from corrosion.

C) Straightening Materials. Before measuring or working rolled material, ensure that it is straight. When straightening is necessary, use methods that will not injure the metal. If sharp kinks and bends are evident, the Engineer will reject the material.

D) Finish. Provide a neat finish to the work. Shear, flame cut, grind, and chip carefully and accurately. Remove all burrs resulting from reaming or drilling.

607.03.03 Bolt Holes. Either punch or drill all holes for connections.

A) Punched Work. Punch all holes full-size except:

1) When there are more than 5 thicknesses, or when any of the main material is thicker than 3/4 inch in structural carbon steel, 5/8 inch in high-strength low alloy steel, or 1/2 inch in quenched and tempered alloy steel, sub-punch all holes, and ream them after assembling according to the requirements of C) below.
2) When the metal is thicker than the size of the bolts, drill the holes

according to the requirements of D) below.

3) Sub-punch and ream punched holes for stringer and floor beam field connections according to the requirements C) below, or sub-punch and ream to a metal template no less than one inch thick, without assembling.

4) Sub-punch and ream punched holes in field connections of main truss or arch members, skew portals, skew portal bracing plate, girder spans, continuous I-beam spans and rigid frames. Punch holes in connection plates or other parts of such members according to the requirements of C) below. Main truss members are the top and bottom chords, end posts, and web members forming the truss.

B) Punched Holes. Punch full-size holes 1/16 inch larger than the nominal diameter of the bolt. Do not allow the diameter of the die to exceed the diameter of the punch by more than 3/32 inch. Ensure that holes are cut cleanly without torn or ragged edges.

Punch holes so that, after assembling the component parts of a member and before reaming, a cylindrical pin 1/8 inch smaller than the nominal diameter of the punched hole may be passed through at least 75 of any group of 100 contiguous holes, or in like proportion for any smaller group of holes. When 10 percent or more of any group of 100 or fewer holes will not pass a pin 3/16 inch smaller than the nominal diameter of the punched hole, the Engineer will reject the mispunched pieces. Ream any holes that must be enlarged to admit bolts.

C) Sub-Punched and Reamed Holes. Punch sub-punched and reamed holes for bolts 3/16 inch smaller than the nominal diameter of the bolts. Ensure that the punch and die have the same relative sizes as specified for full size punched holes.

After assembling, ream sub-punched holes to a diameter of 1/16 inch larger than the nominal diameter of the bolt.

After assembling and firmly bolting pieces forming a built member perform reaming. Do not interchange reamed parts.

Ream holes with twist drills or with short taper reamers. Do not direct reamers by hand unless the Engineer approves. Use solvents, detergents, or other Engineer approved means before cleaning and painting, to thoroughly remove any oil or grease used as a reaming lubricant.

D) Drilled Holes. Ensure that drilled holes are 1/16 inch larger than the nominal diameter of the bolt. However, do not allow drilled holes for turned bolts to be more than 1/32 inch larger than the diameter of the finished bolt. Hold parts securely together while drilling assembled members.

Do not use numerical tape or electronic computer controlled drills unless the fabricator can provide a history showing defect free work of this type. This means that previous work was free of misdrilled holes caused by human errors or machine errors.

Drill holes according to the requirements of E) below. Submit to the Engineer for review with the shop drawings, the proposed procedure for drilling holes and assuring correct fit of members. When using numerical tape or electronic computer controlled drills, the Department will require shop assembly of at least 25 percent of the splices and at least 10 percent of floor beam and bracket main member connections as proof of accurate fit. In the event holes do not match as prescribed for the assembled pieces, assemble and ream all splices to fit and use metal templates to ream all other floor beam connections.

E) Accuracy of Reamed and Drilled Holes. Ensure that reamed or drilled holes are cylindrical and perpendicular to the member. After reaming or drilling, do not allow 85 of any group of 100 contiguous holes, or in like proportion for any smaller group of holes, to show an offset greater than 1/32 inch between adjacent thicknesses of metal.

F) Edge Distance of Bolts. Maintain a minimum distance from the center of any bolt to a sheared or flame cut edge of:

For one inch diameters, 1 3/4 inch.
For 7/8 inch diameters, 1 1/2 inch.
For 3/4 inch diameters, 1 1/4 inch.
For 5/8 inch diameters, 1 1/8 inch.

Ensure that the minimum distance from a rolled or planed edge, except in flanges of beams and channels, is:

For one inch diameters, 1 1/2 inch.
For 7/8 inch diameters, 1 1/4 inch.
For 3/4 inch diameters, 11/8 inch.
For 5/8 inch diameters, one inch.

In the flanges of beams and channels, ensure that the distance is:

For one inch fasteners, 1 1/4 inch.
For 7/8 inch fasteners, 1 1/8 inch.
For 3/4 inch fasteners, one inch.
For 5/8 inch fasteners, 7/8 inch.

Ensure that the maximum distance from any edge is 8 times the thickness of the thinnest outside plate, but does not exceed 5 inches. If the design drawings or the Engineer approves in writing, the Department will allow the use of oversize, short-slotted, and long-slotted holes according to the applicable structural steel design sections of the AASHTO Standard Specifications for Highway Bridges.

607.03.04 Shop Assembly and Material Traceability. Conform to the requirements of A) through D) below when not using numerical tape or electronic controlled drills; conform to E) below for all structural steel fabrication.

A) Assembling Trusses and Other Supports. Assemble trusses, arches, skew portals, skew portal bracing, girder spans, continuous I-beam spans, and rigid frames in the shop, and adjust the parts to line, camber, and fit for drilling or reaming of field connections.

B) Assembling Members. Thoroughly clean surfaces of metal in contact before assembly. Before reaming, assemble, well pin, and firmly draw together the parts of a member with bolts. When necessary, take apart assembled pieces to remove burrs and shavings produced by the reaming operation. Ensure that members are free from twists, bends, and other deformation.

Progressively shop assemble each longitudinal girder unit in no less than 3 contiguous sections adjusted to line, elevation, camber, and fit for drilling or reaming. Add at least one section at the rear end of the assembly when removing any section from the advancing end to ensure that the assembled portion of the structure is never less than 3 contiguous sections.

With connected parts assembled, either drill or ream other major bolted connections to the longitudinal girders in the shop or drill or ream to a metal template without assembly. Keep girder sections assembled until match marked and the Engineer has inspected and approved them.

Do not apply the assembly requirement for drilling or punching to connections for cross frames, diaphragms, lateral bracing, expansion dams, and other minor members.

C) Drifting of Holes. Only allow drifting during assembly to the extent that it brings the parts into position, but does not enlarge holes or distort the metal. Ream all holes that must be enlarged. Do not allow reaming to exceed the allowable tolerances.

D) Match Marking and Identification. Match mark connecting parts assembled in the shop for the purpose of reaming holes in field connections, according to the diagram shown on reviewed shop drawings. Match mark with 3/8 inch

steel, low stress riser dies. Indicate the location of match marks with a circle of paint around them. Use paint for indicating the location of match marks of a different color than that specified for shop paint.

E) Material Traceability. Ensure that the fabricator can demonstrate by a written procedure and by actual practice a method of material application and traceability, visible at least through the "fit up" operation, of all elements of a shipping piece. Ensure that the traceability method is capable of verifying proper material application as it relates to material specification designation; heat number and manufacturer; and material test reports for special requirements where required.

In addition, upon completion of fabrication, furnish the Department with a list of each component of each major load-carrying member and the heat number and manufacturer applicable to the material used for each, including sketches or diagrams when necessary. Provide this list on drafting film which will produce clear prints and microfilms, and submit it as part of the final shop drawings.

607.03.05 Bolted Connections Using High-Strength Steel Bolts.

A) General. Use friction type joint for all connections made with high-strength steel bolts.

To determine the required bolt length, add the grip, the adjustment for bolt size specified in the following table, 3/16 inch for each hardened flat washer, and 5/16 inch for each beveled washer. Grip is the total thickness of all connected materials, exclusive of washers. Then round up to the next 1/4 inch length.

BOLT SIZE ADJUSTMENT	
Nominal Bolt Size (inch)	Adjustment for Bolt Size (inch)
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

The adjustment in the above table allows for manufacturing tolerances and for the use of a heavy hexagon nut, and provides adequate "stick through" at the end of the bolt.

Provide adequate bolt length to allow for the exposure of at least 2 complete threads beyond the face of the nut after tightening.

Where necessary, clip washers on one side and no closer than 0.875 of the bolt diameter from the center of the washer.

Install bolts with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. The Department will allow the use of a flat washer when the abutting 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 the bolt axis. Where outer faces of the bolted parts have a slope of more than 1:20 with respect to a plane normal to the bolt axis, use a smooth beveled washer to compensate for lack of parallelism.

Ensure that bolted parts fit solidly together when assembled and are not separated by gaskets or any other interposed compressible material. Keep all joint surfaces free of dirt, burrs, and other defects that would prevent solid seating of the parts. Maintain contact surfaces free of oil, excess primer, and any other foreign matter.

Tighten all bolts, with properly calibrated wrenches, to provide at least the required minimum bolt tension values shown in the following table on completion of the joint.

BOLT TENSION		
Nominal Bolt Size (inch)	Minimum Bolt Tension ASTM A 325 Bolts (KIPS)	ASTM A 490 Bolts (KIPS)
1/2	12	15
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1 1/8	56	80
1 1/4	71	102
1 3/8	85	121
1 1/2	103	148

Set the calibrated wrenches used to provide the bolt tension specified in the table above so as to induce a bolt tension at least 5 percent in excess of this value.

Calibrate the wrenches twice daily by tightening, in a device capable of indicating actual bolt tension, no less than 3 typical bolts from the lot to be installed. Adjust power wrenches to stall or cut-out at the selected tension. When using manual torque wrenches, note the torque indication corresponding to the calibrating tension and use it in the installation of all bolts of the tested lot. When measuring torque, keep nuts in tightening motion. For short-grip bolts, the Department will allow calibration of wrenches by using direct-tension indicating washers with solid plates in a manner acceptable to the Engineer.

When using calibrated wrenches to install several bolts in a single joint, use the wrench to “touch up” bolts previously tightened, which may have been loosened by tightening of the subsequent bolts, until all are tightened to the prescribed amount.

When required, because of bolt entering and wrench operation clearances, tighten by turning the bolt while preventing the nut from rotating.

Furnish all tension machines and torque wrenches.

The Engineer will approve the procedure for calibration of wrenches.

Operate a manual torque wrench as the Engineer spot inspects installed bolts by observing the indicated torque. Use a torque wrench that has been calibrated as previously described in this subsection. When the Engineer is inspecting bolts, apply the inspecting wrench and its required torque to 10 percent of the bolts, but not less than 2 bolts, selected at random in a connection. The Engineer will accept the connection as properly tightened if the nut or bolt head does not turn when applying the required torque. When applying the required torque and a nut or bolt turns, the Engineer will test all bolts in the connection. Tighten all bolts whose nut or bolt head is turned by the required torque. The Engineer will reinspect all connections whose nut or bolt head is turned by the required torque. Alternatively, the Department will

allow retightening of all of the bolts in the connection and then resubmit the connection for the Engineer to inspect.

Store bolts and nuts in a dry location until use to protect them from contamination by foreign substances and the formation of rust. Only open shipping containers when needed for the work or for inspection purposes. Properly cover and store partially used containers to avoid contamination or exposure to moisture. Only install bolts and nuts that are clean and free of excessive rust. Do not consider a thin, tightly adhering rust as cause to require cleaning; however, apply a dry lubricant to the threads and bearing surface of all nuts to be used when either bolts or nuts show evidence of rust on the threads.

In lieu of using calibrated wrenches, the Department will allow the use of the turn-of-nut method to install bolts. During installation, regardless of the tightening method used, install bolts in all holes of the connection and bring them to a "snug tight" condition. Snug tight is the tightness that exists when the plies of the joint are in firm contact. Attain this condition either by a few impacts of an impact wrench or by the full effort of an ordinary spud wrench. When snug tightening, progress systematically from the most rigid part of the connection to the free edges, and then retighten the bolts of the connection in a similar systematic manner as necessary until all bolts are simultaneously snug tight and the connection is fully connected.

When using turn-of-nut tightening: Check a representative sample of not less than three bolt and nut assemblies of each diameter, length, and grade at the start of work in a device capable of indicating bolt tension. Use the test to demonstrate that the method for estimating the snug tight condition and controlling the turns from snug tight to be used by the bolting crew to develop a tension not less than 5 percent greater than the required tension specified in table above. After bringing to a "snug tight" condition, further tighten all bolts in the connection by the applicable amount of rotation specified in the following table. During the tightening operation, do not allow any rotation of the part not turned by the wrench. When tightening, progress systematically from the most rigid part of the joint to its free edges.

NUT ROTATION FROM SNUG TIGHT CONDITIONS[(1),(2),(3)]

Bolt Length (Under side of head to end of bolt.)	Disposition of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)	Both faces sloped not more than 1:20 from normal to the bolt axis (beveled washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn

[(1)] *Nut rotation is relative to bolt, regardless whether turning the element*

(nut or bolt). For installing bolts by half turn and less, the tolerance is ± 30°; for installing bolts by two-thirds turn and more, the tolerance is ± 45°.

(2) *Applicable only to connections in which all material within the turn grip of the bolt is steel.*

(3) *There is no research available to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, determine the required rotation by actual test in a suitable tension measuring device that simulates conditions of solidly fitted steel.*

Perform the rotational-capacity test described in Section 813 on each rotational-capacity lot prior to the start of bolt installation. Use hardened steel washers for the test even if they are not required in the actual installation procedures.

Verify that a visible lubricant is on the threads of galvanized nuts. Ensure that black bolts are oily to the touch when delivered and installed.

Before installing, clean and relubricate weathered or rusted bolts or nuts not conforming to the requirements of the rotational-capacity test. Retreat recleaned or relubricated nut and washer assemblies to conform to rotational-capacity test requirements before installing.

Use bolt, nut and washer (when required) combinations from the same lot used for the rotational-capacity test.

B) Direct Tension Indicators. When specified in the Plans, the Department will allow tightening all high-strength bolts in diameters of 1/2 inch through 1 1/4 inch inclusive, using direct tension indicators.

Before work begins, furnish the Engineer with the manufacturer's written installation instructions. Install direct tension indicators, and tighten the bolts according to these instructions.

Under normal conditions, install the tension indicator under the bolt head. If it is necessary to install the tension indicator under the nut, or to turn the head, install additional hardened washers according to the manufacturer's instructions. Use bolt lengths sufficient to accommodate the tension indicators and any additional washers required.

Do not reuse tension indicators. If it becomes necessary to loosen a previously tensioned bolt, discard and replace the tension indicator.

Furnish a device capable of measuring actual bolt tension. Before work begins, tighten at least 3 typical bolts and direct tension indicators in the device to the correct bolt tension. Keep the tension device available thereafter for additional checks when the Engineer deems necessary.

The Engineer will inspect bolt installation by inserting a feeler gage into the opening between adjacent flattened protrusions. The Engineer will examine at least 10 percent, but no less than 2, of the bolts in each connection. The Engineer will consider the installation acceptable if the gage will not enter the opening. The Engineer will not consider a zero gap as cause for rejection. If the gap is not uniform around the bolt, the Engineer will base acceptance on the average gap. That is, the Engineer will check the gap at several points around the bolt and if the gage will not enter the gap on at least half the tries, the installation will be acceptable.

Seal the gap behind the indicator completely with paint. If necessary, use moisture cure aluminum polyurethane intermediate coat at that location.

Furnish tension indicators in addition to washers when specified in the Contract.

607.03.06 Reuse of ASTM A 325 Bolts. The Department will allow the use of ASTM A 325 high-strength bolts one additional time after initially tightening them to specification tension, provided a close visual inspection indicates no distress in the bolt. This allows ASTM A 325 bolts to remain installed when tightened to specification tension twice, one time at original installation and one time at reuse. Do not consider touching up or retightening previously tightened bolts, which may have

been loosened by the tightening of adjacent bolts, as reuse, providing the snugging up continues from the initial position. When removing and loosening a bolt after it has been tightened to specification tension twice, discard the bolt and substitute a new bolt.

607.03.07 Welds. Perform all welding, when authorized, according to requirements specified in ANSI/AASHTO/AWS D1.5. Do not field weld, except as specified in the Plans, without the Engineer's written permission.

Ensure that in all cases, welders, welding operators, and tackers have been qualified by testing according to KM 64-110 within the previous 24 months of the time of actual weld performance.

607.03.08 Planing and Finishing.

A) Edge Planing. Plane to a depth of 1/4 inch all sheared edges of plates that are more than 5/8 inch thick and carry calculated stress. The Department will allow fillet re-entranting cuts before cutting.

B) Flame Cutting. Obtain a smooth surface free from cracks and notches, and an accurate profile using a mechanical guide and the Department will allow flame cutting of steel. Only perform flame cutting by hand where the Engineer approves. Smooth the surface by planing, chipping, or grinding. Adjust and manipulate the cutting flame to avoid cutting beyond the prescribed lines. Fillet re-entrant cuts to a radius of no less than 3/4 inch. Do not allow the surface roughness value of oxygen cut surfaces to be greater than that specified in ANSI/ASME B46.1, as follows:

Material Thickness	Surface Roughness Value
Less than 4 inch[1]	1,000 MU inch
4 to 8 inches	2,000 MU inch

[1] *for ends of members not subject to calculated stress at the ends, conform to the surface roughness value of 2,000 MU inches.*

Remove roughness exceeding these values and occasional notches or gouges no more than 3/6 inch deep, on otherwise satisfactory surfaces, by machining or grinding. Leave cut surfaces and edges free of slag. Remove irregularity or unevenness from defects to the oxygen cut surfaces with a slope not exceeding one in 10. Do not repair defects in oxygen-cut edges by welding except with the Engineer's approval. Perform such weld repairs by suitably preparing the defect, welding with low-hydrogen electrodes not exceeding 3/16 inch in diameter and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

Preheat members in the area to be cut to a minimum temperature of 200 °F to prevent edge cracks. Allow sufficient additional width to permit planing, chipping, or grinding to remove rough, burned, cracked, or otherwise defective edges. Grind corners at flame cut edges to a radius of at least 1/16 inch, and remove any evidence of edge cracking by planing, chipping, or grinding to a depth not exceeding 1/4 inch.

C) Heat Curving. The fabricator may either fabricate welded girders by flame cutting the flanges to the required curvature from rectangular plates before fitting and welding to the web, or fabricate welded girders or rolled beams by fabricating straight units and then, through the application of heat to the flange edges, induce the required curvature. Do not perform heat curving in beams or girders fabricated from steels that are manufactured to a specified minimum yield point greater than 50,000 psi or in beams or girders having a radius shorter than the minimum radius of curvature as determined by the procedures outlined in the AASHTO Standard Specifications for Highway Bridges.

When the Contract requires heat curving rolled beams or welded girders,

ensure that the work conforms to the following requirements.

Curve beams and girders by either continuous or V-type heating. For the continuous method, simultaneously heat a strip along the edge of the top and bottom flanges. Ensure that the strip is of sufficient width and temperature to obtain the required curvature. For the V-type heating, heat the top and bottom flanges in truncated triangular areas having their bases along the flange edge and spaced at regular intervals along each flange. Determine the spacing and temperature of the areas necessary to obtain the specified curvature. Apply heat along the top and bottom flanges at approximately the same rate.

For V-type heating, terminate the apex of each truncated triangular area applied to the inside of a flange surface just before reaching the juncture of the web and the flange. To avoid unnecessary web distortion, carefully heat the inside flange surfaces (the surfaces that intersect the web) to avoid applying heat directly to the web. When the radius of curvature is 1,000 feet or more, extend the apex of each truncated triangular heating area applied to the outside of a flange surface to the juncture of the flange and web. When the radius of curvature is less than 1,000 feet, extend the apex of each truncated triangular heating area applied to the outside of a flange surface past the web for a distance equal to 1/8 of the flange width or 3 inches, whichever is less. Ensure that each truncated triangular area has an included angle of approximately 15 to 30 degrees; however, do not allow the length of the base of each triangle to exceed 10 inches. Obtain the Engineer's approval before making any variation in the patterns as prescribed in this subsection.

For both types of heating, heat the flange areas that will be on the inside of the horizontal curve. Concurrently heat both surfaces of flanges when the flange thickness is 1 1/4 inch or greater. Space the heating patterns uniformly along the full length of each flange to produce a uniform arc of a circular curve in the member. When heating causes a chording effect that the Engineer judges not aesthetically pleasing, ensure that the fabricator reheats the member using additional heating patterns as required to obtain the desired results.

Conduct the heat-curving operation so that temperature of the steel does not exceed 1,150 °F. Confine heating to the patterns or areas specified in this section, and apply heat to bring the steel within the patterns or areas to the required temperature as rapidly as possible without overheating the steel. Consider any heating procedure which causes a portion of the steel to be heated to a temperature greater than 1,150 °F as destructive heating and as a possible cause for rejection of the steel. The fabricator may propose to the Engineer various means to reaccept, repair, or replace the steel rejected for overheating. The Engineer will review the fabricator's proposal. Do not artificially cool the steel until it has cooled naturally to 600 °F. Never quench the steel with water or water and air. When appropriate, cool the steel with dry compressed air only after it has cooled to 600 °F. The fabricator shall maintain temperature controls using temperature indicating crayons or other suitable means during heating and cooling of the steel.

The Department will allow heat curving of beams and girders with the web in either a vertical or horizontal position. When heat curving beams and girders in the vertical position, brace or support them in such a manner that the tendency to deflect laterally during the heat-curving process will not cause them to overturn.

When heat curving beams and girders in the horizontal position, support them near the ends and at intermediate points, as required, to obtain a uniform curvature. Do not allow the bending stress in the flanges due to the dead weight of a beam or girder to exceed 20,000 psi. When a beam or girder is positioned horizontally for heating, maintain intermediate safety catch blocks at the midlength within 2 inches of the flanges at all times during the heating process to guard against a sudden sag due to plastic flange buckling.

Heat curve beams and girders in the fabrication shop before painting.

The Department will allow performing of the heat-curving operation either before or after completing all required welding of transverse intermediate stiffeners. However, unless provisions are made for girder shrinkage, locate and attach all connection plates and bearing stiffeners after heat curving. When the Engineer requires longitudinal stiffeners heat curve or flame cut them to the required radius and then weld them to the curved girder. When attaching cover plates to rolled beams, attach them before heat curving when the total thickness of one flange and cover plates is less than 2 1/2 inches and the radius of curvature is greater than 1,000 feet. For other rolled beams with cover plates, heat curve the beams before attaching the cover plates; either heat curve or oxygen cut cover plates separately and then weld them to the curved beams.

Camber girders before heat curving. Obtain camber for rolled beams by heat-cambering methods approved by the Engineer. For girders, cut the web to the prescribed camber with suitable allowance for shrinkage due to cutting, welding, and heat curving. The curving process may tend to change the existing vertical camber. This change will be most pronounced when the top and bottom flanges are of unequal widths on a given transverse cross section. However, subject to approval of the Engineer, correct moderate deviations from the specified camber by a carefully supervised application of heat.

The Engineer will not measure horizontal curvature and vertical camber for final acceptance until after the fabricator has completed all welding and heating operations and the flanges have cooled to a uniform temperature. The Engineer will check the horizontal curvature in each edge of each flange with the beam or girder in the vertical position by measuring offsets from a stringline or wire or by using other suitable means. The Engineer will check camber by similar means.

D) Facing of Bearing Surfaces. Ensure that the surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete conforms to the surface roughness requirements as defined in ANSI/ASME B46.1, Part I:

Steel Slabs	ANSI 2000
Heavy plates in contact in shoes to be welded	ANSI 1000
Milled ends of compression members, stiffeners, and fillers	ANSI 500
Bridge rollers and rockers	ANSI 250
Pins and pin holes	ANSI 125
Sliding bearings	ANSI 125

With the exception of abutting joints and base plates, coat machine-finished surfaces with waterproof grease or other approved coating, as soon as practical after the Engineer has accepted the structural steel and before removing it from the shop. Apply one coat of an approved rust inhibiting primer compatible with the finished coat instead of zinc rich primer to machine finished surfaces that are to be painted.

E) Abutting Joints. Face abutting ends of compression members and girder flanges accurately to secure an even bearing when assembled in the structure. Rough finish ends of tension members at splices to secure close and neat but not contact fitting joints. Where joints are not faced, do not allow the opening to exceed 1/4 inch.

F) End Connection Angles. Build floor beams, stringers, and girders having end connection angles to the exact length specified in the Plans measured between the heels of the connection angles, with a permissible tolerance of + 0 to - 1/16 inch. Where the Contract requires continuity, face end connections. Do not allow the thickness of the connection angles to be less than 3/8 inch, or less than that shown on the detailed drawings.

G) Finished Members. Ensure that finished members are true to line and free from twists, bends, and open joints.

H) Web Plates. Cut web plates to provide for camber of the girder. At bolted web splices, do not allow clearance between ends of web plates to exceed 3/8 inch.

I) Fit of Stiffeners. Mill or grind bearing stiffeners of girders and stiffeners intended as supports for concentrated loads to secure an even bearing against the flanges. Ensure that intermediate stiffeners fit sufficiently tight to exclude water after being painted. Ensure that clearance between the ends of horizontal stiffeners and the sides of vertical stiffeners is one inch. Place bearing stiffeners plumb. Place intermediate stiffeners perpendicular to flanges.

J) Bent Plates. Ensure that unwelded, cold-bent, load-carrying, rolled-steel plates conform to the following:

1) Take them from stock plates so the bend line will be at right angles to the direction of rolling.
2) The radius of bends, measured to the concave face shall not be less and preferably shall be greater than shown as follows where "T" is the thickness of the plate:

Angle of Bend	Minimum Radius
61° to 90°	1.0T
91° to 120°	1.5T
121° to 150°	2.0T

When a shorter radius is essential, bend the plates while hot at a temperature not to exceed 1,150 °F; except for ASTM A 514 or ASTM A 517 steel, in which case bend at a temperature not to exceed 1,125 °F and requench and temper them. Ensure that hot-bent plates conform to the requirements of 1) above.

3) Before bending, round corners of the plate to a radius of 1/16 inch through that portion of the plate where bending is to occur.

607.03.09 Pins and Rollers.

A) General. Accurately turn pins and rollers to the dimensions shown on the drawings. Furnish pins and rollers that are straight, smooth, and free from flaws. Produce the final surface by a finishing cut, and provide a smooth finished surface with an ANSI 125 standard finish.

Forge and anneal pins and rollers more than 7 inches in diameter.

In pins larger than 7 inches in diameter, bore a hole 2 inches or more in diameter full length along the axis after the forging has cooled to a temperature below the critical range. Bore under suitable conditions to prevent injury by too rapid cooling and before being annealed.

Furnish 2 pilot nuts and 2 driving nuts for each size of pin.

B) Boring Pin Holes. Bore pin holes true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other. Produce the final surface by a finishing cut, and leave the finished surface smooth and polished.

Do not allow the outside-to-outside distance of holes in tension members and inside-to-inside distance of holes in compression members to vary from that specified by more than 1/32 inch. Bore holes in built-up members after completing connections.

C) Pin Clearances. Do not allow the diameter of the pin hole to exceed that of the pin by more than 1/64 inch for pins 5 inches or less in diameter, or 1/32 inch for larger pins.

607.03.10 Threads for Bolts and Pins. Furnish threads for bolts and pins that conform to the United States 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 be threaded 6 threads to the one inch, and except as required for high-strength steel bolts.

607.03.11 Annealing and Stress Relieving. For structural members indicated in the Contract to be annealed or normalized, finish machining, boring, and straightening after heat treatment. Normalize and anneal (full annealing) as specified in ASTM E 44. Maintain temperatures uniformly throughout the furnace during heating and cooling so that temperatures at points on the members will not differ by more than 100 °F at any one time.

Maintain a record of each furnace charge that identifies pieces in the charge and lists temperatures and schedule actually used. Provide proper instruments, including recording pyrometers, for determining temperatures of members in the furnace at any time. Make records of the treatment operation available to the Engineer.

Stress relieve members, such as bridge shoes, pedestals, or other parts built up by welding sections of plates together according to the requirements of AWS D1.5 when required by the Contract.

607.03.12 Forgings. Furnish forgings that are free from internal and external cracks and other harmful defects. The Engineer will determine the method of inspection.

607.03.13 Mill and Shop Inspection and Shipping.

A) Notice of Beginning Work. Designate to the Engineer within 30 days subsequent to the award of the Contract the locations of fabricating shops and estimated quantities of steel to be fabricated at each.

The Department will not allow structural steel to be fabricated in more than 2 fabricating locations (a location will be considered all shops within one city) unless approved in writing by the Engineer.

The Engineer will not allow any work to be done in the shop before granting authorization to proceed. Furnish the Department copies of mill tests and analyses reports of such structural shapes bearing the manufacturer's name and heat number. When such identification does not exist, the Engineer may require samples for test purposes be cut from the materials. When mill tests and analyses, or subsequent tests of samples, indicate material does not comply with this section, the Engineer will reject such materials. When the Engineer rejects materials, furnish suitable material.

B) Facilities for Inspection. Furnish all facilities for inspection of material and workmanship in the mill and shop, and allow the Inspector free access to necessary parts of the premises. Notify the Engineer when material is ready for shop inspection.

Furnish power and utilities for operating inspection equipment, provide shop space for inspection work, handle material as necessary, and enforce required safety precautions for radioactive exposure.

C) Mill Orders, Change Orders, Shipping Statements, Mill Test Reports, and Shop Bills. Furnish 3 copies of mill orders, change orders, mill shipping statements, mill test reports, fabricator's shop bills (when not attached to drawings), and shipping statements to the Engineer for all structural steel materials. Ensure that mill test reports show that all materials conform to this section and are signed by a responsible representative of the company. Include the weights of individual members on shipping statements.

D) Facilities for Testing. Furnish test specimens, and all labor, testing machines, and tools necessary to prepare specimens and make full size tests.

E) Rejections. The Inspector's initial acceptance of any material or finished members will not prevent the Engineer from subsequently rejecting material or finished members when he determines that they do not conform to the Contract.

F) Weighing of Members. When the Contract specifies that the Department will pay for any part of the material by weight, weigh the finished work in the

presence of the Inspector. Supply accurate scales and perform all work involved in handling and weighing various parts.

G) Marking and Shipping. Paint or mark each member with an erection mark for identification and furnish an erection diagram with erection marks shown thereon.

Mark the weights of members weighing more than 3 tons on the member. Load structural members on trucks or cars so that they may be transported and unloaded at their destination without being excessively stressed, deformed, or otherwise damaged. Ship girders and store them with the web vertical, unless the Engineer allows in writing.

Pack bolts of one length and diameter and loose nuts and washers of each size separately. Mark a list and description of contents on the outside of each container.

H) Handling Material. Conduct loading, transporting, unloading, and storing of structural material to maintain it clean and free from injury.

607.03.14 Field Inspection. When the substructure is constructed under a separate contract, establish lines and elevations for setting steel from the completed substructure. Obtain the Engineer's approval of the existing lines and elevations prior to submitting shop details for review. The Engineer's approval of the established lines and elevations does not relieve the substructure contractor from the responsibility for constructing the substructure to the lines and elevations shown.

Provide inspection facilities to inspect erection of structural steel. When the Contract does not require shop inspection of the structural steel, the Engineer will inspect the material and workmanship upon site delivery.

607.03.15 Field Storing and Handling Materials. Place material to be stored on blocking above ground. Maintain it clean and properly drained. Place uniform depth girders and beams upright. Support long members, such as columns and chords, on skids placed to prevent injury from deflection.

Use extreme care in handling the steel at all times to prevent damage of any parts. Insulate the steel from binding chains with approved softeners. Pad the hooks and slings used to hoist steel. Place the steel so that rubbing will not occur during shipment. Store the steel at the job site on pallets, or other means approved by the Engineer, so that it does not rest on the ground and so that its components do not fall or rest on each other.

607.03.16 Falsework, Erection Methods, and Equipment. Ensure falsework is properly designed by a Registered Professional Engineer. Construct and maintain falsework for the loads that will be placed thereon. When required, prepare and submit for review plans for falsework or for changes in an existing structure necessary for maintaining traffic. Although the Engineer has reviewed these plans, take responsibility for the falsework design.

Before starting work present for the Engineer's review, the proposed method of erection, and the proposed amount and character of equipment to use for erection. Although the Engineer has reviewed this method, take responsibility for safety and erection.

Provide the Engineer with a certification by a Registered Professional Engineer that falsework towers have been assembled according to the approved falsework drawings before placing loads on the falsework.

When placing falsework installations adjacent to an open public road, design and protect the falsework system from errant highway vehicles or from vibration forces caused by passing vehicles.

607.03.17 Bearings and Anchorages. Set all bearing assemblies level and to the elevations specified in the Plans. Make adjustments in the horizontal positions of bearing assemblies for temperature as the Engineer directs. Obtain full bearing on the concrete under bearing assemblies regardless of tolerances.

Set masonry plates and the bearing plates of bearing assemblies on ground

concrete surfaces, or elastomeric bearing pads, or on lead plates in conformance with the details specified in the Plans.

Immediately before setting bearing assemblies or masonry plates, thoroughly clean the surfaces of concrete and metal to be in contact.

Drill the anchor bolt holes to the depth and dimensions specified in the Plans, after properly setting the base plates. Keep the holes dry during freezing weather. Do not lead or grout anchor bolts until after assembly of each continuous unit or span. After placing the anchor bolts, pour molten lead into the holes and pack them so the holes will be completely filled flush to the top of the base plates. Heat anchor bolts prior to pouring the lead to ensure the lead reaches the bottom and to prevent premature cooling.

Ensure that the final adjustment and setting of expansion rockers, rollers, and anchor bolts take into consideration dead load elongation in the span and temperature at the time of setting. Normal temperature is considered 60 °F. Set rockers so as to be vertical at 60 °F, after applying all dead load. Adjust nuts on anchor bolts at the expansion ends of spans to allow free movement of the span.

When expansion devices such as rockers and expansion dams have been rigidly fixed to hold them in correct alignment, release them immediately upon completing concrete placement in the portion of the structure they are installed.

607.03.18 Straightening Bent Material. Straighten bent plates and angles or other shapes by methods that will not produce fracture or other injury. Do not heat the metal unless the Engineer allows, in which case do not heat to a higher temperature than 1,150 °F as determined by a temperature stick or crayon. After heating and straightening, cool the metal as slowly as possible. Following straightening, carefully inspect the surface of the metal for evidence of fracture. The Department will reject metal with sharp kinks and bends. Do not straighten material by direct hammering.

607.03.19 Field Assembling. Assemble parts accurately as shown, and follow all match marks. Handle material so no part will be bent, broken, or otherwise damaged. Do not injure or distort the members by hammering them. Clean bearing surfaces and surfaces to be in permanent contact before assembling the members. Unless erected by the cantilever method, erect truss spans on blocking that is placed to provide proper camber. Leave blocking in place until tension chord splices and all other truss connections are pinned and bolted, and then release it sufficiently from the falsework to bring compression chord joints into full bearing.

607.03.20 Pin Connections. Use pilot and driving nuts in driving pins. Drive pins so that members will take full bearing. Screw pin nuts tight and burr the threads at the face of the nut with a pointed tool.

607.03.21 Misfits. The Engineer will allow the correction of minor misfits using small amounts of reaming, cutting, and chipping. However, immediately report to the Engineer any error in shop fabrication or deformation resulting from handling and transportation that prevents proper assembly and fitting of parts by moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting. Obtain the Engineer's approval of the proposed method for correction. Make the correction in the Engineer's presence.

For beams or girders that do not conform to the plan camber and grade in the erected position, either adjust the depth of the concrete slab haunch over the steel supporting members or rework the girder camber to meet the plan grade and slab thickness. Do not allow shear connectors to penetrate the slab less than 2 inches.

607.03.22 Removal of Falsework. Upon completion of erection and before final acceptance, remove all falsework, excavated or useless materials, rubbish, and temporary buildings. Replace or renew any fences damaged and restore in an acceptable manner all property, both public and private, which may have been damaged during prosecution of work. Leave the bridge site and adjacent highway in a neat and presentable condition satisfactory to the Engineer. Remove all excavated

material or falsework placed in the stream channel during construction before final acceptance.

607.03.23 Cleaning and Painting.

A) General. Furnish a paint system consisting of one shop coat of zinc rich primer, one field coat of moisture cure aluminum polyurethane intermediate coat, and one field application of urethane finish coat. Furnish a paint system in which all coats are produced by the same manufacturer. Use tie coats and thinners only when specified or recommended in writing by the manufacturer or the Engineer. When using thinners and tie coats, mix according to the manufacturer's written recommendation.

Furnish copies of the manufacturer's technical data sheets, written safety instructions, and written application instructions to the Engineer for review and approval before beginning painting.

Submit written procedures for compliance with this subsection for cleaning and painting in both the shop and the field to the Engineer for approval before beginning work. Include at least the following:

1) Cleaning Methods and Equipment. Operating pressure ranges for blast cleaning and water wash equipment.
2) Painting Methods and Equipment. Methods of access for field painting, safety precautions, and traffic control. Address responsibility for damage due to overspray.
3) Storage and Handling. Methods and equipment for handling and storing painted truss members and other pieces to prevent coating damage to painted parts.
4) Paint Manufacturer's Special Instructions. Recommendations for cleaning primer coated surfaces. Address the possible need for a tie coat before application of the aluminum polyurethane intermediate coating. Recommendations for the preparation of aluminum polyurethane surfaces to ensure adequate bond of subsequent application of urethane finish coat considering chalking, catalytic blush, surface hard curing, and recoat window.
5) Quality Control Plan. Outline a plan for controlling the quality of the completed paint system. Include the following:

    a) Name and qualifications of painting supervisors.
    b) Assurance of authority and responsibility for painting supervisors to halt operations and make corrections upon discovery of non-conforming work.
    c) Methods of informing painting personnel of the written approved painting procedures and their responsibility to comply.

Apply paint only after it has been approved by the Department. The Department may sample and test the paint before delivery or after it is delivered to the project. When the paint is tested and approved before delivery, the Department will label the product containers to indicate approval for use. When the paint is tested and approved after delivery, it must be available for sampling and testing at least 10 calendar days prior to use. Store the paint according to Section 821. The Department will reject the paint when test results indicate that the material does not conform to the requirements of this section. Remove all rejected paint from the job before beginning any painting.

Mix coatings with a high shear mixer, such as Jiffy Mixer, or according to the manufacturer's instructions to obtain a smooth, lump-free consistency. Do not use paddle mixers or paint shakers unless recommended by the paint manufacturer. Mix in the original containers unless otherwise approved by the Engineer. Continue mixing until all of the metallic powder or pigment is in

suspension. Ensure that all of the solids that may have settled to the bottom of the container are thoroughly dispersed. When specified by the manufacturer's product data sheet or application instructions, continuously agitate the mixed primer until applying it.

Spread the paint coatings smoothly and uniformly allowing no excess paint to collect at any point. Paint the contacting surfaces of joints or connections.

When deemed unsatisfactory by the Engineer, remove, clean, and prepare again all paint work at any stage of its completion.

When necessary or requested by the Engineer, furnish a technical representative from the paint manufacturer to observe the initial application of all coatings used, to advise as to proper application techniques, and to determine that proper results are being obtained. Ensure that the technical representative is also available to visit the project at all times during the work if the Engineer requests or deems a visit is necessary.

Keep painted material under cover until the paint is dry or until weather conditions permit exposure. Apply paint only when the weather is cool enough so that blistering or formation of a porous film does not occur.

Apply paint coatings using spray nozzles and pressures recommended by the producer of the coating system to attain the specified dry film thickness.

Provide adequate separators and traps to remove all water and oil from compressed air. Perform blotter tests daily in the presence of the Inspector. Paint only when there is no evidence of moisture or oil in the air lines.

All mil thickness measurements are dry film thickness. Determine dry film thicknesses with a magnetic dry film thickness gage. Calibrate the dry film thickness gage on the blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness or with NIST calibration blocks. Use a Tooke film thickness gage to verify the coating thickness on all coats applied after the primer. The Engineer will reject the total coating system when the Tooke gage shows the primer coat to be less than the specified minimum thickness even when the total dry film thickness exceeds the total of the minimum for all coats.

If the application of the coating at the required thickness in one coat produces runs, bubbles, or sags, apply the coating in multiple passes of the spray gun. Separate the passes by several minutes. Where excessive coating thickness produces mud-cracking of the zinc rich prime in small areas, scrape back to soundly bonded coating and recoat the area to the required thickness. For large areas, re-clean and re-prime the surface.

Provide access for proper inspection of the cleaning and painting at both the fabrication plant and the construction site during all phases of work and for a period of at least 10 working days after completing each painting section. Furnish, erect, and move scaffolding or appropriate equipment approved by the Engineer, to allow the Inspector to closely inspect all surfaces. Use rubber rollers or other protective devices on scaffold fasteners. Do not use metal rollers or other types of fasteners that may mar or damage the freshly coated surfaces.

Comply with all Federal, State, and local regulations relative to environmental contamination, safety, and protection of persons and property.

B) Preparation for Shop Coating. After fabrication and immediately before painting, remove all areas of oil and grease with a solvent and blast clean all exposed surfaces of the metal, except where galvanized or metalized, according to SSPC-SP 10. The Engineer will base acceptance of the surface condition on photographic standards. Acceptance after blast cleaning and immediately before painting, will be according to Pictorial Standards A SP 10, B SP 10, or C SP 10, of SSPC Vis. 1. Ensure that the depth of the anchor texture of the blast-cleaned steel is 1.5 to 3 mils. Do not use a wash primer. Apply zinc coating within 24 hours after blast cleaning.

Remove all fins, tears, slivers, and burred or sharp edges that are present on steel members, and that appear during the blasting operation, by grinding and reblasting the area to achieve a 1.5 to 3 mils surface profile.

When removing scale, do not allow the hammers to scar the metal.

Use clean dry sand, steel shot, mineral grit, or manufactured grit for a blast cleaning abrasive. Remove all abrasive and coating residue from the steel surfaces with a good commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. When using double blowing, vacuum the top surfaces of all structural steel, including flanges, longitudinal stiffeners, splice plates, hangers, and all other surfaces after completing the double blowing operations. Blow the steel clean with an air line that has an in-line water trap, and ensure that the air is free of oil and water as it leaves the air line.

Apply paint only after the Engineer inspects and approves the surfaces.

Defer painting of galvanized surfaces as long as possible in order that the surfaces may weather. Before painting galvanized surfaces, treat according to ASTM D 2092 or treat with a solution composed of 2 fluid ounces of commercial muriatic acid added to 2 ounces each of copper chloride, copper nitrate, and sal ammoniac dissolved in one gallon of water. Prepare the solution in an earthen or glass vessel, never in a metal receptacle. Apply the solution with a wide flat brush. The galvanized surface will assume a very dark color, drying to a grayish film.

C) Application of Shop Coating. Apply one coat of zinc rich primer to all metal surfaces prior to shipping steel from the plant. Include surfaces that are to be field bolted in contact.

Apply paint only when the air temperature at the shop is 40 °F or greater, the surface temperature of the steel members to be painted is at least 5 °F above the dew point temperature, and the relative humidity at the site is between 30 and 85 percent. Do not apply paint to damp or frosted surfaces, nor when the air is misty.

Ensure that the dry film thickness of the prime coat is 3 mils with a tolerance of –0.5 mil and + 2.0 mils on all surfaces except those that are to be field bolted in contact or that will be in contact with concrete. Ensure that the dry film thickness on surfaces to be field bolted in contact or surfaces that will be in contact with concrete is 1.5 mils ± 0.5 mil except when the slip coefficient is based on a coating thickness of 5.0 mils. When the slip coefficient is based on a 5.0-mil thickness, if desired, apply the prime coat to the full specified thickness of 3.0 mils with a tolerance of –0.5 and + 2.0 mils.

If the prime coat is deficient in thickness, thoroughly clean with power washing equipment, then wire brush, vacuum and recoat according to B) above.

Protect freshly coated primed surfaces from subsequent blast cleaning operations. When damage occurs, thoroughly wire brush or if visible rust occurs, reblast to a near-white condition. Vacuum and reprime these surfaces by spraying.

Do not apply subsequent coats of paint over the primer until at least 72 hours have elapsed or until the film is dry throughout. Apply a shop coat of zinc rich primer to all steel surfaces that will be in contact with concrete and to surfaces that will be inaccessible after field assembly. Apply the aluminum polyurethane intermediate coating and urethane finish coat in the shop before assembly or erection in areas that will be inaccessible when assembled in the field. Apply the shop primer to interior surfaces of box sections that are to be sealed by welding. When shear connectors are to be installed in the shop, install them before painting the top surfaces of girders. After installing the shear connectors in the shop, repair all heat damage to the shop paint on the bottom surface of the top flange. The Engineer will not require the repair of heat damage to the top of the flange in contact with concrete. The Engineer will not require painting the shear connectors. If the shear connectors are painted, the Engineer will not require cleaning the

overspray. When installing shear connectors in the field, shop paint the top surface of the girder.

Paint structural steel that is to be welded only after completing welding. When welding the steel in the shop and subsequently erected by bolting, apply one coat of primer after finishing the shop welding and blast cleaning.

Paint surfaces of iron and steel castings only when directed according to Subsection 607.03.08 D).

Transfer or preserve field identification erection marks and weight marks. Load the steel for shipment only after the shop coating has cured at least 72 hours and the Engineer has inspected it.

D) Preparation for Field Coatings. Clean by sections, bays, or other readily identifiable parts of work. Apply paint only after the Engineer has inspected and accepted each section, bay, or part.

After erection, including all bolting and straightening of bent metal, prepare steel for repairs by washing all surfaces with a high pressure water wash. Use a minimum operating pressure of 5,000 psi. After pressure washing, wait until the surface is completely dry, a minimum of 24 hours, before applying the intermediate coating. Apply the intermediate coating within 7 days of the high pressure wash or re-wash. When the aluminum polyurethane intermediate coating is more than 60 days old and when recommended by the manufacturer, inject an abrasive into the high pressure water wash to produce an anchor texture for the urethane finish coat. Completely remove all adhering rust, scale, dirt, grease, or other foreign material. Retouch the shop coating where necessary. Ensure that all contact surfaces of all joints are sealed. After washing, flush the surface with clean water and allow to dry thoroughly before painting.

Remove all lubricant or residuals from the surface of all galvanized nuts, bolts and washers. Blast clean all surfaces that are damaged immediately prior to painting to the pictorial standards described in B) above. When dry overspray from the primer coat exists, remove by sanding before applying the aluminum polyurethane.

E) Application of Field Coatings. Paint between April 1 and November 15. The Department may allow painting at other times when the Engineer approves in writing.

Apply paint only when the air temperature at the bridge to be painted is 40 °F or greater, the surface temperature of the steel members to be painted is at least 5 °F above the dew point temperature, and the relative humidity at the site is between 30 and 85 percent. Do not apply paint to damp or frosted surfaces, nor when it is raining or the air is misty.

Protect pedestrian, vehicular, and other traffic on or underneath the bridge and all portions of the bridge superstructure and substructure against damage or disfigurement by spatters, splashes, and smirches of paint or paint materials. Take responsibility for all damages resulting from paint operations. Submit a detailed written outline to the Engineer for approval before field painting. Include sketches, if necessary, of methods to prevent overspray drift. Include protection of vehicular traffic, boats, and marinas beneath the bridge, and buildings or other property in the vicinity of the bridge.

Apply field coatings only after satisfactorily completing field cleaning and ensuring that the paint applied for retouching the shop coat is thoroughly dry. Do not apply succeeding coats until the previous coats have dried throughout the full thickness of the paint film.

Paint by sections, bays, or other readily identifiable parts of work, as directed.

Apply field coats only at levels greater than 10 feet above the bridge slab until completing concrete work, including final rubbing or application of the masonry coating.

Mitigate dust produced by traffic for the necessary distance on each side of the bridge. Prevent dust and dirt from coming in contact with freshly

painted surfaces or other surfaces before applying paint when the Engineer directs.

Apply the intermediate coat to all exposed surfaces of the completed structure. Ensure that the dry film thickness of the intermediate coating is 2 to 4 mils.

Apply urethane finish coat to all exposed surfaces of the completed structure. Ensure that the dry film thickness of the urethane finish coat is 3.0 ± 1.0 mils.

Stencil the completion date of painting, including the year and month, on the structure as the Engineer directs.

F) Repair of Shop and Field Coatings. Repair according to the manufacturer's recommendations and as otherwise specified in this section.

When using blast cleaning to field repair coatings, use an approved low-dust abrasive. Apply coating systems for repair as follows:

1) Rusted Areas. Zinc rich primer, aluminum polyurethane intermediate coat, and urethane finish coat.
2) Non-rusted Areas. Organic zinc rich primer only in areas where dry film thickness of primer coating is less than specified, aluminum polyurethane intermediate coat, and urethane protective coat.
3) Galvanized Components. Aluminum polyurethane intermediate coat, and urethane protective coat.

When spot repair will not produce a uniform and durable coating, repaint the entire member as the Engineer directs.

Repair surfaces before erection that will be inaccessible after erection.

607.03.24 Name Plates. When shown, furnish and install name plates including fastening devices.

607.04 MEASUREMENT. The Department will measure the quantity by the lump sum. The Department will not measure miscellaneous metals, shop inspections, inspection facilities and equipment, material samples for mill authorization, enforcement of required safety precaution for radioactive exposure, furnishing of technical representatives for paint, extra paint required when bolting, nameplates, or direct tension indicators for payment and will consider them incidental to this item of work.

607.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8160	Structural Steel	Lump Sum

The Department will adjust the Contract unit price for Structural Steel by the following formula when the Engineer makes plan changes that result in an increase of the estimated plan weight of steel:

$$\text{Adjusted Contract Unit Price} = \text{Original Contract Unit Price} \times \frac{\text{(Revised Estimated Plan Weight)}}{\text{(Original Estimated Plan Weight)}}$$

Bear all shop inspection costs incurred at locations other than the 2 original designated locations. The Department will initially pay for the inspection cost. Reimburse the Department subsequently.

The Department will consider payment as full compensation for all work required under this section.

The Department will make partial payment for structural steel plate stored at the fabrication shop when requested. This applies to structural steel quantities of 1,000,000 pounds or more.

SECTION 608 ¾ CONCRETE BRIDGES

608.01 DESCRIPTION. Construct concrete bridges and parts of other bridges that are concrete.

608.02 MATERIALS.

608.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

608.02.02 Steel Reinforcement. Conform to Section 811.

608.02.03 Bearing and Expansion Plates. Conform to Section 813. When the Contract requires self-lubricating plates, furnish machine surfaces with trepanned recesses.

608.02.04 Rockers. Conform to Section 812.

608.02.05 Elastomeric Bearing Pads. Conform to Section 822.

608.02.06 Preformed Cork Expansion Joint Filler (Type II). Conform to Section 807. Use with bearing pads.

608.02.07 Forms. Conform to Subsection 601.02.

608.02.08 Structural Steel. Conform to Section 812.

608.02.09 Masonry Coating. Conform to Section 828.

608.02.10 Anchor Bolts. Conform to Section 813.

608.02.11 Precast and Prestressed Members. Conform to Subsection 605.

608.02.12 Concrete Curing Materials. Conform to Section 823.

608.03 CONSTRUCTION.

608.03.01 Foundation. Begin work after structure excavation, sheet piling, and all bearing piles have been prepared according to Sections 603 and 604.

608.03.02 Falsework and Forms. Construct all falsework and forms according to Subsections 601.03.11 and 601.03.12.

608.03.03 Classes of Concrete for Substructure. Use Class AA concrete in portions of the substructure above the top of caps except pedestals. Use Class A concrete in portions of the substructure below the top of caps and in pedestals. When placing concrete under water, use Class A Modified concrete.

608.03.04 Placing Steel Reinforcement in Substructure. Place steel reinforcement according to Subsection 602.03.

608.03.05 Placing Concrete in Substructure. Proportion, mix, and place concrete according to Subsection 601.03. Construct construction joints according to Subsection 601.03.10. Place concrete for footings to the full depth in one continuous operation, and allow them to set at least 12 hours before placing forms thereon for other parts of the substructure unit. Place concrete in columns in one continuous operation between construction joints. Allow concrete in columns to set at least 12 hours before placing forms for caps. Place concrete for bridge seats according to Subsection 601.03.09.

Finish all exposed surfaces according to Subsection 601.03.18. Bevel all exposed edges 3/4 inch.

Cure according to Subsection 601.03.17.

608.03.06 Placing Anchor Bolts. Place anchor bolts in piers and abutments according to Subsection 607.03.17.

608.03.07 Setting Expansion Devices. Install bearing and expansion plates, bearing pads, rockers, and other expansion devices, except friction or sliding type, according to Subsection 607.03.17.

For friction or sliding expansion devices furnish either structural steel plates, elastomeric bearing pads, or preformed cork. Firmly anchor expansion devices in correct position as specified in the Plans. Thoroughly coat all sliding surfaces of expansion devices with graphite lubricant just before placing them in position. Do not place concrete in a manner that will interfere with free movement of the expansion devices.

When preformed cork expansion devices are specified for sliding joints, furnish preformed cork material that is the full width and depth of each contact surface and is not built up with several pieces or strips.

608.03.08 Protection. Protect the structure during construction. Protect concrete parapet walls of abutments and end bents or ends of concrete spans from damage by equipment or traffic by methods specified in the Plans or as directed. Do not allow any traffic over the structure from the time it is completed until the pavement is completed, without protecting the ends of the bridge.

608.03.09 Placing Superstructure. Do not place any superstructure on finished piers or abutments until attaining the required concrete strength or the table in Subsection 601.03.15 for applying significant loads. With the exception of rigid frame structures, do not start the erecting or placing of the superstructure until removing the forms and determining the character of concrete in the substructure.

Construct the concrete deck according to Subsection 609.03. Construct the concrete beams according to Subsection 605.03.

608.03.10 Concrete Pile Piers, Steel Pile Piers, and Abutments. Construct all precast or cast-in-place concrete pile piers and abutments, and steel pile piers and abutments according to the lines, grades, dimensions, and design specified in the Plans and according to Sections 601, 602, and 604. Remove falsework under pier caps according to Subsection 601.03.14.

608.03.11 Construction Date and Identification. Stencil the construction date and identification according to Subsection 601.03.19.

608.03.12 Inspection Facilities. Provide facilities for inspection of work as it progresses and for final inspection of completed work. Provide ladders, or other satisfactory means, to enable the Engineer to examine and inspect pier and abutment caps and bearings. Remove them after final inspection and the Engineer's approval of work.

608.03.13 General Requirements for Superstructure. Give all exposed surfaces a finish according to Subsection 601.03.18. Construct bridge slabs according to Subsection 609.03. Construct precast and prestressed beams according to Subsection 605.03.

608.03.14 Steel Reinforcement for Superstructures. Place all steel according to Subsection 602.03.

608.03.15 Concrete Bridge Layout. Dimensions specified in the Plans are for a normal temperature of 60 °F. Layout dimensions are horizontal measurements.

608.03.16 Permissible Finish Variations. Do not allow lines of the finished concrete, except bridge slabs and precast piles, to vary more than 1/4 inch per 10 feet or vary from plan lines more than 0.1 percent of the distance between extremities of the unit considered.

The Engineer will decide whether any variations in excess of those stated are cause either for removal and replacement of the work according to Subsection 105.01.04 or for a reduction in payment.

608.03.17 Forms and Steel Reinforcement Quality Control. Perform quality control according to Section 113. Submit a written plan. Describe inspection procedures. Identify jobsite quality control personnel. Provide qualified QC personnel. Locate their personnel in the management diagram.

Perform a thorough dimensional, grade, and location check of all work prior to each concrete placement. Notify the engineer when the inspection is complete and all corrective actions are taken.

The Engineer will perform the Department quality assurance inspection of forms and steel reinforcement. Perform corrective work as direct by the Engineer.

608.04 MEASUREMENT.

608.04.01 Concrete. The Department will measure the quantity according to Subsection 601.04.

The Department will not measure furnishing inspection facilities or stenciling for payment and will consider them incidental to this item of work.

608.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

608.04.03 Structural Steel. The Department will measure the quantity according to Subsection 607.04.

608.04.04 Masonry Coating. The Department will measure the quantity according to Subsection 601.04.

608.04.05 Quality Control. Measure and pay according to Section 113.

608.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8100-8105, 2555	Concrete, Class	See Subsection 601.05[(1)]
8150	Steel Reinforcement	See Subsection 602.05
8160	Structural Steel	See Subsection 607.05
2998	Masonry Coating	See Subsection 601.05

[(1)] *When the variation is not within the permissible limits and the Engineer does not require removal and replacement, the Department will deduct from the total Contract price the product of the volume of Concrete not within the permissible limits multiplied by the Contract unit price for the Concrete.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 609 ¾ REINFORCED CONCRETE BRIDGE SLABS

609.01 DESCRIPTION. Construct reinforced concrete slabs on bridges.

609.02 MATERIALS AND EQUIPMENT.

609.02.01 Steel Reinforcement. Conform to Section 811.

609.02.02 Concrete. Conform to Subsection 601.02 and 601.03.

609.02.03 Joint Materials. Conform to Section 807.

609.02.04 Structural Steel Joints. Conform to Section 812.

609.02.05 Forms. Conform to Subsection 601.02.13.

609.02.06 Concrete Curing Materials. Conform to Section 823.

609.02.07 Welded and Seamless Steel Pipe for Bridge Floor Drains. Conform to Section 810.

609.02.08 Zinc Oxide-Zinc Dust Primer. Conform to Federal Specification TT-P-641, Type II.

609.02.09 Finishing Machines. Provide each finishing machine with at least 2 movable footbridges from which to perform finishing and curing.

Furnish a self-propelled finishing machine equipped with:

1) one or more augers or other equally effective device to move and position the concrete,
2) a cylinder to compact and finish the concrete, and
3) a pan float.

Provide a machine that is readily adjustable so all its devices may be easily operated to satisfactorily position, consolidate, and finish the concrete.

Use machines that span the full width of the bridge, are adjustable to grades paralleling the roadway crown, and are of rigid construction to ensure a surface finish true to the lines, grades, and cross sections specified in the Plans or established by the Engineer. Give consideration to setting finishing machine on skew if angle exceeds 15 degrees.

Support the machine by rails or tracks of sufficient section modulus to withstand the imposed loads and deflect no more than 1/16 inch between the rail supports. Provide rails or track that are sufficiently rigid to prevent the machine from riding up when finishing concrete of the specified slump. Install the rails outside the limits of the roadway slab, set and maintain them true to grades paralleling the bridge grade, throughout the entire finishing operation.

609.02.10 Hand Operated Internal Vibrators. Conform to Subsection 601.02.

609.03 CONSTRUCTION.

609.03.01 Swinging the Spans. Before placing concrete slabs on steel spans or precast concrete release the temporary erection supports under the bridge and swing the span free on its supports.

609.03.02 Forming. Form according to Subsection 601.03.12. Construct falsework according to Subsection 601.03.11. Construct falsework and forms for multiple slab spans to provide the camber required in the finished structure.

Department will allow the use of permanent steel bridge deck forms as follows:

A) Design. Conform to the following criteria for designing permanent steel bridge deck forms:

1) Design the steel forms on the basis of dead load of form, reinforcement, and plastic concrete plus 50 pounds per square foot for construction loads. Do not allow the unit working stress in the steel sheet to exceed 0.725 of the specified minimum yield strength of the furnished material, or to exceed 36,000 psi.
2) Do not allow deflection under the weight of the forms, the plastic concrete, and reinforcement to exceed 1/180 of the form span or 1/2 inch whichever is less, and do not base this deflection on a total loading of less than 120 pounds per square foot.

   Base the permissible form camber on the actual dead load condition. Do not use camber to compensate for deflection in excess of the forgoing limits.
3) Use the design span of the form sheets as the clear span between edges of support angles plus 2 inches measured parallel to the form flutes. Do not use a fabricated panel length that is less than the distance between edges of beam flanges minus 2 inches.
4) Compute physical design properties according to AISI Specification for the Design of Cold-Formed Steel Structural Members.
5) Maintain the plan dimensions of both layers of primary deck reinforcement from each surface of the concrete deck.
6) Do not consider permanent steel bridge deck forms as lateral bracing for compression flanges of supporting structural members.
7) Except when permitted by the Engineer, do not use permanent steel bridge deck forms in panels where longitudinal deck construction joints are located between stringers.
8) Do not weld to any steel girder, stringer, or floor beam; to reinforcement bars in concrete beams; or to form supports fabricated from nonweldable grades of steel. Protect flanges from damage during erection of forms.
9) Submit fabrication, shop, and erection drawings, with design calculations, to the Engineer for review. Clearly indicate on these plans the grade of steel, the physical and section properties for all permanent steel bridge deck form sheets, and the locations where the forms are supported.
10) Adjust the steel forms to grade, from the plan construction elevations, to provide the plan slab thickness with no additional dead load other than that of the steel forms.
11) Fasten laps between sheets to ensure mortar tightness. Consider direction of concrete placement to determine lap orientation.

B) Installation. Install all forms according to approved fabrication and erection plans.

On steel members, do not rest form sheets directly on the top of the girder, stringer, or floor beam flanges. Securely fasten sheets to form supports with a minimum bearing length of one inch at each end. Place form supports in direct contact with the flange of girder, stringer or floor beam. Make all attachments by permissible welds, screws, bolts, clips or other approved means. However, do not weld form supports to flanges of steel. Ensure that welding and welds are according to the provisions of AWS D 1.5 pertaining to fillet welds, except that the Engineer will allow 1/8 inch fillet welds. Welder certification is not required.

Securely fasten all forms to supports while placing them.

On concrete beams, show all support hardware that is to be cast into the beam, on the shop drawings. Make attachments to the form supports or to

the auxiliary components by permissible welds, screws, bolts, clips, or other approved means.

Protect the concrete beam from damage.

Clean all form welds of slag and wire brush just before placing the deck concrete.

Thoroughly clean, wire brush, and paint any form metal where the galvanized coating has been damaged or where white rust has formed on the metal with 2 coats of zinc oxide-zinc dust primer with no color added, to the satisfaction of the Engineer. It is not necessary to touch up minor heat discoloration in areas of welds.

Locate transverse construction joints in the concrete deck slab at the bottom of a flute and field drill 1/4 inch weep holes at not less than one foot on center along the line of the joint. Locate the joint and weep holes at the lowest portion of the concrete soffit.

C) Inspection. The Engineer will carefully observe placement of the bridge deck slab. If the Engineer determines that an event such as a delay that may have caused a cold joint or insufficient vibration of concrete during the placement of the concrete warrants inspection of the underside of the deck, remove at least one section of the forms at a location and time selected by the Engineer to provide visual evidence that the concrete mixture and construction procedures are obtaining the desired results.

When forms are removed for inspection, do not replace the forms, but repair the adjacent metal forms and supports to present a neat appearance and ensure their satisfactory retention. Upon removal of the forms, the Engineer will examine the concrete surfaces for cavities, honeycombing and other defects. If the Engineer finds irregularities, and determines that these irregularities do not justify rejection of the work, repair the concrete and give it an ordinary surface finish. If the Engineer determines that the concrete where the form was removed is unsatisfactory, remove additional forms, as necessary, for the Engineer to inspect. Modify methods of construction as the Engineer requires to obtain satisfactory concrete in the slab. Remove or repair all unsatisfactory concrete.

Provide all facilities reasonably required for the safe and convenient conduct of the Engineer's inspection procedures.

609.03.03 Placing and Fastening Reinforcement. Place all steel reinforcement to within ± 1/4 inch vertically and horizontally of the position shown and according to applicable requirements of Subsection 602.03. When concrete overlays are included in the original bridge construction, construct according to the tolerance requirements for a new slab. Tie down reinforcing mats securely with wire 0.148 inch or greater in diameter at intervals of no greater than 8 feet in both the longitudinal and transverse directions to prevent upward movement of reinforcement during construction operations. When tied to the forms, extend the ties through the forms.

Do not deposit any concrete until the reinforcement is in place and the Engineer has inspected and approved it, and observed a complete and thorough "dry run" with the finishing machine over the entire slab area to be placed to ensure accurate placement of steel top clearance and proper slab depth.

The Engineer may allow splicing the reinforcement according to Subsection 602.03.

609.03.04 Expansion and Fixed Joints. Place all joints according to the details specified in the Plans or as directed. Correct improperly placed joints to the satisfaction of the Engineer even when the correction requires removal and replacement.

A) Open Joints. Place open joints in the locations specified in the Plans and construct them by the insertion and subsequent removal of a template of approved material. Accomplish the insertion and removal of the template without chipping or breaking the corners of the concrete. Do not extend

reinforcement across an open joint.

B) Steel Joints. Accurately shape the plates, angles, or other structural shapes at the shop, to conform to the configuration of the concrete slab. Ensure that the surface in the finished plane is true and free of warping. Employ methods in placing the joints to keep them in correct position during placement of the concrete. Set the opening at expansion joints to the temperature adjustment specified in the Plans. Avoid impairment of the clearance. When placing concrete, make adjustments in the joint widths to accommodate temperature changes.

C) Cold-Applied or Hot-Applied Sealing Compound. Ensure that all joints to be sealed are free of cracked or spalled areas. Chip cracked areas back to sound concrete.

Ensure that the faces of all joints to be sealed are free of all foreign matter, curing compound, oils, greases, paint, dirt, free water, and laitance. Thoroughly clean all joint faces by sandblasting or by means of a mechanical rotary wire brush.

Immediately before sealing, blow out the joint with air from an air compressor equipped with an oil and water trap. Use an air compressor of such capacity as will maintain 90-psi pressure when air is delivered to the joint through a nozzle no more than 1/4 inch in diameter.

When any sealing compound has not bonded to the joint wall or face, remove it and clean and reseal the joint.

Place all cold-applied sealing compound with a manufacturer recommended applicator, and follow the manufacturer's mixing and placing instructions. Provide a copy of these instructions and the specifications for the applicator to the Division of Materials.

D) Preformed Neoprene Joint Seals. Ensure that all joints are true to alignment and have vertical faces. Ensure that each joint is uniform in width throughout its length. Reform, reconstruct, and resaw or otherwise modify improperly constructed joints to the satisfaction of Engineer.

Construct expansion joints to be sealed by this method according to the details shown on the Standard Drawings or specified in the Plans.

When a joint, as constructed, has a width larger or smaller than the specified width, provide a seal for that joint that is the correct size for the as-built width.

Ensure that all joints to be sealed are free of cracked or spalled concrete.

Chip damaged areas back to sound concrete and repair them with an approved epoxy resin compound or other materials approved by the Department.

Install the seals in the properly prepared joints by a tool designed specifically for installing joint seals. Remove and replace any seal that is damaged during installation. Remove any seal that is improperly positioned in the joint and reinstall it at the proper elevation. Use hand methods to install seals only in areas that are inaccessible to the machine, or obtain the Engineer's written permission to install seals by hand methods.

The Engineer will measure seals before and after installation as a check against stretch. Remove any installed seal that shows more than 5 percent stretch and correctly reinstall it or replace it. Install the seals in structures immediately after expiration of the curing period. Install all seals securely and ensure that they are free from any objectionable curling or twisting in the joint groove. Use a lubricant adhesive that covers both sides of the seal over the full area in contact with the sides of the joint. Apply the lubricant adhesive either to the faces of the joint or to the seal, or to both. Install all seals in a highly compressed state so that the top of the seals is 3/8 ± 1/8 inch below the level of the roadway surface. Install the seals in one piece, without field splicing, for the full length of each of the transverse joints. The Engineer will allow one factory splice per transverse joint. Obtain the Engineer's approval for any field splices required by partial width construction.

When specified for longitudinal joints in structures, install the seals in practical lengths, without field splicing.

E) Neoprene Expansion Joints. Furnish neoprene expansion joint consisting of any one of the manufactured joint seals specified in the Plans. Determine which of the specified joint seals will be used and obtain written approval of joint details, prior to placing the deck concrete.

Submit shop drawings for approval according to Subsection 607.03.01. Ensure that these drawings, along with joint details, include a layout plan of the joint units to be used. Also include procedures for setting expansion joint width, so the opening will be the specified width at 60 °F. The Engineer will approve of details of installation and his decision will be final.

Include the details and material specifications for the manufactured neoprene expansion joints and incidental accessories, sealants, and adhesives with the shop drawings for approval.

Before beginning work on the joint, furnish the manufacturer's written installation instructions.

Comply with the manufacturer's installation instructions, apply sealants and adhesives, and install joint units as shown on the approved shop drawings and as specified in this section.

When the Engineer requests, obtain technical assistance from the supplier of the joint. Failure of the joint supplier to provide adequate technical assistance may be cause for removal of the joint seal from the Department's List of Approved Materials.

Remove all forms and debris from the joint opening. Ensure that concrete or metal surfaces where the neoprene expansion joints are to be set are dry; clean and free from dirt, grease, and contaminants; level; and sound with no broken or spalled concrete. Ensure that adjacent joint seats are on a straight plane with each other.

Furnish and install the neoprene strip sealing element in one continuous unbroken length for the entire joint length. For the strip seal type joint, ensure that the locking groove in the metal extrusion is clean and free of any dirt or corrosion before installing the neoprene strip seal element. Bond the strip seal in place with the manufacturer's recommended adhesive which meets the Engineer's approval.

Where longitudinal joints cross transverse joint seals, provide a seal by flattening and extending the longitudinal joint neoprene seal element under the transverse joint pad. When this procedure is not practical, use a separate neoprene apron, bonded to the longitudinal seal element.

Ensure that the finished joint presents a smooth, neat appearance. Wipe or scrape away excess sealant before it becomes hard. Upon completion of an entire joint, grind any uneven concrete or armored edge.

609.03.05 Drainage. Install deck drains at the locations shown or as directed and place them before placing the bridge deck slab. Paint all drain pipes according to Subsection 607.03.23. Provide transverse drainage of the roadway surface by means of a suitable crown or cross slope in the floor slab. Effectively drain gutters using weep holes or drain scuppers constructed at locations and in the manner specified in the Plans. Install drain scuppers to prevent drainage water from staining exposed surfaces of girders and abutment walls. In general, extend drain pipes through the concrete slab to a distance of no less than one inch below the slab or underlying beam. Provide the under surface of cantilever brackets and overlapping slabs with a V groove (drip strip) 1/2 inch in depth at a point no more than 6 inches from the outside face of the overhang for the purpose of arresting flow of moisture to prevent staining.

609.03.06 Weather Limitations and Placing Concrete. Do not place any concrete within deck slabs during the months of January or February, except for barriers, plinths, curbs, walks, etc. Place all deck concrete according to Subsection 601.03.09. Any time the ambient temperature is anticipated to be 85 °F or higher, place concrete in the deck slab during evening hours after ambient temperatures cool to

below 85 °F and cease placement before temperatures rise above 85 °F. Cool forms and beams tops by water spray if their temperature exceeds 85 °F.

Always protect deck placement from rain water being introduced into the concrete and from rainwater surface damage. Cease deck placement immediately or cover it for complete protection when rain occurs.

609.03.07 Depositing, Consolidating, and Striking Off Slab Concrete. Wet the reinforcing steel and forms with water prior to placing concrete. Deposit the concrete between the curbs or between the longitudinal joints when specified in the Plans to the full depth of the slab, and consolidate it. Consolidate by means of hand-operated internal vibrators according to Subsection 601.03.09. Use a spade in addition to vibrating, if required, to ensure that no honeycomb, voids, or air pockets exist against the forms. Continue consolidating the concrete until there is complete contact between the reinforcing steel and the concrete, and until mortar flushes to the top surface.

When using permanent steel bridge deck forms, place emphasis on proper vibration of the concrete to avoid honeycombing and voids, especially at construction joints, expansion joints, and valleys and ends of form sheets. Obtain the Engineer's approval of pouring sequences, procedures, and mixtures.

Continuously place concrete in any slab between expansion joints or between construction joints as specified in the Plans.

Prevent displacement of reinforcement during placing of concrete. Place concrete in the sequence as specified in the Plans and in the absence of such designation, place as directed. Obtain written approval to change the pouring sequence. Provide sufficient work capacity to place concrete at a minimum rate of 25 cubic yards per hour.

When, in case of an emergency, it becomes necessary to introduce a construction joint, form it by means of a vertical bulkhead constructed to produce a keyed joint and located as approved by the Engineer.

In placing concrete around steel shapes, place it only on one side of the shape until it flushes up over the bottom flange of the shape on the opposite side, after which place it on both sides to completion.

Do not place concrete railings monolithic with the slab.

On continuous, composite design structures, keep concrete in slabs plastic for a sufficient length of time to allow the structure to deflect to the natural deflected shape.

Place the concrete in each integral unit of the superstructure continuously. Do not begin placing concrete without sufficient approved material on hand nor without sufficient forces and equipment to complete that unit without interruption. Avoid joints in the concrete due to work stoppage. Form construction joints, when necessary, according to Subsection 601.03.10.

Place concrete in slab spans in one continuous operation for each span. Place concrete in transverse strips the entire width of the bridge. Place concrete for the full depth and ensure that the width of strips is such that concrete in any one strip does not take its initial set before placing the adjacent strip.

When expansion devices such as rockers, expansion dams, and similar fixtures have been rigidly fixed to hold them in correct alignment, immediately release them upon completion of concrete placement in the portion of the structure in which they are installed.

Immediately following consolidation of the concrete, strike off the surface to crown and cross section with the finishing machine. Move the machine in the direction that work is progressing. Maintain a slight excess of concrete at all times so no low spots are left in front of the finishing machine. Prevent the excess concrete from tearing the surface. After finishing, do not work, walk on, or disturb the concrete in place except as described in this section.

In general, do not add water to the surface of the concrete to assist in finishing operations. If the Engineer allows the application of water to the surface, apply it as a fog spray using approved spray equipment.

609.03.08 Working the Surface. Following the striking off or screeding, randomly check the surface for irregularities and mortar ridges, at least every 50 feet of

bridge length, with an approved 10-foot straightedge operated parallel to the centerline of the bridge and slab surface. Eliminate all variations greater than 1/8 inch.

After the concrete slab has cured, the Engineer will again check the slab for variations exceeding 1/8 inch. Perform any corrective action that the Engineer deems necessary.

After completing the finishing operation, ensure that the surface of the concrete presents a uniform appearance; conforms to the required grade and cross section; and is free from surplus water, rough and porous spots, irregularities, depressions, and other objectionable surface features resulting from improper finishing.

609.03.09 Finish with Burlap Drag. If the Contract does not require texturing, finish the slab using a burlap drag. Use a burlap drag of double thickness, at least 3 feet wide, and long enough to span between curb faces. Lay the burlap on the slab surface and drag it in the direction the slab is being placed, keeping approximately 2 feet of its width in contact with the slab surface. Keep the burlap drag damp, clean, and free from hardened concrete.

609.03.10 Texturing. Texture the surface by forming transverse grooves. Form the transverse grooves by approved manual tools such as rakes with spring steel tines. Form the grooves in the concrete at an appropriate time during concrete set, so that in the hardened concrete, the grooves will be between 0.09 to 0.13 inch in width, between 0.12 and 0.19 inch in depth, and be spaced at random intervals between 0.3 and 1.0 inch. Terminate the grooves approximately 18 inches from faces of the curbs, concrete barrier walls, or other vertical walls.

Regardless of the method used to form the grooves, ensure that the grooves are relatively smooth and uniform, are formed without tearing the surface or without bringing pieces of the coarse aggregate to the top of the surface, and are formed to drain transversely.

Correct any individual areas of hardened grooved concrete that do not conform to these requirements by the cutting of acceptable grooves in the hardened surface with an approved cutting machine or by other approved methods.

609.03.11 Waterproofing Membranes and Surface Courses for Slabs. When a waterproofing membrane overlay or special surface course is specified in the Contract, prepare the slab surface according to the procedures designated in the Contract. Do not texture the surface and do not apply a liquid membrane forming curing compound when the slab is to be waterproofed or receive a surface course.

609.03.12 Curing. Immediately after finishing and while the surface is slightly damp, apply Type II (white pigmented) membrane-forming curing compound to the slab between the curb lines. Do not dilute or alter the compound, but thoroughly agitate it immediately before applying it. When the compound is too viscous to apply, warm it in a water bath to approximately 100 °F before applying it. Apply the compound uniformly using an approved pressure sprayer at a rate of one gallon per 120 square feet. If the Engineer deems the application is not uniform as it progresses, apply the compound in 2 applications, each at a minimum rate of one gallon per 240 or less square feet. Start the second application after completing the first application. The Engineer will determine the total quantity of compound actually applied to the slab and compute the actual rate of application. When the Engineer determines the total actual application rate is less than one gallon per 120 square feet actual coverage, apply additional compound immediately and uniformly over the entire surface at a rate the Engineer directs.

When the Contract does not require texturing, reduce the total rate of application to one gallon per 150 square feet. If the Engineer deems the application is not uniform as it progresses, apply the compound in 2 applications, each at a minimum rate of one gallon per 300 square feet. Start the second application after completing the first application. When the Engineer determines the total actual application rate is less than one gallon per 150 square feet actual coverage, apply additional compound immediately and uniformly over the entire surface at a rate the Engineer directs.

Prevent the compound from being applied to reinforcing steel, concrete surfaces to be bonded to other concrete, or any other surfaces not specifically designated to receive the compound. When having inadvertently applied the compound to areas or surfaces not designated, remove by sandblasting or other approved methods.

After applying the compound, and as soon as possible without damaging the surface texture, cover the slab between the curb lines with curing blankets or a double thickness of burlap and keep the slab continuously wet until the required compressive strength is attained as determined by testing field cured cylinders. If other operations are not delayed, the Engineer may require 7 days wet cure regardless of cylinder strengths. If using curing blankets, place and maintain blankets and apply water as specified in Subsection 601.03.17.

When using Class S concrete, wet cure according to Subsection 601.03.17.

609.03.13 Surface Finish. Finish exposed areas of curbs, railings, and plinths, as specified in Subsection 601.03.18.

609.04 MEASUREMENT.

609.04.01 Concrete. The Department will measure the quantity in cubic yards according to the Record Plans. The Department will base the final quantity on the design quantity. When there is an error or omission in the design quantity in excess of 2 percent, the Department will adjust the design quantity accordingly. The Department will adjust quantities resulting from authorized dimension changes. The Department will not subject these quantities to the 2 percent limitation.

The Department may measure the depth of concrete cover above the top mat of steel reinforcement in inches according to KM 64-313. The Department will not measure the depth of concrete cover above the top mat of steel reinforcement as a separate pay unit, but will use it to calculate an adjusted Contract quantity for Concrete.

The Department will not measure furnishing inspection facilities, joint construction, or stenciling for payment and will consider them incidental to this item of work.

609.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

609.04.03 Drain Pipe. If this item is a separate pay item, the Department will measure the quantity in linear feet. If this item is not a separate pay item, the Department will not measure the quantity for payment and will consider it incidental to Structural Steel.

609.04.04 Structural Steel. The Department will measure the quantity, including drainage systems and structural steel expansion joint systems, according to Subsection 607.04. The Department will not measure paint, fittings, and connections for payment and will consider them incidental to this item of work.

609.04.05 Neoprene Expansion Dams. The Department will measure the quantity in linear feet.

609.04.06 Joint Sealing. The Department will measure the quantity according to Subsection 601.04.

609.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8100-8105, 2555	Concrete, Class[1]	See Subsection 601.05
8150	Steel Reinforcement	See Subsection 602.05

8160	Structural Steel	See Subsection 607.05
2998	Masonry Coating	See Subsection 601.05
8820, 8821	Drain Pipe, Size	Linear Foot
8469-8472	Neoprene Expansion Dam, Size	Linear Foot
8540	Joint Sealing	See Subsection 601.05

(1) *The Department will adjust the Contract quantity for Concrete by the Schedule for Adjusted Quantity for Depth of Cover Deficiency. The adjusted quantity is equal to the theoretical slab volume of concrete times the ratio of the area in square feet, which is not within the specified tolerance to the plan slab area in square feet, times the factor listed in the Schedule for Adjusted Quantity for Depth of Cover Deficiency. The Department will not make additional payment for depth of cover in excess of the specified thickness.*

Schedule for Adjusted Quantity for Depth of Cover Deficiency

Depth of Cover Deficiency (inches)	Quantity Adjustment Factor
0.00 to -0.50	0.00
-0.51 to -0.63	0.12
-0.64 to -0.75	0.25
-0.76 to -0.88	0.50
-0.89 to -1.50	(1)
-1.51 or greater	(2)
0.00 to +0.50	0.00
+0.51 to +0.63	0.12
+0.64 to +0.75	0.25
+0.76 to +0.88	0.37
+0.89 to +1.00	0.50
+1.01 or greater	(3)

(1) *Construct a concrete overlay at no expense to the Department. The Department may apply a factor of 1.00 to small isolated areas in lieu of a concrete overlay.*
(2) *Remove and replace these areas with concrete of the specified thickness at no expense to the Department.*
(3) *Perform corrective work at no expense to the Department. The Department may require removal of any excess concrete or removal and replacement of the entire slab. The Department may apply a factor of 1.00 to small isolated areas in lieu of corrective work.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 610 — CONCRETE BOX CULVERTS AND CONCRETE HEADWALLS

610.01 DESCRIPTION. Build all concrete box culverts and concrete headwalls according to the Contract.

For box culverts constructed using precast sections, conform to Section 611. For precast headwalls, conform to Section 710.

610.02 MATERIALS.

610.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

610.02.02 Steel Reinforcement. Conform to Section 811.

610.02.03 Concrete Pipe. Conform to Section 810.

610.02.04 Joint Materials. Conform to Section 807.

610.02.05 Masonry Coating. Conform to Section 828.

610.02.06 Concrete Curing Materials. Conform to Section 823.

610.03 CONSTRUCTION. Conform to Subsection 601.03 for all concrete construction.

610.03.01 Footings. Construct footings to the elevation specified in the Plans, and increase the depth when the Engineer determines that it is necessary to provide sufficient bearing or to prevent undermining. Only raise footing elevations when encountering solid rock at elevations above those specified in the Plans and with the approval of the Engineer.

Form the outside face of all footings of concrete headwalls for pipe, box, or arch culverts to the full depth of the footing. Do not place any concrete in the foundation until the Engineer has inspected and approved the depth of excavation and character of the foundation material.

Whenever the natural foundation material is not sufficiently stable to support the structure or whenever it is anticipated that high water may cause excessive erosion around the footings, the Engineer may order Extra Work to provide the structure with adequate support or protection according to Subsection 109.04.

When the condition of excavation for footings is otherwise satisfactory but is such that concrete cannot be placed without mud becoming mixed with the concrete, remove the entire mass of mud and replace it with stable material or prevent infiltration of mud by methods such as a layer of coarse aggregate and geotextile fabric or a layer of plastic material. Perform work by methods other than removing and replacing the entire mass of mud according to Subsection 109.04.

610.03.02 Apron Walls and Headwalls.

A) Apron Walls. The Engineer may require additional depth than that specified in the Plans if necessary to prevent undermining. Form the outside faces of all concrete apron walls for the full depth. When necessary to form the back face or the end of apron walls due to the lack of solid material, do not exceed the excavation limits specified for footing structure excavation.

Pave the space between wings when the Engineer directs. In this event, relocate the apron walls so that they are in a straight line between the ends of the wings, or at locations to provide the best protection.

B) Headwalls. Construct headwalls according to the Standard Drawings for Headwall Supplement. When headwalls for pipe culverts are located at the shoulder, construct the top of the headwalls parallel to the shoulder line for

both line and grade.

610.03.03 Drainage. Place weep holes consisting of 4-inch pipe or formed to 4 inches in diameter at intervals not to exceed 25 feet in retaining walls, nor exceeding 10 feet in box culverts. Place the outlet invert elevation of weep holes in box culverts 4 inches above the flowline of the culvert. Raise box culvert weep holes to accommodate significant silting when the Engineer directs. Make adequate provisions for thorough drainage of backfill and embankment according to Subsection 603.03.

610.03.04 Placing Concrete. Place concrete according to Subsection 601.03.09.

Place the base slab or footings, and allow them to cure before constructing the remainder of the structure. Construct base slabs, footings, and apron walls as monolithic units when practical. When construction joints are necessary, place them at right angles to the culvert barrel.

Bond construction joints, according to Subsection 601.03.10.

In constructing all box culverts having a clear height of 5 feet or more, place concrete in the side walls, and allow it to set before placing the top slab.

For culverts having a clear height of less than 5 feet, if desired, pour the culvert top slab monolithically with the side walls. When using this method of construction, make all necessary construction joints vertical and at right angles to the axis of the culverts.

Construct each wingwall as a monolithic unit. Place construction joints, where unavoidable and when not specified in the Plans, horizontal or vertical as appropriate.

610.03.05 Removing Forms. Remove forms according to Subsection 601.03.14..

610.03.06 Surface Finish and Placing Fill. Finish surfaces according to Subsection 601.03.18. Texture top slabs of box culverts to be used as the wearing surface for traffic according to Subsection 609.03.10, and conform to the roadway rideability requirements of Subsection 501.03.19.

Place backfill or embankment as allowed by concrete strength.

Backfill according to Subsection 603.03. Construct embankment according to Subsection 206.03.

610.03.07 Extensions to Existing Culverts. Construct extensions according to the lines and grades established and to dimensions specified in the Plans.

Remove portions of the existing structure designated to be removed according to Subsection 203.03. Remove portions of the existing structure designated to be removed in a manner that provides a neat junction with the extension, and leave undamaged that portion of the existing structure that is to remain in service. For exposed joints in the finish work, the Engineer may require sawing of the existing concrete to a depth sufficient to ensure a neat joint. Repair all damage to the existing structure due to his activities. Remove and dispose of all silt or other debris that may have collected within the barrel of the existing structure. The Engineer will only require this silt and debris removal once, unless erosion control measures were not adequate.

610.04 MEASUREMENT.

610.04.01 Concrete. The Department will measure the quantity according to Subsection 601.04.

610.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

610.04.03 Structure Excavation. The Department will measure the quantity according to Subsection 603.04. The Department will measure the removal and replacement of unstable material in footing excavation as Structure Excavation.

610.04.04 Removal of Existing Structure. The Department will measure the

quantity according to Subsection 203.04. The Department will not measure repair of damage to, removal of silt and debris from, and providing a neat cut for the joint on the portion of the structure designated to remain for payment and will consider them incidental to this item of work.

610.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8100-8105, 2555	Concrete	See Subsection 601.05
8150	Steel Reinforcement	See Subsection 602.05
8160	Structure Excavation	See Subsection 603.05
2731	Remove Existing Structure	See Subsection 203.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 611 ¾ PRECAST REINFORCED CONCRETE BOX CULVERT SECTIONS

611.01 DESCRIPTION. Install precast reinforced concrete box sections used as culverts, storm drains, and sewers.

611.02 MATERIALS.

611.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

611.02.02 Steel Reinforcement. Conform to Section 811.

611.02.03 Backfill Material. Conform to Subsection 206.03.01.

611.02.04 Free Draining Backfill Material. Conform to Section 805.

611.02.05 Grout. Conform to Subsection 601.02.

611.02.06 Sand. Conform to Section 804.

611.02.07 Sand for Pipe Bedding. Conform to Section 804.

611.02.08 Crushed Aggregate for Bedding. Conform to Section 805.

611.02.09 Joint Sealer for Rigid Pipe. Conform to Section 807.

611.02.10 Geotextile Fabric. Conform to Section 843.

611.03 CONSTRUCTION.

611.03.01 Transportation and Handling. Transport and handle precast units according to Subsection 605.03.09.

Remove and replace all sections that are not in true alignment and grade or that show undue settlement after laying, or are otherwise damaged.

611.03.02 Precast Unit Construction. Construct units according to AASHTO C789 and ASTM C850 with the following exceptions and additions:

1) For building forms, mixing, casting, curing, removing forms, requirements for a mix design, plant certification and certified concrete technicians, and surface finish, conform to the applicable requirements of Section 605. Do not use water meters if using dry-cast methods.
2) Make all markings by indentation, except the Department will allow the use of waterproof paint to indicate the month and day of casting. Place indented markings on the inside top of each section, in letters at least 1 inch high. When a manufacturer has more than one plant, mark the plant letter that the Division of Materials assigns on the inside of the culvert. Paint the month and day of casting on the outside of the sections
3) Furnish precast sections at least 4 feet long.

611.03.03 Shop Drawings. Submit shop drawings for review according to Subsection 105.02, except do not include original tracings. Include on the shop drawings details of joint configuration, the size of rubber or flexible plastic gaskets when used, the area of steel reinforcement, lift holes, and the size and location of reinforcement.

611.03.04 Excavation. Perform structure excavation according to Section 603, except as modified in this subsection.

611.03.05 Bedding. Perform bedding as specified in the Plans or Standard Drawings. Level the compacted bedding with a template or straightedge to ensure uniform support throughout the entire width and length of the structure.

When desired, substitute crushed aggregate up to 3/4 inch maximum size for sand as bedding material. Do not use DGA or gravel base for this substitution. Substitute measure for measure.

The Engineer will require a vertical trench from the bottom of the excavation to the top of the culvert or original ground, whichever is lower, as specified in the Plans or Standard Drawings.

611.03.06 Laying Sections. Do not lay any unit until the Engineer approves the proposed location. Take soundings for foundation design at the inlet and outlet of each culvert and at intervals no greater than 20 feet along the grade line of the bottom of the culvert, to a depth of 3 feet. Perform soundings on the centerline and at each edge of the culvert. Where ledge rock, gravel, hardpan, or other unyielding material is encountered or known to exist within the limits stated, prepare the foundation as specified in the Plans or Standard Drawings.

Camber the box culvert sections as the Engineer directs. Begin placing sections at the outlet end of the pipe with the bell or groove end being laid upgrade. Fully extend successive spigot ends into each adjoining hub. Provide a "come-along" or other mechanical device to pull each section firmly into the previously placed section, tightly meshing the joints. Do not push sections together with a tractor-mounted blade. After installing the sections, seal lift holes by inserting a tapered precast concrete plug and coating the top of the joint around the plug with asphalt mastic material.

When the Plans require the volume between side-by-side installations to be filled with grout, use grout consisting of one part cement to 6 parts mortar sand or concrete sand, with sufficient water to provide a consistency suitable for job conditions.

Provide drainage with 4-inch weepholes as specified in Subsections 610.03.03 and 603.03.05 respectively, except that for side-by-side installations separated by grout, place weepholes in the extreme outside walls only.

Grout formed openings between the precast sections and any side entry of pipes or top entry of manholes to form a watertight joint. When manholes are to be placed directly on the top slab of the precast sections, provide sufficient additional steel reinforcement in the top slab to compensate for the section removed.

611.03.07 Joints. Use either rubber, flexible plastic gaskets, or asphalt mastic joint sealing compound in joints between the precast box sections. Use the same material throughout each individual structure.

A) Rubber Gaskets. Use a cement and lubricant to facilitate joining the sections that is recommended by the manufacturer of the rubber gaskets. Install the rubber gaskets in a manner to snugly fit in the beveled surface of the tongue and groove ends of the section to form a flexible water-tight seal under all conditions of service.

B) Flexible Plastic Gaskets. Use a primer; rate and method of primer application; and width and method of application of the flexible plastic gaskets recommended by the gasket manufacturer. Provide the Engineer with the manufacturer's literature for installation procedures.

C) Asphalt Mastic Joints. Prime and seal asphalt mastic joints according to Subsection 701.03.

D) Joint Fit. Regardless of the of type sealant to be used, ensure proper meshing of the joints.

Do not allow sand or foreign materials to intrude into joints. If sand or foreign material is present within the joint upon joining the sections, thoroughly clean until no sand or foreign material is present, and reseal the joint.

If the joint is not entirely filled with sealant after connecting the culvert sections

fill all exposed unsealed areas, both inside and outside the culvert, with asphalt mastic or other approved material. If using plastic gaskets, use an additional sealant compatible with the plastic and recommended by the gasket manufacturer.

Fill the exterior joint gap on the top of precast reinforced concrete boxes with mortar. Cover the exterior joint with a minimum of a 15-inch double layer geotextile fabric joint wrap. Before applying the wrap, ensure that the surface is free from dirt and foreign substance. Use one continuous roll of double layered joint wrap to cover the joint on the top of the box and to extend completely down the sides to the bottom of the box. During backfilling, keep the joint wrap in the proper location over the joint. Apply the joint wrap to all joint sections.

611.03.08 Backfilling. Backfill according to Subsection 603.03, the Plans, and the Standard Drawings. Place free draining backfill between side-by-side installations when required by the Plans. Compact the backfill as the Engineer directs.

611.03.09 Headwalls. Construct headwalls as specified in the Plans or Standard Drawings.

611.04 MEASUREMENT.

611.04.01 Structure Excavation. The Department will measure the quantity according to Subsection 603.04. For necessary side-by-side installations, the Department will measure the entire excavated volume between sections when the Plans or the Engineer require excavation of this volume. The Department will measure embankment placed and subsequently excavated according to the plan requirements for bedding as structure excavation. The Department will not measure free draining backfill or grout between side-by-side installations for payment and will consider them incidental to this item of work.

611.04.02 Precast Reinforced Concrete Box Sections. The Department will measure the quantity in linear feet according to the length dimensions specified in the Plans. The Department will not measure joint materials (including the geotextile fabric wrap), shear connectors required for joining sections, and any required acceptance coring for payment and will consider them incidental to this item of work.

The Department will not measure repair of sections not in true alignment and grade or that show undue settlement after laying, or otherwise damaged.

611.04.03 Headwalls. The Department will measure the quantity of concrete and steel reinforcement in headwalls according to Subsections 601.04 and 602.04 respectively.

611.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8160	Structure Excavation	See Subsection 603.05
3010-3038	Precast Concrete Box Sections, Size	Linear Foot
8100-8105, 2555	Concrete, Class	See Subsection 601.05
8150	Steel Reinforcement	See Subsection 602.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 612 ¾ STRUCTURAL PLATE SOIL INTERACTION STRUCTURES

612.01 DESCRIPTION. Furnish and install corrugated metal multi-plate soil interaction structures where an equivalent inner diameter of greater than 10 feet and less than or equal to 20 feet is required for drainage or other openings. Corrugated metal multi plate soil interaction structures include pipe, pipe arches, and arches.

612.02 MATERIALS.

612.02.01 Pipe. Conform to Section 809 for the following:

1) Corrugated Aluminum Alloy Structural Plate Pipe, Pipe Arches, and Arches.
2) Corrugate Steel Structural Plate Pipe, Pipe Arches, and Arches.

612.02.02 Concrete. Conform to Subsection 601.02 and 601.03.

612.02.03 Asphalt Material for Coating and Paving. Conform to Section 806.

612.02.04 Bedding and Backfill Materials.

A) Fine Aggregate. Conform to Section 804, Sand for Pipe Bedding.
B) Coarse Aggregate. Conform to Section 805, Structural Granular Backfill.
C) Flowable Fill. Conform to Section 601.02 and 601.03.

612.02.05 Joint Materials. Conform to Subsection 701.02.

612.03 CONSTRUCTION.

612.03.01 Composition. Provide structures that consist of prefabricated sections ready to be assembled and erected at the site. Furnish prefabricated sections consisting of asphalt coated galvanized (zinc coated) corrugated steel or aluminum alloy plates that have been factory shaped and punched. The Department will allow the use of a factory assembled structure when units are available that conform to the requirements of the Contract for opening size, material, corrugation dimensions, metal thickness, and coating. Ensure that factory assembled steel units are asphalt coated. The Department will not extend the Contract time to accommodate the use of factory assembled pipe or pipe arches. Ensure that field and factory assembled steel pipe and pipe arch units are asphalt coated and paved.

612.03.02 Transportation and Handling. Transport and handle according to Subsection 701.03.04.

612.03.03 Erections Plans. Submit 3 full sets of erection plans for each unit to the Engineer. Include with each submitted set of erection plans a natural scale plan, an elevation view of the structure, and the design calculations. In lieu of design calculations, the Department will accept a manufacturer's certification that the proposed structure conforms to all of the Department's structural design requirements. The Department will return one set after review with needed corrections noted. Each time the Department requires corrections, submit 3 full sets of the erection plans. The Department will have 20 calendar days to review each submission.

After the Department has approved the erection drawings, submit one full set of the approved drawings. Submit final drawings on 22 inches wide by 36 inches long and 0.003 inch thick mylar film or equivalent capable of producing clear prints and microfilms.

612.03.04 Shop Drawings. Before fabricating any parts of the structure, submit shop drawings according to Subsection 607.03.01.

612.03.05 Soundings for Foundation. Take the soundings for foundation design for pipe, and pipe arches according to Subsection 701.03. Where rock foundations are encountered or known to exist within the limits specified, excavate the foundation to a depth below the proposed outside bottom of the structure of 1/2 inch per foot of fill to a subgrade elevation above the proposed outside top of the structure. Excavate no less than one foot and no more than 0.75 times the height of the structure. Replace with material conforming to Subsection 612.02.04. Rock foundations include ledge rock, gravel, hardpan, or other unyielding material. Camber the pipe or pipe arch whenever directed. Do not lay the pipe in cuts until completing the rough grading.

When an unstable foundation is encountered at the grade established, remove the unstable material and replace it with material conforming to Subsection 612.02.04 to a width and depth that will provide a uniform and firm foundation.

612.03.06 Installation. Install steel pipe, pipe arches, and arches according to ASTM A 807. Install aluminum alloy pipe, pipe arches, and arches according to ASTM B 789. Provide the type and method of bedding according to ASTM A 807 and B 789.

Compact backfill according to Subsection 206.03.03. Construct in lifts of not exceeding 8 inches in thickness. Exercise care to avoid displacement of the true line of the arch. Backfill with flowable fill when the Engineer directs. Proportion flowable fill according to Subsection 601.03.

Conform to the elongation tolerance in Appendix A, Tabulation of Construction Tolerances.

612.03.07 Paving. After erecting steel structures and constructing the embankments, pave the inverts throughout their length and to a minimum width of 25 percent of the circumference for circular pipes or to a minimum of 38 percent of the circumference for pipe arches. Pave with wire reinforced asphalt paving mixture or similarly reinforced concrete.

A) Asphalt Paving. Place wire mesh of a diameter of 0.1 inch or more, having openings 6 by 6-inch or less, in the invert, and securely fasten it to bolts of the structure with wire or suitable clips. Provide reinforcing mesh in widths that are one foot less than the finished width of the pavement. Provide an asphalt paving mixture that consists of 70 percent mortar sand and 30 percent mineral filler combined with sufficient bituminous material (9 to 12 percent by weight) to provide a workable plastic mixture. Provide an asphalt material that consists of a PG 58-22 asphalt binder. Heat the aggregate and asphalt binder separately to 300 ± 60 °F, then combine and thoroughly mix them. Ensure that the invert of the culvert is clean and dry while spreading and compacting the mixture. Spread and shape the mixture by means of a template. Compact the mixture to a minimum depth of one ± 0.2 inch over the crest of the corrugations. While the compacted paving material is still warm, apply a 0.1 inch coating of heated asphalt cement throughout its width and length by spraying or other suitable means.

During the paving operation take precautions against asphyxiation, heat, or the accumulation of inflammable vapors in culverts. The Department recommends using forced ventilation.

B) Concrete Paving. Place wire mesh of a diameter of 0.1 inch or more, having openings 6 by 6-inch or less, in the invert, and securely fasten it to bolts of the structure with wire or suitable clips. Spread and shape Class D Concrete having 3/4 inch maximum size coarse aggregate throughout the required width and length of the invert to provide a uniform thickness of 1.5 ± 0.5 inch over the crest of corrugations. Shape and smooth the concrete pavement by means of a template to conform to the approximate contours of the invert. Float finish the concrete. After initial set, cure the concrete for 3 calendar days using a double layer of wet burlap.

612.03.08 End Structures. Construct end structures according to the Contract.

612.04 MEASUREMENT.

612.04.01 Structural Plate Pipes, Pipe Arches, and Arches. The Department will measure the quantity in linear feet along the bottom centerline. The Department will not measure paving, bedding, backfilling, bolts and other hardware, erection plans and shop drawings for payment and will consider them incidental to this item of work.

612.04.02 Embankment-In-Place. The Department will measure the quantity according to Subsection 701.04.10.

612.04.03 Roadway Excavation. The Department will measure the quantity according to Subsection 701.04.11.

612.04.04 Pipe Undercut. The Department will measure the quantity according to Subsection 701.04.12.

612.04.05 Structure Excavation Unclassified. The Department will measure the quantity according to Subsection 701.04.13.

612.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Aluminum Alloy Structural Plate Pipe, Size	Linear Foot
----	Aluminum Alloy Structural Plate Pipe Arch, Size	Linear Foot
----	Aluminum Alloy Structural Plate Arch, Size	Linear Foot
----	Steel Structural Plate Pipe, Size	Linear Foot
----	Steel Structural Plate Pipe Arch, Size	Linear Foot
----	Steel Structural Plate Arch, Size	Linear Foot
2230	Embankment-In-Place	See Subsection 701.05
2200	Roadway Excavation	See Subsection 701.05
2219	Pipe Undercut	See Subsection 701.05
2203	Structure Classification, Unclassified	See Subsection 701.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 613 ¾ RETAINING WALLS

613.01 DESCRIPTION. Construct a standard gravity, cast-in-place reinforced concrete (CIP), or gabion retaining wall as specified in the Contract.

613.02 MATERIALS. Use the same material throughout all individual walls, and at both ends of all individual structures. Use only approved systems and materials.

613.02.01 Concrete. Conform to Section 601.02 and 601.03.

613.02.02 Reinforcing Steel. Conform to Section 811**.**

613.02.03 Joint Materials. For CIP walls conform to Section 807.

613.02.04 Geotextile Fabric. Conform to Section 843, Table I. Use fabric sheets with a minimum width and lap of 18 inches for vertical joints, one foot for horizontal joints, and 4 inches for all laps in fabric.

613.02.05 Granular Embankment. Conform to Section 805.

613.02.06 Gabion Baskets. Conform to Section 813.

613.02.07 Gabion Fill Material. Conform to Section 805.

613.02.08 Grout. Conform to Subsection 601.02.

613.03 CONSTRUCTION.

613.03.01 Design. When the plans do not include a complete design for the retaining wall, provide all design calculations, shop drawings, and construction plans required.

Comply with Subsection 107.05, covering the use of patented devices, materials, and processes.

1) Design the wall through a Registered Professional Engineer.
2) Design the wall in conformance with the AASHTO Standard Specifications for Highway Bridges, current edition and all published interims, and all other AASHTO or Industry specifications required by the plans.
3) Require a minimum top wall thickness of 10 inches for standard gravity walls and a 9 inches minimum for all other CIP walls.
4) No materials are to be furnished and no fabrication or work done before the Department's review of the proposed design, drawings, and instructions.

613.03.02 Foundation. Excavate the foundation bed for the retaining wall as required. Before wall construction, compact the foundation to 95 percent of the maximum density as determined by KM 64-511. Remove and replace all foundation soils found unsuitable. If shown on the plans or directed by the Engineer, place structure granular backfill to the dimensions required under the footings or bottom units. Obtain approval by the Engineer before erection is started.

613.03.03 Standard Gravity Wall. Construct according to Standard Drawing No. RGX-002. Construct walls, footings, leveling pads, copings, and all other cast-in-place appurtenances using Class B concrete according to Subsection 601.03. When the wall will be surcharged, special drawings are required.

Ensure the base width is half the vertical height of the wall and the top width is one foot. Place transverse expansion joints 1/2 inch in width at minimum intervals of 30 feet throughout the length of retaining walls and fill with expansion joint material.

All exposed edges shall be beveled 3/4 inch.

When it is not practical to pour the wall to full height in one operation, ensure construction joints are truly horizontal and provide a bond between the sections with keys formed by beveled timbers. Where necessary to provide construction joints in the length of the wall, ensure joints are truly vertical and provide a bond between the sections with shear keys formed by beveled timbers.

Grout around and behind all pipes in the wall face. Proportion grout according to Subsection 601.03.

At the end of each day's operation slope the last level of the backfill away from the wall facing to direct runoff away from the wall face. Do not allow surface runoff from adjacent areas to enter the wall construction site.

When shown on the Plans or directed by the Engineer, backfill with structure granular backfill.

613.03.04 CIP Walls. Construct according to the structure plans.

613.03.05 Joints. Provide contraction joints at 30-foot intervals and 1/2-inch expansion joints at 100-foot intervals in all standard gravity and CIP walls. Provide 1/2-inch joint material in all expansion joints. Place 24-inch long, 1/2-inch diameter, commercial grade steel dowels and 12-inch long, 5/8-inch inside diameter, commercial grade steel dowel sleeves across the joint. Provide caps on one end of the sleeves. Grease one end of the dowel and insert into the sleeve. Space dowels and sleeves at 12-inch intervals along the centerline of the wall stem. Do not pass reinforcing steel through either joint. Seal joints from top to bottom with waterstops.

613.03.06 Drainage. Provide 4-inch weep hole drains at 8-foot intervals through standard gravity and CIP walls. Place fabric wrapped backfill drains at each weep hole according to Subsection 603.03.05. Place weep hole inverts 6 inches above finish grade at the front face.

613.03.07 Gabion Walls. Construct according to Standard Drawings and the Contract. Place the basket flat on the ground, flatten any kinks or bends, and erect the sides, ends and diaphragms. Ensure all creases are in the correct position and the tops of all sides level. Lace the 4 corners of the basket together with alternating single and double loops at 5-inch intervals. Secure both ends of the lacing wire by looping and twisting. Install and lace internal diaphragms in the same manner. Place the individual assembled baskets in their proper location. Connect all adjoining baskets using individual tie wires looped and twisted at approximately 3-inch intervals along the entire perimeter of their contact surfaces.

Partially fill the first basket in line for anchorage and stretch the connected gabions to proper alignment using a come-along or other means of at least one ton capacity. Keep the baskets in tension while filling. Control joints to avoid any unravelling. Filled in one-foot layers, in a manner that will minimize voids. Place 2 connecting wires in each direction between each layer in all cells by looping lacing wire around 2 mesh openings in the front and back face, and in the ends and diaphragms. Securely fasten the ends of the connecting wires to prevent their loosening under tension. Fill cells in each course of in stages. Do not allow any cell at any time to be filled to a depth exceeding one foot more than the adjoining cell. Level the last layer of stone with the top of the basket to allow proper closing of the lid and provide an even surface for the next course. Stretch the lids tightly over the stone fill using crowbars or similar methods, until the lid meets the edges of the front and ends. Tie the lids along all edges, ends, and diaphragms in the same manner as required for connecting adjoining baskets. Place and connect succeeding courses or tiers as specified for the first course. Offset vertical joints for succeeding courses at least 18 inches from course to course. Place baskets as headers or stretchers in accordance with the Contract. Tie each course of baskets to the lower course after stretching but before filling, with individual tie wires looped and twisted at approximately 3-inch spacing along all edges and diaphragms. Reinforce vertical edges at each end of the wall that are not connected to an adjoining basket by looping and twisting individual

tie wires at approximately 3 inches spacing the full length of such edges.

Ensure the stone fill is firmly in place, bulging or distortion of the filled baskets is minimal, and all lacing and tying is thoroughly wound, looped and twisted to preclude loosening in service.

613.04 MEASUREMENT. The Department will measure items such as concrete barriers that are not a part of normal retaining wall construction as the wall area. When barriers are constructed on retaining walls, the plans will show the top of the wall for payment purposes.

The Department will consider all joint material, design calculations, shop drawings, and construction plans with required corrections, manufacturer supplied technical assistance incidental to the retaining wall.

613.04.01 Standard Gravity and CIP Walls. The Department will measure concrete, steel reinforcement, and structure excavation according to Subsections 601.04, 602.04, and 603.04, respectively. The Department will consider backfill, foundation preparation, portions of the footings for cast-in-place walls outside of the approved gross area, structure granular backfill, and geotextile fabric required incidental. The Engineer may include portions or all of the footings for cast-in-place walls in the gross area as shown on the plans. The Department will include the WWF dowel and dowel sleeves in the weight of steel reinforcement.

613.04.02 Gabion Walls. Unless the Contract provides for payment based on field measurements, the Department will not measure gabion walls but will make final payment at the Contract unit price for the design quantity, increased or decreased by authorized adjustments.

The Department will measure structure excavation according to Subsection 603.04.

613.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8100-8105, 2555	Concrete	See Subsection 601.05
8150	Steel Reinforcement	See Subsection 602.05
8160	Structure Excavation	See Subsection 603.05
2223	Granular Embankment	Cubic Yard
2610	Retaining Wall, Gabion	Cubic Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 614 ¾ MAINTENANCE CLEANING AND PAINTING STEEL BRIDGES

614.01 DESCRIPTION. Clean and prepare all surfaces to be painted; furnish and apply all paint; maintain, protect, and control all pedestrian and vehicular traffic; and protect the structure and all other property against damage that may result from this work. The surfaces to be painted include all structural steel surfaces and other exposed metal surfaces that may exist within the limits of the project, such as handrails, guardrails, cables, wire fence, light fixtures, metal flooring, and other metal appurtenances, except items specifically deleted in the Contract.

614.02 MATERIALS AND EQUIPMENT.

614.02.01 Paint. Conform to Section 821 or as the Contract designates.

614.02.02 Brushes. Use brushes not exceeding 4 inches in width. Maintain brushes in a usable and acceptable condition at all times.

614.02.03 Spraying Equipment. Conform to the paint manufacturer's recommendations. Use equipment that applies the paint in a fine, even spray without adding thinner. Provide adequate separators and traps in the air spraying equipment to remove all water and oil from the compressed air.

614.03 CONSTRUCTION.

614.03.01 Responsibility for Damage. Protect all pedestrian, vehicular, and other traffic upon or beneath the bridge; all adjacent property; and all portions of the bridge superstructure and substructure against damage or disfigurement by paint or paint materials.

When performing work in urban areas, or when developed areas exist in the close vicinity of the work, submit for the Engineer's review a detailed written outline, including sketches, if necessary, of the proposed methods to prevent damage to these areas from the work. Include specific information for protecting vehicular traffic on or beneath the bridge, boats and marinas beneath the bridge, and buildings or other property in the vicinity of the bridge. Do not begin work until the Engineer reviews and accepts the protection methods.

Take sole responsibility for all damage resulting from painting operations, even if the Engineer reviewed and accepted the protection methods.

614.03.02 Seasonal and Weather Limitations. Do not paint between November 15 and April 1 unless the Engineer provides written permission. Apply paint only when the temperature measured at the area of the bridge to be painted is 40 °F or greater; the surface temperature of the steel members to be painted is at least 5 °F above the dew point temperature; and the relative humidity measured at the site is 90 percent or less. Do not apply paint when the surfaces are hot enough to cause the paint to blister or produce a porous film; when the air is misty; when there is moisture or frost on the surfaces; or when other weather conditions, in the judgment of the Engineer, are unsatisfactory for work.

614.03.03 Prosecution of the Work. Upon beginning the operation of cleaning and painting, proceed with the operation on all working days, without stoppage, until completion. When specified in the Contract, submit a schedule proposing the sequence and time needed to clean and paint all structures included in the Contract.

Clean and paint all areas in strict conformance with the Contract, unless the Engineer approves alternate methods in writing.

614.03.04 Maintaining Traffic. Maintain all pedestrian, highway, railway, and waterway traffic while working. Do not leave cleaning or painting equipment on the roadways or sidewalks of any structure overnight.

Furnish and erect all necessary warning signs and other traffic control devices as directed to ensure public safety and convenience.

614.03.05 Surface Preparation. Before applying any paint, thoroughly clean and properly prepare all surfaces to be coated, including drains, expansion dam troughs, and other areas subject to build up of rust and debris, to the satisfaction of the Engineer. Expect that surface conditions may vary throughout the structure, requiring different cleaning methods to prepare the surfaces for painting. Remove all contaminants that might prevent paint from adhering tightly to the underlying surface.

Pressure wash and tool clean all steel surfaces to be overcoated to requirements specified in the Contract. Obtain the minimum acceptable surface quality immediately before painting that corresponds to the Contract requirements. Do not apply paint until the Engineer inspects and accepts the cleaned surfaces.

Remove and clean all trash, debris, and other foreign substances from pockets and crevices and from around expansion dams, bearing plates, shoes, etc. Clean the entire surface of the bridge seat on each unit of the structure. Cut and remove all tree limbs or other growth overhanging or fouling the structure.

Proceed with cleaning by sections, bays, or other readily identifiable parts of work. Completely clean each section, bay, or part, and have it inspected and accepted by the Engineer before applying any paint. Provide safe access to the work to allow the Engineer to properly inspect the cleaning and painting.

When traffic or any other source produces an objectionable amount of dust, prevent dust and dirt from coming in contact with the cleaned or freshly painted surfaces.

614.03.06 Paint Application. Before beginning painting, provide the Engineer with the manufacturer's technical data sheets, safety instructions, material safety data sheets, and application instructions for the paint to be used.

When necessary or requested by the Engineer, furnish a technical representative from the paint manufacturer to observe the initial application of all coatings used, to advise as to proper application techniques, and to determine that proper results are being obtained. Ensure that the technical representative is also available to visit the project at all times during the work if the Engineer requests or deems a visit is necessary.

Spread the paint smoothly and uniformly, and work it into all corners and crevices without allowing excess paint to collect at any point. When the Engineer determines that work done by spraying or rolling is not satisfactory, the Engineer may require hand brushing or removing and repainting. Apply paint with sheepskin daubers on surfaces inaccessible to brushes. When applying paint with spray equipment, immediately brush the area sprayed as necessary to secure uniform coverage and to eliminate wrinkling, blistering, and air holes.

Paint from the top toward the bottom, and proceed by sections, bays, or parts of the work, as directed or as specified. Finish painting each coat on each section, bay, or part of work before applying a succeeding coat to any portion of that section, bay or part. Ensure that each coat is thoroughly dry throughout the full thickness of the coat before applying another coat.

Conform to the tolerance requirements of Appendix A, Tabulation of Construction tolerances or as the Contract specifies.

A) Thinning. Do not thin paint unless the Engineer gives written permission. Add only thinners specified or recommended in writing by the manufacturer according to the written recommendations of the manufacturer. Provide the Engineer with the manufacturer's technical data sheets and application instructions for the thinner and its use with the paint.

B) Mixing. Thoroughly mix the paint in the original containers. Use a mechanical mixer to mix the paint so the pigment is in uniform suspension.

Frequently stir the paint to keep it thoroughly mixed while being applied to keep the pigments in suspension, according to the paint manufacturer's written instructions or as directed.

C) Marking. Stencil the Maintenance Project Number, the month and year of the painting completion date, and any existing panel numbering system or any panel numbering system set forth in the Contract on the structure at approved locations. Make the legend in letters and numerals 2 inches high, and use a paint color that contrasts with the background.

614.03.07 Unsatisfactory Work. Remove paint, at any stage of its completion, that the Engineer finds unsatisfactory, and clean, prepare again, and repaint the surface at no expense to the Department and to the satisfaction of the Engineer. Unsatisfactory work includes but is not be limited to:

1) failure to properly clean and prepare the surface;
2) poor workmanship in application of the paint;
3) painting with impure, improperly mixed, thinned, or unauthorized paint; and
4) failure of the paint to adhere to the metal or to previously applied paint coat.

614.04 MEASUREMENT. The Department will measure the quantity as a lump sum unit. The Department will not measure necessary cleaning and painting; and furnishing all materials, equipment, tools, tackles, and scaffolding for separate payment but will consider them incidental to this item of work. The Department will consider having the manufacturer's technical representative present incidental to this item of work.

614.05 PAYMENT. The Department will pay for this work at the lump sum Contract price for Clean and Paint Structural Steel, or a designated section of a structure. The Department will base partial payments on Department estimates per section as the work progresses. When the structure is not divided into sections, the Department will consider the entire structure as one section for pay purposes. For purposes of partial payments, the Department will allocate percentages of the lump sum Contract price to the various phases of the work as set out below depending on the number of paint coats specified.

The Department will make payment for the completed and accepted quantity under the following:

Code	Pay Item	Pay Unit
8434	Clean and Paint Structural Steel	Lump Sum[(1)]

[(1)] *Two-Coat System. When the specified number of paint coats consists of a prime coat and finish coat, the Department will allocate 40 percent to the satisfactory cleaning and acceptable spot painting (if applicable), 30 percent to the acceptable application of the prime coat of paint, and the remaining 30 percent to the acceptable application of the finish coat of paint.*

Three-Coat System. When the specified number of paint coats consists of a prime coat, an intermediate coat, and a finish coat, the Department will allocate 10 percent to the satisfactory cleaning and spot painting (if applicable), 40 percent to the acceptable application of the prime coat, 25 percent to the acceptable application of the intermediate coat, and the remaining 25 percent to the acceptable application of the finish coat.

The Department will consider payment as full compensation for all work required under this section.

DIVISION 700

DRAINAGE, TRAFFIC, AND ROADSIDE CONSTRUCTION

SECTION 701 ¾ CULVERT PIPE, ENTRANCE PIPE, STORM SEWER PIPE, AND EQUIVALENTS

701.01 DESCRIPTION. Furnish and install culvert pipe, entrance pipe, and storm sewer pipe. Use units conforming to the dimensions, fabrication, material, and strength requirements for the type (culvert, entrance, or storm sewer), diameter, cover height, and pH level the Contract specifies. This work may include removing pipe, and relaying pipe.

701.02 MATERIALS.

701.02.01 Pipe. Conform to Section 810 for the following:

1) Reinforced Concrete Circular Pipe.
2) Reinforced Concrete Horizontal Elliptical Pipe.
3) Corrugated Steel Circular Pipe with Helical Lock Seam or Helical Welded Seam.
4) Corrugated Steel Circular Pipe with Longitudinal Riveted or Spot Welded Seam.
5) Corrugated Steel Pipe Arch.
6) Corrugated Aluminum Alloy Circular Pipe with Helical Lock Seam.
7) Corrugated Aluminum Alloy Pipe Arch.
8) High Density Polyethylene (HDPE) Pipe (Thermoplastic).
9) Polyvinyl Chloride (PVC) Pipe (Thermoplastic).
10) Spiral Rib Steel Circular Pipe.
11) Spiral Rib Steel Pipe Arch.
12) Spiral Rib Aluminum Alloy Circular Pipe.
13) Spiral Rib Aluminum Alloy Pipe Arch.

701.02.02 Structural Plate Pipe. Conform to Section 809 for the following:

1) Corrugated Aluminum Alloy Circular Pipe with Longitudinal Seam with Aluminum or Steel Bolts.
2) Corrugated Aluminum Alloy Circular Pipe Arch with Longitudinal Seams with Aluminum or Steel Bolts.
3) Corrugated Steel Pipe Arch with Longitudinal Seams with Steel Bolts.
4) Corrugated Steel Pipe with Longitudinal Seams with Steel Bolts.

701.02.03 Joint Materials.

A) Mortar Joints. Conform to Section 801 for cement and Section 804 for mortar sand.
B) Asphalt Mastic Joint Sealing Compound. Conform to Section 807.
C) Rubber Gaskets. Conform to Section 807.
D) Flexible Plastic Gaskets. Conform to Section 807.
E) Elastomeric Seals. Conform to ASTM F477.
F) Couplings for Thermoplastic Pipe. Conform to Section 810.
G) Cleated and Non-Cleated, Integral Welded Bell Coupler with Gaskets. Conform to Section 810.

701.02.04 Bedding Materials. Use No. 8 aggregate, No. 9M aggregate, or a crushed aggregate up to 3/8-inch maximum size, for bedding material. Do not use a DGA or gravel base material for bedding material.

701.02.05 Backfill Materials.

A) Granular Backfill.

1) For Reinforced Concrete Pipe. Use size No. 2, 23, 3, 357, 4, 467, 5, 57, 67, 68, 78, 8, or 9M aggregate or material conforming to AASHTO M 145 Al, A2 or A3 material with a maximum plasticity index of 10 (see table below). Limit rock fragments to a 3-inch maximum size.
2) For Corrugated Metal Pipe. Use size No. 2, 23, 3, 357, 4, 467, 5, 57, 67, 68, 78, 8, or 9M aggregate or material conforming to AASHTO M 145 Al, A2 or A3 material with a maximum plasticity index of 10 (see table below). Limit rock fragments to a size that does not exceed the corrugation width.
3) For Thermoplastic Pipe. Use size No. 5, 57, 67, 68, 78, 8, or 9M aggregate or material conforming to AASHTO M 145 Al or A3 material (see table below). Limit rock fragments to a 1.5-inch maximum size. For corrugated pipe, limit rock fragments to a size that does not exceed the corrugation width or 1.5 inches, whichever is least.
4) For Structural Plate Pipe. Use Structure Granular Backfill conforming to Section 805.

A1, A2, and A3 Characteristics[1]				
		A1	A2	A3
Sieve Analysis:	Percent passing No. 10	—	—	—
	Percent passing No. 40	50 max	—	51 max
	Percent passing No. 200	25 max	35 max	10 max
Plasticity index of material passing No. 40		6 max	10 max	—

[1] *For a complete description see AASHTO M 145*

B) Flowable Fill. Conform to Subsection 601.03.03 B).

701.02.06 Embankment. Conform to Subsection 206.

701.02.07 Geotextile Fabric Material. Use Type IV fabric with a minimum width of 36 inches conforming to Section 843.

701.02.08 Asphalt Material for Coating. Conform to Section 806.

701.03 CONSTRUCTION.

701.03.01 Pipe Foundations. Take soundings for the pipe foundation design at the inlet and outlet, and along the grade line of each culvert on 20 foot intervals. Take the soundings to a depth of 1/2 inch per foot of embankment height (measured from the crown of the pipe to the maximum fill height) or 24 inches, whichever is greater.

Where rock foundations (ledge rock, gravel, hardpan or other unyielding material) are encountered or known to exist within the limits specified, prepare the foundation according to the Standard Drawings.

Where unstable (soft) foundations are encountered at the established grade line, remove the material that the Engineer determines is unstable and replace with a material conforming to Subsection 701.02.04. The Department will determine the depth of the over excavation by a soils investigation for the specific structure. Wrap the replacement material in geotextile fabric when backfilling.

701.03.02 Trench Conditions. Install all pipe in excavated trenches. Where an embankment condition exists, excavate the trench only after constructing the embankment according to Section 206 to an elevation equal to, or greater than, the minimum cover height of the pipe.

701.03.03 Pipe Bedding. Construct bedding according to the Standard Drawings and this section. Shape the bedding to conform to the invert shape throughout the entire width and length of the proposed structure. Place the bedding up to an elevation of 0.30 the culvert diameter.

701.03.04 Pipe Hauling, Handling, and Installation. Furnish a copy of the manufacturer's handling and installation procedures to the Engineer before beginning work. Ensure that pipe structures do not sustain damage during loading, unloading, placement on the bedding, compaction of the backfill, by movement of excessively heavy equipment over the fill, or by any other forces that may cause damage. Repair or replace damaged structures as the Engineer directs. Remove and replace any structure that is not constructed to true alignment or shows undue settlement after installation, or is otherwise damaged, without additional compensation.

A) Reinforced Concrete Pipe. Install the pipe beginning at the outlet end of the culvert, with the bell or groove end laid upgrade. Extend successive spigot or tongue ends fully into each adjoining bell or groove. When the pipe includes markings to designate the top and bottom, lay the pipe so the mark is less than 5 degrees from the vertical plane throughout the longitudinal axis of the pipe. Cover all lift holes after installing the pipe by the following:

1) Coat an area 8 inches or wider than the holes on the outside of the pipe with an asphalt coating material;
2) Place a piece of sheet metal 4 inches or wider than the holes and shaped to conform to the outer pipe diameter over each hole; and
3) Apply an additional coating of asphalt material over the entire area of previously applied metal. When desired, use precast lift hole plugs instead of the asphalt and sheet metal.

B) Corrugated Metal Pipe.

1) Asphalt Coating. Apply according to AASHTO M-190.
2) Transporting and Handling. Transport and handle coated pipe using equipment and methods that prevent damage to the coating. When storing pipe on the project, keep it supported above the ground using wooden timbers or pallets. Repair minor damage to exterior and interior coating with asphalt coating material according to AASHTO M 243 or as the Engineer directs before installing the pipe. Repair significant damage and coating deficiencies at the pipe fabrication site as the Engineer directs. Significant damages include spalled coating on the interior of the pipe, uncoated areas due to manufacturing error, and insufficient coating thickness on the interior or exterior of the pipe.

   At all times during construction, use every precaution to prevent damage to the protective coating. Do not allow any metal tools or heavy objects to unnecessarily come in contact with the finished coating. Repair any damage to the protective coating from any cause during installation and before final acceptance as the Engineer directs.
3) Installing. Assemble according to the manufacturer's instructions. Install in the bed starting at the downstream end. When using corrugated metal pipe with paving material, install the pipe with paving material along the bottom centerline or flowline. Construct struts and vertical elongation of corrugated metal pipe as specified in the Plans. Remove the struts only after completing the embankment over the structure.

C) Thermoplastic Pipe. Handle thermoplastic pipe according to the manufacturer's recommendations. Provide a manufacturer's technical representative to assist in the installation of the pipe when the Engineer requests.

D) Structural Plate Pipe. Install the pipe according to the manufacturer's specifications and installation procedures. When the Engineer requests, provide a manufacturer's technical representative to assist in pipe construction. Do not place backfill until all plates in a ring are complete and all bolts in the structure are tightened.

701.03.05 Joints. Provide soil tight joints. Wrap all pipe joints with a geotextile fabric when their inner diameters are 54 inches and greater.

A) Reinforced Concrete Pipe. Use only one type of jointing materials system throughout each single structure. Construct joints for reinforced concrete pipe with one of the following options.

1) Mortar Joints. Use a mixture containing one part cement and 2 parts sand. Use enough water, not exceeding 5 1/2 gallons per sack of cement, to product a stiff, workable mortar. Thoroughly clean and wet the ends of the pipe before joining them. Place the mortar in the lower half of the bell or groove section that has been laid, and apply mortar to the upper half of the spigot or tongue of the pipe that is being laid. Insert the spigot or tongue in the bell or groove of the pipe already laid, pull the joint tight, and ensure that the inner surfaces of the abutting sections are flush and even. After laying a section of the pipe and before laying the succeeding section, thoroughly plaster the lower portion of the bell or groove of the preceding section on the inside with mortar to such a depth to ensure a smooth joint between the abutting sections. Fill the remainder of the joint flush with mortar. Finish the inside of the joint and wipe smooth around the full circumference. After the initial set, protect the mortar from air and sun with a burlap cover, or permanently backfill.
2) Asphalt Mastic Joints. Immediately before installation, apply the asphalt mastic joint sealing compound to the ends of the pipe section in the same manner as mortar joints except precoat all joining surfaces. Precoat with the manufacturer's recommended primer or an approved emulsified asphalt. Apply enough sealer to extrude a bead of the compound from the joint on the inside and outside of the pipe when completely meshed. Remove excess material to form a smooth, flush joint.
3) Rubber Gaskets. In addition to the requirements of Subsection 701.02, use a pipe section conforming to AASHTO M 198. Use the gasket manufacturer's recommended cement and lubricant. Snugly fit the rubber gasket in the beveled surface of the tongue and groove ends of the sections to form a flexible seal under all conditions of service.

When a joint is located 12 feet or less from the outlet on a 3:1 or steeper slope, provide a tied joint according to the Standard Drawings.

B) Corrugated Metal Pipe. Construct joints using a band with annular corrugations and a bolt, bar and strap connector. Use a minimum nominal band width of 12 inches for pipe less than 42 inches in diameter and a minimum nominal band width of 24 inches for pipe 42 inches in diameter or greater. Use a nominal 24-inch or wider band regardless of pipe diameter whenever a joint is within 12 feet or less from an outlet on a 3:1 or steeper slope. Ensure the band is manufactured from the same base material as the pipe it is joining. The Department may allow dimple band connections for

field cut pipe. Install the connecting bands according to the manufacturer's written recommendations.

C) Thermoplastic Pipe. Use an integral bell and spigot type with elastomeric seal joints. When a joint is located 12 feet or less from the outlet on a 3:1 or steeper slope, use a cleated integral bell locking joint or a standard coupling aided by two #14 by 2-inch galvanized sheet metal screws inserted through the coupling into the corrugation crest 2 inches apart circumferentially at the bell and spigot coupler's quarter points.

701.03.06 Initial Backfill. Locate a suitable backfill source for each project. For backfill containing soils, have an AASHTO accredited lab classify the material, run a standard proctor, and certify that the material conforms to the specified granular material. Keep the material certification on file and available to the Engineer upon request.

Place the backfill material in a trench condition as the Contract specifies. Use 6-inch lifts and ensure the backfill is compacted to not less than 95 percent of the maximum density as determined according to KM 64-511.

When the top of the pipe is within one pipe diameter of the subgrade, backfill with flowable fill to an elevation of one foot above the pipe from the outside edge of shoulder or back of curb to outside edge of shoulder or back of curb as applicable. When installing under existing pavement, backfill with flowable fill to the subgrade elevation.

When granular backfill is used, the surrounding conditions are not similar in gradation, and the pipe is located within the area bounded by the centerline and a distance 25 feet outside the edge of shoulder or back of curb, as applicable, wrap the bedding and granular backfill in geotextile fabric. The Department will not require geotextile fabric for entrance pipe. When geotextile fabric is required according to this section or the Engineer's direction, install according to Section 214.

When the Contract specifies, perform quality control testing to verify compaction according to KM 64-412. The Department may verify the density results at any time of the duration of the project.

A) Reinforced Concrete Pipe. When the top of the pipe is not within one pipe diameter of the subgrade, use either granular backfill or flowable fill up to the springline, an elevation equal to 1/2 the pipe diameter, and either granular backfill, flowable fill, or embankment material in 6-inch lifts to an elevation of one foot above the pipe.

B) Corrugated Metal, Thermoplastic, and Structural Plate Pipe. When the top of the pipe is not within one pipe diameter of the subgrade, backfill with either granular backfill or flowable fill to an elevation at least one foot above the top of the pipe.

701.03.07 Construction Loads. Do not allow construction equipment or traffic to travel over the top of the structure material until the fill is compacted to a minimum depth of 48 inches over the top of the structure. The Engineer may require temporary cover where the final grade is less than 48 inches. The Engineer may raise but will not lower the minimum cover based on the pipe manufacturer's recommendations.

701.03.08 Testing of Pipe. The Engineer will visually inspect all pipe. The Department may require camera or mandrel testing, KM 64-114, for any pipe when deflection, cracking, joint faulting, or any other interior damage is suspected. If the pipe shows damage, repair or replace as the Engineer directs. If the pipe shows deflection of 10 percent or greater, remove and replace the pipe. If the pipe shows deflection greater than 5 percent but less than 10 percent, the Department will allow the pipe to remain in place at a reduced unit price. Do not pave over any pipe until inspection and any required testing is completed. When paving will not be delayed by the wait, test pipe 30 days or more after backfilling is completed.

701.03.09 End Structures. Construct anchors, concrete headwalls, and other end structures specified in the Plans according to Section 610, Section 710, and the Standard Drawings.

701.03.10 Extensions to Existing Culvert Pipe and Entrance Pipe. Construct pipe extensions for culvert pipe, entrance pipe, and equivalent pipe arches according to this section and the Contract. Remove the necessary portions of the existing structure to provide a neat junction with the extension. Do not damage the portion that is to remain in service. Remove all silt and debris that has accumulated in the remaining portion of the structure for a distance back equal to twice the pipe diameter or as the Engineer directs.

701.03.11 Removing Pipe, Removing and Relaying Pipe. Remove all pipe designated for removal in the Contract. Safely store all reusable pipe. Restore or replace, any pipe designated for reuse that incurs damage or destruction through faulty handling. Relay all removed pipe the Contract designates to be relayed. Where pipe is not to be relayed, fill the area to the existing ground line according to 207.03.

The Department will retain ownership of reusable pipe that is not to be relaid in areas on the project. Unless the Engineer directs otherwise, deliver all reusable pipe not relayed on the project to the designated maintenance facility in the county where the project is located. Take ownership of and remove from the project all pipe that is not designated for reuse or salvage.

701.04 MEASUREMENT.

701.04.01 Culvert Pipe. The Department will measure the quantity in linear feet from end-to-end along the bottom or pipe invert of the installed structure. The Department will include bends, elbows, crosses, tees, reducers, laterals, wyes, and other shapes in the pipe lengths measured. The Department will not measure joint materials and bedding materials for payment and will consider them incidental to this item of work. The Department will not measure replacement of damaged pipe for payment and will consider it incidental to this item of work. The Department will not measure for payment the providing of a manufacturer's technical representative to assist in the construction of the pipe and will consider it incidental to this item of work.

701.04.02 Culvert Pipe Equivalent. Culvert Pipe Equivalent includes elliptical culvert pipe and culvert pipe arches. The Department will measure the quantity in linear feet according to Subsection 701.04.01.

701.04.03 Entrance Pipe. The Department will measure the quantity in linear feet according to Subsection 701.04.01.

701.04.04 Entrance Pipe Equivalent. Entrance Pipe Equivalent includes elliptical entrance pipe and pipe arches. The Department will measure the quantity in linear feet according to Subsection 701.04.01.

701.04.05 Storm Sewer Pipe. The Department will measure the quantity in linear feet according to Subsection 701.04.01.

701.04.06 Storm Sewer Pipe Equivalent. Storm Sewer Pipe Equivalent includes elliptical storm sewer pipe and storm sewer pipe arches. The Department will measure the quantity in linear feet according to Subsection 701.04.01.

701.04.07 Testing. When testing is performed due to a disagreement with a visual inspection and the Department is in error, the Department will measure the quantity as Extra Work according to Subsection 104.03.

701.04.08 Geotextile Fabric, Type IV. The Department will measure the quantity

in square yards.

701.04.09 Flowable Fill. The Department will not measure the quantity for payment and will consider it incidental to the pipe bid item. When the Engineer determines that it is necessary and to the Department's benefit to excavate beyond the typical excavation limits shown in the Standard Drawings, the Department will measure the quantity of flowable fill required for backfill outside the typical excavation limits as Extra Work.

701.04.10 Embankment-In-Place. The Department will measure the quantity where there is unstable foundation material in excess of 3 times the width of outside diameter of the pipe or the width of the outside diameter plus 4 feet, whichever is less, in cubic yards according to Subsection 206.04.

701.04.11 Roadway Excavation. The Department will measure the quantity for removal of unstable foundation material in excess of 3 times the width of outside diameter of the pipe or the width of the outside diameter plus 4 feet, whichever is less, in cubic yards according to Subsection 204.04.

When using Special Design, the Department will measure the quantity by the length of the trench the Contract specifies or as the Engineer directs. The Department will not measure backfilling the trench with bedding material for payment and will consider it incidental to this item of work.

The Department will not measure any other excavation and will consider it incidental to Culvert Pipe, Entrance Pipe, and Storm Sewer Pipe.

701.04.12 Pipe Undercut. The Department will measure the quantity for removal of unstable foundation material or bedded rock in cubic yards up to a maximum of 3 times the width of the outside diameter of the pipe or the width of the outside diameter of the pipe plus 3 feet, whichever is less, and to a depth of up to 2 feet. The Department will measure the quantity at a depth of greater than 2 feet as Extra Work according to Subsection 109.04.

701.04.13 Structure Excavation Unclassified. When the Engineer changes the pipe's plan length or location and causes the required excavation to increase more than 10 percent above the original average excavation per yard, the Department will measure the quantity in cubic yards according to Subsection 603.04. When the Department requires a substantial increase in excavation, submit verification to the Engineer before starting excavation. The Engineer will then measure the quantity of excess volume. The Department will not consider the excavation of unstable material from the foundation when determining the percentage of material increase.

701.04.14 Removing Pipe. The Department will measure the quantity in linear feet of net laying length per section. The Department will measure bends, elbows, crosses, tees, reducers, laterals, wyes, and other shapes in linear feet along the central axis of the unit. The Department will not measure furnishing and placing any borrow material necessary to refill the area to the original ground line for payment and will consider it incidental to this item of work. When the Department retains ownership, the delivery of the pipe to the designated maintenance facility will not be measured for payment and is considered incidental to this item of work.

Unless design quantities are included in the Contract, the Department will not measure pipe within the typical section for payment and will consider it incidental to roadway excavation.

701.04.15 Removing and Relaying Pipe. The Department will measure the quantity according to Subsection 701.04.01. The Department will not measure sections that are damaged or broken for payment and will consider them incidental to this item of work. The Department will not measure furnishing and placing any borrow material necessary to refill the area to the original ground line for payment and will consider them incidental to this item of work. When the Department retains ownership, the

delivery of the pipe to the designated maintenance facility will not be measured for payment and is considered incidental to this item of work.

701.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0460-0482	Culvert Pipe, Size	Linear Foot
0490-0512	Culvert Pipe Equivalent, Size	Linear Foot
0439-0445	Entrance Pipe, Size	Linear Foot
0450-0454	Entrance Pipe Equivalent, Size	Linear Foot
04520-0542	Storm Sewer Pipe, Size	Linear Foot
0551-0572	Storm Sewer Pipe Equivalent, Size	Linear Foot
2598	Fabric-Geotextile, Type IV	Square Yard
2230	Embankment-In-Place	See Subsection 206.05
2200	Roadway Excavation	See Subsection 204.05
2219	Pipe Undercut	Cubic Yard[1]
2203	Structure Excavation, Unclassified	See Subsection 603.05
1310	Removing Pipe	Linear Foot
1312	Removing and Relaying Pipe	Linear Foot

[1] The unit price is $20.00 per cubic yard for pipe undercut 2 feet in depth or less. The Department will pay for pipe undercut exceeding a depth of 2 feet, as specified in Subsection 109.04.

*** The unit price is $2.00 per square yard for Geotextile Fabric, Type III.*

PIPE DEFLECTION DETERMINED BY CAMERA TESTING	
Amount of Deflection (%)	Payment
0.0 to 5.0	100% of the Unit Bid Price
5.1 to 7.5	75% of the Unit Bid Price
7.6 to 8.5	50% of the Unit Bid Price
8.6 to 9.9	25% of the Unit Bid Price
10 or greater	Remove and Replace

PIPE DEFLECTION DETERMINED BY MANDREL TESTING	
Amount of Deflection (%)	Payment
0.0 to 5.0	100% of the Unit Bid Price
5.1 to 9.9	50% of the Unit Bid Price
10 or greater	Remove and Replace

The Department will consider payment as full compensation for all work required under this section.

SECTION 702 ¾ SLOTTED DRAIN PIPE

702.01 DESCRIPTION. Furnish and place slotted drain pipe of the specified size and wall thickness, at the locations specified in the Plans or designated by the Engineer.

702.02 MATERIALS.

702.02.01 Slotted Drain Pipe. Conform to Subsection 810.04.05.

702.02.02 Coupling Bands. Provide coupling bands recommended by the manufacturer.

702.03 CONSTRUCTION. Conform to Section 701.03 and the Standard Drawings for excavation of the pipe trench, pipe placing, and backfill.

Do not begin installing the slotted drain pipe until paving of the traffic lanes adjacent to the pipe has been completed at the location where the pipe is to be installed.

Before backfilling, plug the upgrade end of the slotted drain pipe with a metal cap or by other methods the Engineer approves.

During the backfilling operations and paving operations adjacent to the slot, cover the slot to prevent infiltration of material into the pipe, and do not damage the slotted drain pipe. Remove foreign material that enters the pipe, and repair any damage to the slotted drain pipe to the satisfaction of the Engineer, at no expense to the Department.

702.04 MEASUREMENT.

702.04.01 Slotted Drain Pipe. The Department will measure the quantity in linear feet. The Department will not measure structure excavation, backfill, plugging, removal of foreign material, or coupling bands for payment and will consider them incidental to this item of work.

702.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
0980-0985	Slotted Drain Pipe, Size	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 703 ¾ SLOPE PROTECTION AND CHANNEL LINING

703.01 DESCRIPTION. Furnish and place the specified material for a protective covering for slopes or linings in channels and ditches, according to the Contract or as the Engineer directs. Slope protection includes the following types: Reinforced Concrete Slope Wall, Cyclopean Stone Riprap, and Crushed Aggregate Slope Protection. Channel lining includes the following types: Class IA (mattress units), Class II, Class III, and Class IV (prepared from rock excavation).

703.02 MATERIALS.

703.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

703.02.02 Steel Reinforcement. Conform to Section 811.

703.02.03 Coarse Aggregate. Conform to Section 805.

703.02.04 Fine Aggregate. Conform to Section 804, natural sand.

703.02.05 Joint Material. Conform to Section 807, preformed joint filler.

703.02.06 Drain Pipe. Conform to Section 810.

703.02.07 Mattress Units for Channel Lining Class IA. Conform to Section 813.

703.02.08 Anchor Bars for Channel Lining, Class IA. Use Grade 40 or better steel reinforcing bars conforming to the dimensions shown on the Standard Drawings. The Engineer will base acceptance of the anchor bars on visual inspection.

703.02.09 Geotextile Fabric. Use Type I fabric conforming to Section 845.

703.03 CONSTRUCTION.

703.03.01 Slope Protection.

A) General. Do not allow slopes on which protection is placed to be steeper than the natural angle of repose. Shape the slopes to the slope and contour indicated or as the Engineer directs. Use slope templates in determining the slope. Bring depressions to the required slope line with fill material moistened and compacted as the Engineer directs.

Unless solid rock is encountered, begin all slope protection, except crushed aggregate slope protection, in a trench 2 feet below the natural ground. Where solid rock is encountered, stop the lower terminus of the slope protection at the solid rock line unless the Engineer directs otherwise.

Unless solid rock is encountered, underlay cyclopean stone riprap, crushed aggregate slope protection and all classes of channel lining with geotextile fabric.

B) Reinforced Concrete Slope Wall. Use 6-inch slope walls on slopes 1/4 to one or flatter.

Construct porous aggregate underdrains at the location of all construction joints at the intervals shown on the Standard Drawings. Ensure that the porous aggregate underdrains consist of a 12-inch by 12-inch trench excavated in the earth or solid rock and filled with coarse aggregate or natural sand. Place weep holes along the toe of the reinforced concrete slope walls at a maximum of 10-foot intervals. Construct weep holes by using 4-inch diameter pipe or suitably formed 4-inch diameter holes through the walls.

Construct slope walls using Class A concrete according to Subsection

601.03. Construct slope walls using the size, position, width of sheets, length of laps, and diameter of the mesh shown on the Standard Drawings. Construct the finished slope walls with an even, smooth surface that will not show a variation from a true plane of more than 1/2-inch in 4 feet. Build warped or curved surfaces to the same degree of accuracy as plane surfaces. Cure concrete according to Subsection 601.03. After completing the slope protection, backfill excavated areas that are not filled by slope protection to the surface of the original groundline.

C) Cyclopean Stone Riprap Slope Protection. Construct cyclopean stone riprap to a minimum thickness of 2 feet measured perpendicular to the slope. The Department will allow dumping stone in place and relocating it in a manner to produce a surface of approximate regularity not varying more than 6 inches from a true plane.

D) Crushed Aggregate Slope Protection. Unless otherwise shown, place the aggregate to a depth of one foot measured perpendicular to the slope flush with the embankment slopes under the bridge; extend it from the face of the abutments or end bents across the berm and down the slope to the toe of the slope; and extend it laterally to 18 inches beyond the outer edges of the superstructure.

The Department will allow dumping the crushed aggregate in place and relocating it in a manner to produce a uniform surface varying no more than 1 1/2 inches in 4 feet from a true plane. The Department will not require hand placing except as necessary to correct irregularities exceeding the specified tolerances.

703.03.02 Channel Lining. Before placing any channel lining materials, excavate and shape the area to receive the channel lining, so that the completed channel lining will be uniform and will conform to the designated lines, grades, and cross section.

A) Channel Lining, Classes II and III. Construct Channel Lining Classes II and III to the dimensions specified in the Plans, Standard Drawings, or as the Engineer directs. The Department will allow dumping the stone in place and relocating it in a manner to produce a surface of approximate regularity, varying no more than 3 inches from a true plane. The Department will not require hand placing except as necessary to correct any surface irregularities exceeding the specified tolerance.

B) Channel Lining, Class IV. Unless solid rock is encountered, begin the channel lining in a trench 2 feet below the natural ground or 2 feet below the channel flowline when the flowline is not lined. Where solid rock is encountered, stop the lower terminus of the slope protection at the solid rock line. Construct Channel Lining, Class IV to the minimum thickness specified in the Plans. The Department will allow dumping the stone in place and relocating it in a manner to produce a surface of approximate regularity not varying more than 6 inches from a true plane.

C) Channel Lining, Class IA. Construct according to the Standard Drawings. Set empty mattress units to the required line and grade. Use lacing wire to join the units together.

After the mattress units are set to line and grade, stretch them to remove any kinks from the mesh and to hold alignment.

Fill the mattress units with stone. Place by hand or machine to ensure good alignment. Avoid bulging of the mesh by minimizing voids between the stones. After filling a unit, close its top so that it meets the sides and ends of each mattress unit. Then, secure the top to the sides, ends, and the diaphragms with lacing wire as shown on the Standard Drawings.

When placing the mattress unit on a grade, begin placing the stone at the bottom of the slope and progress upgrade. Overfill mattress units approximately one inch to allow for settlement.

When space limitations prevent the installation of a complete mattress on the slope, cut the unit to fit in the manner the Plans specify. Drive anchor

bars in place at the locations shown on the Standard Drawings when the grade is 5 percent or greater.

703.04 MEASUREMENT.

703.04.01 Reinforced Concrete Slope Walls. The Department will measure the quantity in square yards of surface area including the area of the front face of concrete placed within the trench below natural ground. The Department will not measure steel reinforcement or any excavation required for the construction of slope protection for payment, and will consider them incidental to this item of work.

703.04.02 Cyclopean Stone Riprap. The Department will measure the quantity in tons. The Department will not measure excavation required for the construction of slope protection for payment and will consider it incidental to this item of work.

703.04.03 Crushed Aggregate Slope Protection. The Department will measure the quantity according to Subsection 703.04.02.

703.04.04 Channel Lining, Class IA. The Department will measure the quantity in tons. The Department will not measure excavation below the upper surface of any channel lining for payment and will consider it incidental to the work. The Department will not measure anchor bars, wire mesh, lacing wire, or other material necessary to acceptably complete the wire mattress units for payment, and will consider them incidental to this item of work.

703.04.05 Channel Lining Class II. The Department will measure the quantity in tons. The Department will not measure excavation below the upper surface of any channel lining for payment and will consider it incidental to this item of work.

703.04.06 Channel Lining Class III. The Department will measure the quantity according to Subsection 703.04.05.

703.04.07 Channel Lining Class IV. The Department will measure the quantity according to Subsection 204.04.

703.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
8014, 8016	Reinforced Concrete Slope Wall, Size	Square Yard
8019	Cyclopean Stone Riprap	Ton
8020	Crushed Aggregate Slope Protection	Ton
2482	Channel Lining, Class IA	Ton
2483	Channel Lining, Class II	Ton
2484	Channel Lining, Class III	Ton
2488	Channel Lining, Class IV	See Subsection 204.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 704 ¾ UNDERDRAINS

704.01 DESCRIPTION. Construct underdrains of perforated pipe, non-perforated pipe, and porous aggregate. When required, construct headwalls according to Section 710, and the Standard Drawings.

704.02 MATERIALS AND EQUIPMENT.

704.02.01 Underdrain Pipe.

A) All Underdrain Pipe Except Edge Drain Outlet Pipe. Conform to Section 810 for the following:

1) Circular Reinforced Concrete Pipe.
2) Corrugated Steel Pipe, Type III.
3) Corrugated Aluminum Alloy Pipe, Type III.
4) High Density Polyethylene (HDPE) Pipe (Thermoplastic).

B) Edge Drain Outlet Pipe. Conform to Section 810 for the following:

1) Corrugated Steel Pipe, Type III.
2) Corrugated Aluminum Alloy Pipe, Type III.
3) High Density Polyethylene Pipe (HDPE), Type S (Thermoplastic).
4) Polyvinyl Chloride (PVC) Pipe (Thermoplastic) as follows:

   a) Smooth. Conform to ASTM D 1785 for Schedule 40, or ASTM D 2241 for SDR 17.
   b) Ribbed. Conform to ASTM F 794 for series 46.
   c) Corrugated. Conform to ASTM F 949.

704.02.02 Coarse Aggregate. Conform to Section 805.

704.02.03 Natural Sand. Conform to Section 804.

704.02.04 Geotextile Fabric. Use Type II fabric conforming to Section 843.

704.02.05 Pipeline Inspection Camera. Provide a pipeline inspection camera for edge drains having the following:

1) Capable of recording the station, milepost, distance into the drain or other indicators of location on the video.
2) A device for measuring the distance the camera has been pushed from the end of the outlet.
3) The ability to record the distance superimposed on the video.
4) An outside diameter no greater than 3 inches.
5) Color capability with a minimum horizontal resolution of 400 lines according to the manufacturer's specifications.
6) Capable of being pushed in the 4-inch outlet pipes and mainline pipes for a minimum of 250 feet to ensure 100 percent inspection coverage on outlets spaced 500 feet apart. Capable of inspecting both ends when there is loop construction.
7) Capable of being pushed or tractored for 1,000 feet in 8-inch or larger pipes serving as a collector system for edge drains without headwalls.
8) A video output jack for connecting a VCR.
9) Capable of being connected to controls, including the VCR, for the pipeline inspection equipment in the inspection vehicle.

704.02.06 VCR. Provide a VCR capable of connecting to the videooutput jack

on the pipeline inspection system for recording the inspection.

704.02.07 Inspection Vehicle. Provide an inspection vehicle that will accommodate the operation of the inspection camera and VCR, and 2 passengers. Provide a pipe inspection operator to operate the vehicle and observe the inspection. The Engineer may accompany the pipe inspection operator in the vehicle at any time.

704.02.08 Flowable Fill. Conform to Subsection 601.03.03 B).

704.02.09 Headwalls. Conform to Subsection 710.02.

704.02.10 Concrete. Conform to Subsection 601.02.

704.03 CONSTRUCTION.

704.03.01 Porous Aggregate Underdrain. Excavate the trench to the lines, grades, and section according to the Contract. Finish the bottom of the trench so that it is smooth and firm. Tamp if necessary.

After preparing the trench, place the aggregate in the trench, in loose layers not exceeding 6 inches in depth, and firmly tamp each layer in place. Use either crushed or uncrushed coarse aggregate, including pea gravel, or natural sand. Continue backfilling the trench with aggregate until the backfill reaches the compacted depth specified in the Plans. When using coarse aggregate, completely wrap the aggregate in geotextile fabric, Type II, according to Subsection 214.03. Backfill above the aggregate with soil that the Engineer approves and tamp in place in layers not exceeding 6 inches loose thickness.

704.03.02 Perforated and Non-Perforated Pipe Underdrains.

A) All Pipe Underdrains Except Pavement Edge Drains. Excavate the trench to a depth of not less than 3 inches below the outside bottom of the plan underdrain elevation and to a width of at least one foot wider than the external diameter of the pipe. Place and compact a minimum 3-inch bedding layer of Size No. 78, 8, or 9M coarse aggregate or natural sand in the bottom of the trench for its full width and length. Then, place pipes true to line and grade.

Place perforated pipe with the perforations in the invert. Join perforated sections with coupling fittings or bands. Where perforated pipe installations outlet into open ditches provide a minimum of 8 feet of non-perforated pipe from the outlet, or obtain the Engineer's permission to use perforated pipe; in which case, position the pipe section or sections so that perforations are located in the top portion of the section or sections. Where installations outlet into open ditches, the Engineer will not require aggregate backfill above and below the pipe for the 8-foot outlet portion.

For non-perforated pipe installations, place the pipe with the bell end upgrade and with open joints not exceeding 3/8 inch. Join the last 2 outlet sections.

Close the upgrade ends of all underdrain pipe installations with plugs to prevent entry of debris. Equip the outlet end of underdrain pipe with a screen.

After placing the pipe, place coarse aggregate or natural sand to a height of at least one foot above the top of the pipe. When using natural sand for backfill, wrap the perforated pipe in geotextile fabric; when using coarse aggregate for backfill, completely wrap the aggregate in geotextile fabric, according to Subsection 214.03. Fill any remaining portion of the trench with either granular or impervious material according to the Contract or as the Engineer directs. Do not allow the minimum height of fill to be more than 2 feet above the top of the pipe, except the Engineer will allow one foot of fill from the top of the pipe to the top of subgrade in cases where 2 feet would

not allow proper installation for drainage. Thoroughly compact the fill material in layers not exceeding 6 inches loose measurement. During placement of the aggregate and granular or impervious material do not damage or displace the pipe.

Encase any pipe that has less than one foot of cover at the outlet end in 6-inch thick concrete of any class or flowable fill. Proportion the concrete or flowable fill according to Subsection 601.03.

B) Pavement Edge Drains. Construct using 4-inch diameter pipe according to Subsection 704.03.02 A) except for the following:

1) Backfilling. When backfilling, place geotextile fabric in the trench and shape to the sides and bottom of the trench without stretching the fabric. Secure the geotextile fabric so that the edges do not pull down into the trench when placing the backfill material. Do not damage the geotextile fabric when placing the filter aggregate. Partially wrap the aggregate according to Subsection 214.03. Fold the fabric over the backfilled trench and secure. Encase any edge drain pipe that has less than 18 inches of cover at the outlet end with concrete of any class or flowable fill. Proportion concrete or flowable fill according to Subsection 601.03.
2) Headwalls for Outlets. When the Contract requires outlet headwalls, the Engineer will require adjustments to the headwalls when necessary to fit existing drainage conditions. Place precast headwalls according to Subsection 710.03.01 B). Install the headwall with a slope of 1/2 inch in one foot. When practical, place the toe of the headwall a minimum of 6 inches above the bottom of the ditch. Place crushed aggregate size No. 2 a minimum depth of 4 inches around the headwall as specified in the Contract.
3) Cored Hole Drainage Box or Cross Drain Headwall Connector. Make the connection according to Section 705. Make the cored hole drainage box connection a minimum of one foot above the bottom of the box. Attach a rodent screen to all edge drain outlet structures according to the Standard Drawings.
4) Construction Near Guardrail. When guardrail is attached to a structure, adjust the placement of the outlet pipe so that guardrail posts will not be driven within one foot of the outlet pipe. When the guardrail is not attached to a structure, adjust the placement of the outlet pipe or the guardrail so that guardrail posts will not be driven within one foot of the outlet pipe. Mark the location of the outlet with paint or other means the Engineer approves. Conduct a mandrel test after driving the guardrail posts by pushing a piece of flexible 2-inch gas pipe through the outlet pipes. Replace all damaged outlets.
5) Field Data. Visually observe the condition of each headwall. Observe the extent of debris blocking the headwall. Provide a description of the debris, the condition of the rodent screen, a description of the ditch line drainage, and the percent grade of the headwall. Take photographs of significant distresses and provide copies of the photographs to the Engineer. Describe the location of these significant distresses and the headwall type for each headwall. Record all observations and data and submit them to the Engineer.
6) Inspection of Edge Drain Systems. Inspect installed pavement edge drain system immediately before placing the final surface.

   Use a pipeline inspection camera to determine if the edge drain system is functioning properly. Beginning at the rodent screen, push the camera through the outlet pipe system and into the mainline edge drain system. Push the camera into the mainline edge drain until there is resistance against further movement, the end of the pipe segment is reached, or for approximately 150 feet, and record this distance. Use the camera as a mandrel for determining locations of compressed pipes when desired. Document observed distresses, including blockages, rips,

separations, backfill in the crushed pipe, crushed pipe, improper couplings, improper connections, and all other distresses. Make all photographic observations on video tape and provide a copy to the Engineer. Record all observations and data and submit to the Engineer.

7) Certification of Edge Drain Systems. Provide certification that the installed pavement edge drain system is functioning properly before formal acceptance of the project.
8) Trenching Material. Use surplus dense graded aggregate from the trenching operations to dress existing shoulders. Dispose of pavement material removed during the trenching operation off the right-of-way at sites the Engineer approves.
9) Corrective Work. The Department may require corrective work when the video or Inspection report indicates there are pipe distresses.

704.04 MEASUREMENT.

704.04.01 Porous Underdrain. The Department will measure the quantity in linear feet along the centerline of the underdrain. The Department will not measure excavation for the trench less than or equal to 4 feet in depth or the geotextile fabric used to wrap coarse aggregate for payment and will consider them incidental to this item of work.

704.04.02 Perforated and Non-Perforated Pipe. The Department will measure the quantity of each size of Perforated and Non-Perforated Pipe in linear feet along the centerline of the pipe. The Department will not measure materials for bedding and backfill, encasement with concrete or flowable fill, geotextile fabric used for wrapping perforated pipe or for wrapping coarse aggregate backfill, or excavation of the trench up to 4 feet in depth for payment, and will consider them incidental to this item of work.

704.04.03 Perforated Pipe Headwalls. The Department will measure the quantity according to Subsection 710.04.

704.04.04 Structure Excavation, Common. The Department will measure the quantity of excavation for the trench in excess of 4 feet in depth in cubic yards. The Department will measure the maximum trench width as that specified in the Plans or Standard Drawings.

704.04.05 Crushed Aggregate Size No. 2. The Department will measure the quantity used for edge drain headwall outlet erosion control by the ton. The Department will not measure removal of excess material for payment and will consider it incidental to this item of work.

704.04.06 Inspect and Certify Edge Drain System. The Department will measure Inspect and Certify Edge Drains System by the lump sum. The Department will not measure corrective work due to the construction operation for payment and will consider it incidental to this item of work.

704.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2679	Porous Underdrain	Linear Foot
1000-1004	Perforated Pipe, Size	Linear Foot
1010-1014	Non-Perforated Pipe, Size	Linear Foot
1020-1035	Perforated Pipe Headwalls, Type, Size	See Subsection 710.05
8001	Structure Excavation Common	See Subsection 603.05
0078	Crushed Aggregate Size No. 2	Ton
1015	Inspect and Certify Edge Drain System	Lump Sum

The Department will consider payment as full compensation for all work required under this section.

SECTION 705 ¾ CORED HOLE DRAINAGE BOX CONNECTOR

705.01 DESCRIPTION. Core drill a hole in the side or sides of existing small drainage structures, and connect the outlet end of 4, 6, or 8-inch underdrain pipe, instead of constructing concrete headwalls on the underdrain pipe.

705.02 MATERIALS.

705.02.01 Non-Shrink Grout. Conform to Subsection 601.03.03 B).

705.02.02 Asphalt Mastic Joint Sealing Compound. Conform to Section 807.

705.02.03 Pipe. Conform to Subsection 704.02. Furnish the same type and size as the underdrain pipe.

705.02.04 Styrofoam Backer Rod. Obtain the Engineer's approval.

705.03 CONSTRUCTION. Cut holes by core drilling into existing small drainage structures at the locations specified in the Contract or where the Engineer directs, without damaging the existing structure. Cut holes of a diameter equal to the outside diameter of the pipe with a tolerance of plus 1/2 inch. Place 2 styrofoam backer rods on the pipe near each wall face, and seal the opening around the pipe with mastic material or a non-shrink grout. Use wyes, tees, and ells in the pipe system to reduce the number of holes to be drilled. Patch all damage to the existing wall in the coring operation with non-shrink grout. Apply non-shrink grout according to Subsection 601.03.

705.04 MEASUREMENT. The Department will measure the quantity by each individual unit. The Department will not measure pipe, wyes, tees, ells, styrofoam backer rods, or repair of damage to existing wall for payment and will consider them incidental to this item of work.

705.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1740-1742	Cored Hole Drainage Box Connector, Size	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 706 ¾ BORING AND JACKING OF ENCASEMENT PIPE

706.01 DESCRIPTION. Provide a bored and jacked encasement pipe under a roadway or other sensitive area.

706.02 MATERIALS.

706.02.01 Welded and Seamless Steel Pipe. Conform to Section 810.

706.03 CONSTRUCTION. Construct access pits on both sides of the area to be tunneled, one for the boring equipment and one on the receiving end.

Use a boring and jacking machine that is capable of keeping the advanced bore hole within the required alignment. Maintain the alignment of the guide rails to the proper line and grade, immediately correcting any possible displacement, until completing the boring and jacking operation.

Use a smooth casing pipe of sufficient strength and diameter to provide a tight fit against the earth sides of the bore hole and of sufficient size to allow installation of the carrier pipe and any required positive anchorage. Weld the joints with a continuous circumferential weld.

Frequently check the line and grade and adjust the alignment as practical. When a physical obstruction or other situation requires the abandonment of a partially completed bore hole and the starting of a new hole, backfill as the Engineer directs.

706.04 MEASUREMENT.

706.04.01 Bored and Jacked Encasement Pipe. The Department will measure the completed length of encasement pipe through the flowline from end to end in linear feet. When abandoning a bore hole due to an unforeseen physical obstruction or situation, the Department will measure the work according to a negotiated supplemental agreement. When abandoning a bore hole due to mechanical malfunction, improper alignment, or other problems due to construction operations, the Department will not measure the backfill and relocation for payment and will consider it incidental to this item of work.

706.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Bored and Jacked Encasement Pipe	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 707 ¾ TUNNELS BY USE OF STEEL LINER PLATES

707.01 DESCRIPTION. Tunnel using conventional tunneling methods and install tunnel liner plates.

707.02 MATERIALS.

707.02.01 Liner Plates. Conform to Section 819.

707.02.02 Grout. Conform to Subsection 601.02.

707.03 CONSTRUCTION. Excavate tunnels by full face, heading and bench, multiple drift procedures, or other Engineer approved methods. Complete all work under the supervision of a superintendent familiar with tunneling and the use of tunnel liner plates.

Begin tunneling at either end unless otherwise directed. When necessary to reach the entrance grade, construct an access pit of sufficient size to accommodate the tunnel excavation, spoil removal, access rails, liner plates, and other items necessary for the tunnel operation. Sheet or shore the access pit to accommodate all requirements for safety and stability. Excavate for the tunnel in close conformance to the outside shape of the liner plates.

Replace any liner plates damaged during handling and placing. Handle coated plates in a manner that prevents damage to the coating. Assemble the liner plates according to the manufacturer's recommendations at such time so there will not be more than 2 feet of tunnel mucking ahead of the bolting up of plates. At the end of each work day, construct a bulkhead inside the assembled liner plate at the construction face unless the Engineer specifically grants permission to omit the bulkhead.

Install grout blocks at each end after completing bolting of liner plates. Proportion grout according to Subsection 601.03. Force grout into voids through the grouting holes in the plates with such pressure that all voids occurring between the liner plates and excavation will be filled.

Grout and install liner plates simultaneously.

707.04 MEASUREMENT. The Department will measure tunnels of each size in linear feet along the invert.

707.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Tunnel, Size	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 708 ¾ FILLING AND CAPPING, SAFELOADING, AND PLUGGING ABONDONED UNDERGROUND STRUCTURES

708.01 DESCRIPTION. Fill and cap designated wells, inlets, catch basins, and manholes. Safeload designated small drainage structures and underground containers. Plug designated pipe and wells. This work does not include the removal of hazardous material.

708.02 MATERIALS.

708.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

708.02.02 Steel Reinforcement. Conform to Section 811.

708.02.03 Coarse Aggregate. Conform to Section 805, No. 8 or 9M.

708.02.04 Flowable Fill. Conform to Subsection 601.02 and 601.03.

708.02.05 Cement. Conform to Section 801.

708.02.06 Sand. Conform to Section 804.

708.02.07 Water. Conform to Section 803.

708.02.08 Fly Ash. Conform to Section 844.

708.03 CONSTRUCTION.

708.03.01 Filling and Capping Wells, Catch Basins, Inlets, and Manholes (Diameters 24 inches or less). Fill all wells (except water wells), catch basins, inlets, and manholes having an average diameter of 24 inches or less, with coarse aggregate to within 18 inches of their surface elevation. Place, then rod or tamp aggregate without creating large voids or unfilled pockets. After placing the aggregate, fill the remaining 18 inches with concrete. Use Class A concrete according to Subsection 601.03. Tamp, rod, or vibrate the concrete in place. The Department will not require curing the concrete. When it is not practical to completely fill a deep well, the Engineer may allow plugging according to Subsection 708.03.03 and then filling and capping the well or structure.

708.03.02 Filling and Capping Wells, Catch Basins, Inlets, and Manholes (Diameters over 24 inches). Fill all wells (except water wells), catch basins, and manholes having an average diameter exceeding 24 inches with select compatible soil or other approved material to within 8 inches of their surface elevation. Place and compact the soil or other approved material in layers not exceeding one foot in thickness. Compact by hand or mechanical tamping. Cap the remaining 8 inches with an 8-inch reinforced concrete slab either precast or cast-in-place. Use Class A concrete according to Subsection 601.03. Reinforce the slab with No. 4 reinforcing bars placed at 6-inch centers in both directions and located 2 inches from the bottom surface of the slab. Cure slabs according to Subsection 601.03.

708.03.03 Plugging Water Wells. Plug water wells according to 401 KAR 6:310. Employ a Kentucky certified water well driller as required by KRS 223.400 through 223.460 to perform the work. Furnish copies of the driller's log sheets to the Engineer after completing the plugging work.

708.03.04 Safeloading Small Drainage Structures. When safeloading, either completely fill the designated areas with grout in such a manner to make them safe

from collapse or fill the designated area with flowable fill. Mix flowable fill according to Subsection 601.03. Furnish grout consisting of one part cement or cement with fly ash to 6 parts mortar sand or concrete sand, by volume, and water. Mix to a workable consistency. Add an amount of fly ash that does not exceed 20 percent of the cement quantity.

Clean septic tanks before safeloading. Remove appreciable deposits of debris from other structures prior to safeloading. Plug the ends of existing culverts with bulkheads containing small openings at the tops through which the grout or flowable fill may be pumped at a minimum pressure of 15 psi. Completely fill all structures that require safeloading with grout or flowable fill.

708.03.05 Plugging Pipe. Shape or place plywood, 3/4 inch or greater in thickness, or use other approved material to snugly fit the interior of the pipe to be plugged. When bracing is necessary, adequately secure it in the designated location to ensure that the placement of concrete will not move or distort it. Place the forming material within the pipe a distance of no less than 5 feet, measured along the flowline, from the end of the pipe to be plugged. Then completely fill the portion to be plugged with concrete. Use Class A concrete according to Subsection 601.03. Tamp, rod, or vibrate the concrete in a manner to form a dense mass and to exclude voids. Keep the plastic concrete within the pipe using adequately braced forms. The Department will not require curing the concrete.

708.04 MEASUREMENT.

708.04.01 Filling and Capping (Diameters 24 inches or less). The Department will measure the quantity of wells (except water wells) by each individual unit. The Department will not measure plugging wells (except water wells) for payment and will consider plugging wells other than water wells incidental to this item of work.

708.04.02 Plug Water Wells. The Department will measure the quantity by each individual unit.

708.04.03 Capping (Diameters over 24 inches). The Department will measure the quantity in square yards of the finished reinforced concrete cap.

708.04.04 Embankment-in-Place (Diameters over 24 inches). The Department will measure the quantity according to Subsection 206.04. The Department will measure material used in lieu of select compatible soil as embankment-in-place.

708.04.05 Roadway Excavation (Diameters over 24 inches). The Department will measure the quantity according to Subsection 204.04. The Department will measure material used in lieu of select compatible soil as roadway excavation.

708.04.06 Safeloading. The Department will measure safeloading structures in cubic yards.

708.04.07 Plugging Pipe. The Department will measure the quantity by each individual unit per end plugged.

708.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1710, 1717, 1786	Filling and Capping (Item), (24 inches or less)	Each
2473, 2479	Capping (Item), (over 24 inches)	Square Yard
2220	Roadway Excavation	See Subsection 204.05
2230	Embankment-in-Place	See Subsection 206.05
2475	Plugging Water Well	Each
2690	Safeloading	Cubic Yard

1314	Plugging Pipe	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 709 ¾ FLUME INLETS AND PAVED DITCHES

709.01 DESCRIPTION. Construct reinforced concrete flume inlets and paved ditches.

709.02 MATERIALS.

709.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

709.02.02 Steel Reinforcement. Conform to Section 602.

709.03 CONSTRUCTION. Construct according to the Plans and Standard Drawings. Excavate the subgrade to the required depth below the finished grade. Remove all soft and yielding material, replace it with suitable material, compact the subgrade, and finish it to a firm and smooth surface.

Place Class A concrete with steel reinforcement, finish, and cure according to Subsection 601.03.

When adjacent to a concrete pavement or shoulder, tie flume inlets to the concrete pavement or shoulder by means of deformed steel tie bars. Furnish and install strips of recessed type longitudinal metal joint, punched to accommodate tie bars, at the designated locations adjacent to the forms at the pavement edge. Bend tie bars to right angles at the midpoints and install them in the pavement with one end of each tie bar placed in the grooves of the metal joint so the bar can be straightened after removing the pavement forms.

When constructing flume inlets prior to installing guardrail posts, provide a blockout in the inlet using a 6-inch radius. After setting the posts, fill the holes between the posts and flume inlets with concrete.

Construct paved ditches at the locations and to the widths the Engineer directs. The location and width specified in the Plans are for purposes of estimating only.

Construct anchors according to the Standard Drawings. Construct end anchors at the inlet and outlet ends. When required construct intermediate anchors on 20-foot centers. Form and cast against earth the exposed ends of end anchors for paved ditches and the other ends of end anchors and all intermediate anchors.

Moisten the subgrade prior to placing the concrete.

Place sod in areas the Standard Drawings designate.

709.04 MEASUREMENT.

709.04.01 Flume Inlets. The Department will measure the quantity as each individual unit. The Department will not measure steel tie bars, longitudinal metal joints, or blockouts for payment and will consider them incidental to this item of work.

709.04.02 Paved Ditches. The Department will measure this quantity in square yards of actual surface area. The Department will not measure intermediate anchors for payment and will consider it incidental to this item of work.

709.04.03 Roadway Excavation. The Department will measure this quantity according to Subsection 204.04.

709.04.04 Sod. The Department will measure this quantity according to Subsection 212.04.

709.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1689-1691	Flume Inlet, Type	Each
2155-2158	Paved Ditch, Type	Square Yard
2220	Roadway Excavation	See Subsection 204.05
5990	Sodding	See Subsection 212.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 710 ¾ SMALL DRAINAGE STRUCTURES

710.01 DESCRIPTION. Construct, reconstruct, or adjust inlets, outlets, manholes, junction boxes, catch basins, edge drain outlet headwalls, and other small drainage structures.

710.02 MATERIALS.

710.02.01 Concrete. Conform to Subsection 601.02.

710.02.02 Steel Reinforcement. Conform to Subsection 811.

710.02.03 Manhole Pipe. Conform to Section 810.

710.02.04 Brick Unit Masonry. Conform to Section 824.

710.02.05 Preformed Joint Filler. Conform to Section 807.

710.02.06 Dense Graded Aggregate. Conform to Section 805.

710.02.07 Pipe. Conform to Section 810.

710.02.08 Mortar. Conform to Section 601.02.

710.02.09 Structural Steel. Conform to Section 812.

710.02.10 Miscellaneous Metals. Conform to Section 813.

710.02.11 Steel Manhole Risers. Conform to Section 813.

710.02.12 Manhole Covers and Lids. Conform to Section 813.

710.02.13 Precast Manhole Sections. Conform to ASTM C 478 and the Standard Drawings. For flat top slabs, a tongue and groove design is optional.

The Department will allow the use of lightweight aggregate provided that it conforms to Subsection 805.04.02.

710.02.14 Manhole Steps. Provide manhole steps that are on the Department's List of Approved Materials.

710.03 CONSTRUCTION

710.03.01 Newly Constructed Small Drainage Structures.

A) General. Construct all small drainage structures according to the Contract or as the Engineer establishes. The Engineer may approve similar units that conform to the typical features depicted in the Standard Drawings. Construct small drainage structures using Class A concrete according to Subsection 601.03.

Attach all cast iron grates and lids and all structural steel grates to the frames, or to the concrete in the event there is no frame, with a chain of sufficient length to permit removal for clean out and maintenance purposes. Obtain the Engineer's approval, in writing, of shop drawings for the security device, when different from what the Plans specify.

When extending pipe through the walls of small drainage structures, use pipe that is the same size and type, and conforms to the same requirements as the existing pipe with which it is to be connected. Use extensions of sufficient length to provide for connections and construction to prevent

leakage of the pipe and structure wall joint.

When excavation for small drainage structures extends under pavement, curb, gutter, or sidewalk, backfill the excavation with dense graded aggregate or gravel base. For backfill under aprons around drop box inlets or similar structures, use dense graded aggregate or gravel base when required by the Standard Drawings. Use dense graded aggregate or gravel base backfill as the Engineer directs, and compact it in layers not exceeding 6 inches loose thickness.

When structures abut rigid pavement, place 1/2 inch preformed joint filler between the rigid pavement and the structure for the full depth of the pavement.

Construct concentric or eccentric concrete pipe cones for manholes according to the Standard Drawings. Use precast concrete, precast concrete pipe sections, and cast-in-place concrete, for manhole construction according to the Standard Drawings. Use precast concrete, precast concrete pipe sections, cast-in-place or brick for adjustment of existing manholes according to the Standard Drawings.

The Department will allow the use of square outside cast-in-place bases in lieu of round bases.

Form and construct a U-shaped channel in the base of circular pipe manholes with Class A concrete for a smooth continuation of the pipe. Do not allow the channel height to be less than 3/4 of the diameter of the smaller pipe that is intercepted.

Construct the tops of box inlets specified in the Standard Drawings to the same cross slope as any existing or proposed shoulder, sidewalks, medians, or islands that will abut the box inlets.

Install steps according to the Standard Drawings in all manholes 4 feet or greater in depth.

Do not paint frames, grates, and lids made of structural steel or cast iron for any of the structures.

B) Precast Structures Except Manholes. If furnishing precast structures, conform to the following requirements.

Furnish only products on the Department's List of Approved Materials. If a product is not on the Department's List of Approved Materials, submit 5 copies of shop drawings to the Engineer for review and approval. Ensure that the shop drawings show details of any variation from the Department's Standard Drawings and include any special installation instructions necessary. Submit specifications for any special materials for joint construction with the shop drawings, and submit samples of joint materials when requested.

Before beginning fabrication, furnish copies of the approved shop drawings to the Engineer.

Use concrete that equals or exceeds the requirements for Class A concrete. Conform to Section 605 for the fabrication of the structures, the requirements for a mix design, and a Certified Concrete Technician.

Set the precast structures on a foundation of at least 4 inches of dense graded aggregate compacted using mechanical tampers. Backfill box inlets with cantilevered portions to the elevation of the bottom of the cantilevered element, and place 4 inches of compacted dense graded aggregate before placing the cantilevered element.

Make positive seals between the pipe and the precast structure, and between individual precast segments of the structure, in the field. Obtain any special materials required for joint construction from the structure fabricator at no additional expense to the Department.

The Department will sample and test all materials used in manufacture of the precast elements, including cement, aggregates, water, admixtures, steel reinforcement, and galvanized metal items according to the Department's standard procedures for these items. Do not begin fabrication until the Department has approved these materials.

Repair or replace structures damaged during handling, transporting, erecting, or backfilling, or any structure that cannot be placed satisfactorily, as the Engineer directs or approves.

710.03.02 Reconstructed Small Drainage Structures. Reconstruct existing units to the required line and elevation according to the Standard Drawings. Recondition structures where work is in excess of the limits required for adjusting small drainage structures.

710.03.03 Adjusted Small Drainage Structures. Adjust existing frames and covers or gratings to the proper elevation. Accomplish this by removing or adding cast-in-place concrete masonry, precast reinforced concrete masonry, brick masonry, or an adjusting ring, for a vertical distance not to exceed one foot above or below the existing masonry, and replacing existing castings firmly and permanently in place.

When the Contract specifies, use the Adjusting Ring Method as described in this section, for adjusting manhole castings to grade. When applicable, use the Adjusting Ring Method in lieu of the methods outlined in the preceding paragraph. Raise a casting by inserting an additional casting into the existing frame as follows:

1) Use an adjusting casting of an approved type. Hold it rigidly to the existing frame using set screws in the bearing leg of the ring, or spot weld the adjusting ring to the existing frame in 4 equally spaced locations.
2) Adjust existing manhole covers to the proper elevation by inserting variable height adjustable casting that the Engineer approves into the existing frame. Use an adjustable casting capable of diameter adjustment as well as vertical height adjustment.

   When the difference between the existing elevation and the proposed elevation is less than the outer thickness of the cover or grate plus 1/2 inch, insert a casting that provides for receiving a new casting that is 2 inches less in diameter in any horizontal measurement than the existing casting. Furnish a new cover or grate similar in design to the existing cover or grate, except for the diameter or other horizontal dimensions.
3) Use a steel expanding manhole riser that is of the correct height and is designed to receive the existing manhole cover.

710.04 MEASUREMENT.

710.04.01 Newly Constructed Small Drainage Structures Except Type 12 Drop Box Inlets. The Department will measure the quantity by each individual unit. The Department will not measure any increase in the height of a structure to one foot from the Plan height for payment and will consider it incidental to this item of work. The Department will measure for payment a change in height that exceeds one foot. The Department will measure the quantity of reinforcing steel and concrete placed in excess of the plan height plus one foot according to Subsections 602.04 and 601.04, respectively. The Department will not measure excavation or materials for backfill for payment and will consider them incidental to this item of work. The Department will not measure extra work or materials required for use of precast units and will consider them incidental to this item of work.

710.04.02 Type 12 Drop Box Inlets. The Department will measure the quantity by each individual unit according to Subsection 710.04.01, except the Department will measure the units in linear feet.

710.04.03 Reconstructed Small Drainage Structures. The Department will measure the quantity by each individual unit.

710.04.04 Adjusted Small Drainage Structures. The Department will measure the quantity by each individual unit.

710.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
1432-1799	Newly Constructed Small Drainage Structure (except Type 12 Drop Box Inlets), Type, Size	Each
1709, 1719, 1792, 1791	Adjusting Small Drainage Structure, Type, Size[1]	Each
1633, 1708, 1720, 1789	Reconstructing Small Drainage Structure, Type, Size	Each
1547	Type 12 Drop Box Inlets	Linear Foot

[1] *When small drainage structures that require adjusting exist on a project and there is not a bid item for adjusting small drainage structures, the Department will make payment according to Subsection 104.03.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 711 ¾ PREFABRICATED VERTICAL WICK DRAINS

711.01 DESCRIPTION. Furnish and place prefabricated vertical wick drains at the locations shown on the Plans.

711.02 MATERIALS. Use prefabricated wick drains that are included in the Department's List of Approved Materials.

711.03 CONSTRUCTION. Stake the proposed location of the drains before installation. Do not vary the locations by more than 6 inches from those shown on the Plans. Maintain staked locations during construction. Install trial drains at locations within the work area. Demonstrate that all equipment and materials produce a satisfactory installation. Obtain approval from the Engineer that materials and installation procedures are satisfactory. Perform corrective action if trial drains are not accepted.

Install the prefabricated wick drains with a protective mandrel or sleeve. Provide an anchor plate or similar arrangement at the bottom to prevent soil from entering the bottom of the mandrel during installation of the drain and to anchor the drain tip at the required depth. Advance the mandrel or sleeve by continuously pushing or vibrating into the soil and retract after each installation. The maximum cross sectional area of the mandrel or sleeve is 14 square inches, including the attached anchor. Pre-auger when mandrel or sleeve cannot be continuously pushed or vibrated and when the Engineer deems necessary. Use augers with a maximum outside diameter of 8 inches. Install the prefabricated wick drains vertically from the top of the working platform to the elevation shown on the plans. Ensure that plumbness of the drain does not deviate from the vertical more than 2 1/2 inches in 10 feet. Provide the Engineer a means to verify plumbness of the equipment and the depth of the drain.

Splice, no less than 6 inches, or connect the drain material according to the manufacturer's recommendations to ensure continuity of flow. Limit splices to one per drain. Cut the drain flush with the upper surface of the working platform. Install the drains in a sequence that prevents travel over previously installed drains.

Repair or replace drains that are more than 6 inches from the plan locations, improperly installed, or damaged during construction at no cost to the Department. Remove any auger cuttings or debris from the top of the working platform before continuing with fabric and fill placement over drains.

711.04 MEASUREMENT. The Department will measure prefabricated vertical wick drains in linear feet. The Department will not measure trial drains or pre-augering for payment and will consider it incidental Prefabricated Vertical Wick Drains.

711.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2774	Prefabricated Vertical Wick Drains	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 712 — RAISED PAVEMENT MARKERS

712.01 DESCRIPTION. Furnish and install raised pavement markers.

712.02 MATERIALS.

712.02.01 Markers. Use Type IV or Type V raised markers, as designated in the Contract, that conform to Section 840.

712.02.02 Adhesives. Conform to the manufacturer's recommendations.

712.03 CONSTRUCTION. Before installing the markers, furnish the manufacturer's current recommendations for adhesives and installation procedures to the Engineer.

Use one brand and design throughout the project for each type of marker required.

The Contract or Standard Drawings will specify either mono-directional or bi-directional markers, and the marker color.

Remove all excess adhesive from in front of the reflective faces.

If any adhesive or foreign matter cannot be removed from the reflective faces, or if any marker fails to properly adhere to the pavement surface, remove and replace the marker.

712.03.01 Type IV Markers. Before installing new markers, remove all portions of the existing Type IV marker, and all traces of adhesive, rust, and dirt from the casting, to the satisfaction of the Engineer. Sandblast or use other methods approved by the Engineer. Ensure that the casting surface is dry and free from dirt and other deleterious material before placing the marker in the casting.

Place adhesive on the marker or casting in sufficient quantity to ensure complete coverage of the contact area with no voids present and with a slight excess after the marker is pressed in place.

Firmly seat the marker in the casting with a minimum load of 100 pounds.

Ensure that the pavement surface temperature is at or above 45 ºF at the time of application. Conform to a higher temperature if recommended by the adhesive manufacturer.

712.03.02 Type V Markers. Install Type V Markers in slots cut into the pavement, as specified on Standard Drawing TSC-400. Do not cut the slots until the pavement has cured sufficiently to prevent tearing or raveling.

Place Type V markers as much in line with existing pavement striping as possible. Offset markers a minimum distance of 2 inches from a longitudinal crack or joint. Ensure that the finished line of markers is straight, with minimal lateral deviation.

Prepare the pavement surfaces, and install the markers according to the manufacturer's recommendations and the following requirements. Remove all dirt, grease, oil, loose or unsound layers, and any other material from the marker area which would reduce the bond of the adhesive. Maintain pavement surfaces in a clean condition until placing markers. Ensure that the adhesive bed area is equal to the bottom area of the marker, and apply adhesive in sufficient quantity to force excess out around the entire perimeter of the marker. Use materials, equipment, and construction procedures that ensure proper adhesion of the markers to the pavement surface.

After applying adhesive, press the markers into place so the height of the installed marker is 1/2 inch or less above the pavement.

712.03.03 Location and Spacing. Install markers as specified on the Standard Drawings. Do not install markers in bridge decks.

Place markers installed at double yellow centerlines between the 2 lines. Place markers installed along an edgeline or channelizing line so that the near edge of the casting is no more than one inch from the near edge of the line. Place markers installed

along a lane line or dashed yellow centerline between and in line with the dashes. Do not place markers over the lines except where the lines deviate visibly from their correct alignment, and then only if the Engineer approves the location.

712.04 MEASUREMENT. The Department will measure the quantity by each individual unit.

712.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
6580-6584	Pavement Marker, Type IV (mono- or bi-directional, color)	Each
6589-6593	Pavement Marker, Type V (mono- or bi-directional, color)	Each

The Department will consider payment as full compensation for all work required under the section.

SECTION 713 ¾ PERMANENT PAVEMENT STRIPING

713.01 DESCRIPTION. Furnish and apply striping paint to provide lane lines, edgelines, and gore markings as specified in the Contract.

713.02 MATERIALS AND EQUIPMENT.

713.02.01 Paint. Conform to Section 842.

713.02.02 Drop On Glass Beads. Conform to Section 839.

713.02.03 Application Equipment. Use a self-propelled striper capable of heating the paint to provide uniform flow and enhance quick drying of the paint. Ensure that the striper has a guide boom or optical pointer to attain smooth and straight lines. Ensure that the equipment maintains proper paint pressure at all times. Provide equipment capable of applying a single line or parallel lines of the specified width and in any combination of a skip line and a solid line in one pass.

Provide equipment with a paint cutoff device to provide clean, square marking ends of the paint lines.

Equip the paint pots or tanks with an agitator that will keep the paint thoroughly mixed.

Provide equipment with bead dispensers, one for each paint spray gun, placed such that the beads are applied to the paint almost instantly as the paint is being placed on the roadway surface. Design and align the bead dispensers so that beads are applied under air pressure uniformly to the entire surface of the paint lines. Equip the bead dispensers with cutoff controls synchronized with the cutoff controls for the paint spray guns.

713.03 CONSTRUCTION. Provide yellow centerline markings, which are defined as those separating traffic moving in opposite directions. Provide white lane line markings, which are defined as those separating traffic moving in the same direction. Ensure that these markings are skip lines and solid lines as required by Part III of the MUTCD. Ensure that edge lines are solid lines, and determine the color from Part III of the MUTCD.

On interstates and parkways, and roadways with pre-existing 6-inch wide striping, install pavement striping that is 6 inches in width. On other routes, install pavement striping that is 4 inches in width. Ensure that all lines have clean edges with a width tolerance of plus 1/2 inch. The Engineer may waive the tolerances when deviations are caused by undulation in the pavement surface.

Construct skip lines with a stripe-to-gap ratio of a 10-foot paint stripe to a 30-foot gap. Ensure that the length of the stripe is between 10 and 10 1/2 feet. Ensure that the stripe-gap cycle is between 40 and 40 1/2 feet.

Apply striping before sunset on new pavement that is to be driven over by the public. When rain or other unavoidable occurrences prevent marking before sunset, mark the pavement during daylight hours as soon as conditions permit.

713.03.01 Records. On resurfacing, pavement restoration, and pavement rehabilitation projects, prepare and keep a written record of the locations of existing pavement markings, and furnish a copy to the Engineer before removing or obliterating the markings.

713.03.02 Pavement Surface Preparation. Clean grease, oil, mud, dust, dirt, grass, loose gravel, or other deleterious material from the surface where pavement markings are to be applied. Use only Engineer approved cleaning methods.

713.03.03 Paint Application. On resurfacing, pavement restoration, and pavement rehabilitation projects, put back the recorded existing pavement markings as modified by the Engineer. On new construction, place the markings as the Contract

specifies or as the Engineer designates.

Apply paint at a rate of not less than 16.5 gallons per mile of solid 4-inch line and 24.8 gallons per mile of solid 6-inch line. Apply glass beads at a rate of not less than 6 pounds per gallon.

713.03.04 Marking Removal. Remove all markings made in error or not conforming to the traffic operation in use. Remove markings by either an abrasion or burning process to the satisfaction of the Engineer. Do not paint with asphalt binder or other material to obliterate the markings.

713.03.05 Proving Period. A proving period will follow the application of the permanent pavement striping. During this period, the Engineer will make such observations as are necessary to determine if the markings are acceptable. The proving period begins when the facility is opened to traffic.

A) Requirements. The minimum retroreflectivity requirements at the end of the proving period, as measured with a LTL 2000 or a mobile retroreflectometer (30 M geometry), are as follows:

White:	175 mcd/lux/square meter
Yellow:	150 mcd/lux/square meter

The Department will take these measurements between 30 and 60 days after the start of the proving period, with acceptance based on KM 202 for LTL 2000 readings and KM 203 for mobile readings. If the Department determines that the markings are acceptable, the installation of the markings will be considered complete.

B) Failure. For any one-mile section and each gore area during the proving period, the Department will consider the section defective when the retroreflectivity falls below the minimum required. The Department will consider each edge line, centerline, lane line and gore area marking separately.

C) Corrective Work. If a line is found to be defective, repair or remove and replace the line. Perform pavement marking replacement according to the requirements specified in this subsection for the initial application. The corrective work will be subject to a proving period as listed above.

713.04 MEASUREMENT. The Department will measure the quantity in linear feet. When a bid item is not included for gore markings, the Department will measure the quantity by converting the actual length and width of line installed to an equivalent length of the normal width line on that section of roadway.

713.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
6514-6517	Pavement Striping - Permanent Paint, Width	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 714 ¾ DURABLE PAVEMENT STRIPING

714.01 DESCRIPTION. Furnish and install durable marking materials, thermoplastic or Type I tape, to provide lane lines, edgelines, and gore markings as specified in the Contract.

714.02 MATERIALS AND EQUIPMENT.

714.02.01 Thermoplastic. Conform to Section 837.

714.02.02 Type I Tape. Conform to Section 836.

714.02.03 Binder. Furnish a binder that the manufacturer of the pavement marking material recommends and the Engineer approves. Provide a binder that forms a continuous film that dries rapidly and adheres to the pavement. Provide a material that does not discolor or cause any noticeable change in the appearance of the pavement outside of the finished pavement marking. Submit a sample of the binder and the recommended method of application to the Engineer and obtain the approval of the Engineer and the manufacturer of the pavement marking material, in writing, before applying it.

714.02.04 Drop On Glass Beads. Conform to Section 839.

714.02.05 Thermoplastic Application Equipment. Provide equipment with an extrusion die that simultaneously deposits and shapes lines at a minimum thickness of 90 mils on the pavement surface. Do not use spray and ribbon gun applicators.

Ensure the application equipment conforms to the following:

1) Capable of providing continuous and uniform heat to maintain the material between 400 and 440 °F throughout the mixing, conveying, and dispensing.
2) The kettle is capable of continuous agitation during mixing and heated storage and is equipped with an automatic thermostat control device and material thermometer.
3) Motorized and capable of applying a uniform line at a rate of 3 mph.
4) Equipped with a cutoff device that provides clean, square stripe ends.
5) Equipped with an automatic bead dispenser.

714.03 CONSTRUCTION. Provide yellow centerline markings, which are defined as those separating traffic moving in opposite directions. Provide white lane line markings, which are defined as those separating traffic moving in the same direction. Ensure that these markings are skip lines and solid lines as required by Part III of the MUTCD. Ensure that edge lines are solid lines, and determine the color from Part III of the MUTCD.

Install pavement striping at the width specified in the Contract. Ensure that all lines have clean edges with a width tolerance of plus 1/2 inch. The Engineer may waive the tolerances when deviations are caused by undulation in the pavement surface.

Construct skip lines with a stripe-to-gap ratio of a 10-foot stripe to a 30-foot gap. Ensure that the length of the stripe is between 10 and 10.5 feet. Ensure that the stripe-gap cycle is between 40 and 40.5 feet.

714.03.01 Layout. Install all pavement markings according to Part III of the MUTCD and the following requirements.

Make the width of lane lines and edgelines as specified in the Plans or as the Engineer directs. Make lines for gore area markings twice the normal width line for that section of roadway.

Unless striping plans are included in the proposal or otherwise directed by the Engineer, install gore area markings as shown in Figures 3-11 and 3-12 of the MUTCD. Do not use the optional markings shown (transverse lines in the neutral area and dotted extension of the right edgeline).

Due to the possibility that water may be retained on the roadway by the thermoplastic edgelines, place a one foot gap every 20 feet in all thermoplastic edgelines. Do not install gaps for taped edgelines.

Offset longitudinal lines at least 2 inches from longitudinal pavement construction joints. Offset longitudinal lane lines on multi-lane highways 2 inches towards the median.

On resurfacing, pavement restoration, and pavement rehabilitation projects, prepare and keep a written record of the locations of existing pavement markings, and furnish a copy to the Engineer before removing or obliterating the markings. The Engineer will notify you of any changes to the existing markings.

Before applying the pavement marking material, pre-mark the pavement surface and obtain the Engineer's approval of the proposed location, alignment, and control guides.

714.03.02 Surface Preparation.

1) Remove existing pavement markings and clean grease, oil, mud, dust, dirt, grass, loose gravel, or other deleterious material from the surface where pavement markings are to be applied, as directed by, and by methods acceptable to, the Engineer.
2) Remove the existing pavement markings until a minimum of 90 percent of the pavement surface is uniformly exposed throughout. Ensure that the pavement surface is in proper condition for successful bonding of the pavement markings and provides a neat appearance. Do not leave any loose or flaking existing pavement markings.
3) When removing the existing pavement markings, ensure that the finished pavement surface is not damaged or left in a condition that may mislead or misdirect the motorist. Repair any damage to the pavement, pavement joint materials, or the pavement surface caused by the removal of the existing pavement markings in a manner acceptable to the Engineer. After completing these operations, use compressed air to blow clean the pavement surface of residue and debris resulting from the removal of existing pavement markings.
4) When removal of existing pavement markings and objectionable materials obscures existing pavement markings of a lane occupied by public traffic, immediately remove the residue, including dust, from the surface being treated. Obtain the Engineer's approval of the removal methods.
5) Place the final pavement markings on the same day that the existing pavement markings are removed.
6) On concrete surfaces and as the Engineer directs on older asphalt pavements, apply binder to the area where placing pavement marking material.
7) On new concrete pavement surfaces, remove the curing compound from the pavement surface before applying the binder and the pavement marking material.

714.03.03 Application.

A) Type I Tape. Apply according to the manufacturer's recommendations.

B) Thermoplastic. Rather than installing thermoplastic pavement markings on fresh asphalt, the Department will allow temporary striping with paint. When choosing this option, cover the temporary striping with the thermoplastic pavement markings within 30 calendar days. The Department will not require removal of the interim pavement marking paint before applying the thermoplastic pavement markings.

Install the thermoplastic material at a minimum thickness of 90 mils on the pavement surface in a melted state at a temperature from 400 and 440 °F.

Apply additional glass beads by drop-on or pressure spray methods at a uniform minimum rate of 0.92 lbs/square yard of markings.

Verify the adhesion of the thermoplastic to asphalt pavements at least 4 per mile of line by performing bond checks as follows. Approximately 60 to 120 seconds after applying a thermoplastic line to the roadway surface, cut and lift approximately a 6-inch section of thermoplastic. The thermoplastic is successfully bonding to the pavement surface if a layer of asphalt clings to the removed thermoplastic stripe and the pavement surface under the removed stripe is shiny and black.

Provide finished markings that are continuous and uniform in shape, having clear and sharp dimensions. Ensure that all lines have well-defined edges.

714.03.04 Restrictions. Do not apply the pavement marking material when air and pavement temperatures are below 50 °F or when the overnight temperature was below 40 °F.

Do not apply the pavement marking material when the surface of the pavement contains evidence of moisture in amounts significant enough to prevent the pavement marking material from bonding to the pavement. Significant amounts of moisture can be caused by heavy dew or very humid nights as well as from rainfall.

If encountering significant amounts of moisture while applying the thermoplastic, the Contractor, at his own risk, may attempt to apply thermoplastic subject to the following restrictions. Heat the thermoplastic material to the upper temperature limit specified by the manufacturer, and apply a test line on the pavement. Perform a bond check according to Subsection 714.03.03. If the thermoplastic successfully bonds to the pavement continue to apply thermoplastic lines, provided there is evidence that the moisture is escaping through the surface of the line, as indicated by very small pin holes. If there is excessive moisture, as indicated by larger sized holes or bubbles on the surface of the line, do not apply thermoplastic until the moisture can be effectively dealt with. Perform a sufficient number of bond checks to ensure that the thermoplastic is bonding to the pavement.

714.03.05 Project Conflicts. When other construction projects are in progress within the limits of the designated work areas, install no pavement markings that will be removed or damaged by immediate subsequent construction. The Engineer will give notification of all conflicting construction projects. Schedule the installation of pavement markings after completion of the conflicting construction. When scheduling is impossible or creates an undue hardship, the Engineer will delete the intersection from this project.

714.03.06 Proving Period for Durable Markings. A 180 day proving period will follow the application of the durable markings. During this period, the Engineer will make such observations as are necessary to determine if the markings are acceptable. The proving period begins when the facility is opened to traffic.

A) Requirements.

1) Type I Tape. During the proving period, ensure that the pavement marking material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement, loss of retroreflectivity, vehicular damage, and normal wear.
2) Thermoplastic. During the proving period, ensure that the thermoplastic pavement marking material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings,

chipping, spalling, poor adhesion to the pavement materials, loss of retroreflectivity, vehicular damage and normal wear.

The minimum retroreflectivity requirements at the end of the proving period, as measured with a LTL2000 or a mobile retroreflectometer (30 M geometry), are as follows:

White:	300 mcd/lux/square meter
Yellow:	175 mcd/lux/square meter

The Department will take these measurements between 150 and 210 days after the start of the proving period, with acceptance based on KM 202 for LTL 2000 readings and KM 203 for mobile readings. If the Department determines that the markings are acceptable, the installation of the markings will be considered complete.

B) Failure. For any one mile section and each gore area during the proving period, the Department will consider the section defective when the retroreflectivity falls below the minimum required or more than 10 percent of the material fails to meet the other requirements of A) above. The Department will consider each edge line, centerline, lane line and gore area marking separately.

C) Corrective Work. If a line is found to be defective, repair or remove and replace the line. Perform pavement marking replacement according to the requirements specified in this subsection for the initial application. The corrective work will be subject to a proving period as listed above.

714.03.07 Marking Removal. Remove all markings made in error or not conforming to the traffic operation in use. Remove markings by either an abrasion or burning process to the satisfaction of the Engineer. Do not paint with asphalt binder or other material to obliterate the markings.

714.03.08 Acceptance of Non-Specification Thermoplastic Markings. When reasonably acceptable work has been produced but retroreflectivity requirements are not met, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the markings may be left in place, the Department will accept them at a reduction in the Contract unit bid price according to Acceptance Pay Schedule for Thermoplastic.

714.04 MEASUREMENT. When a bid item is not included for gore markings, the Department will measure the quantity by converting the actual length and width of line installed to an equivalent length of the normal width line on that section of roadway.

714.04.01 Thermoplastic Pavement Markings. The Department will measure for payment by the units listed in the Quantity Summary. The Department will not measure sampling, testing, surface preparation, pre-marking, interim marking, and binder application for payment and will consider them incidental to the thermoplastic bid items. The Department will not measure corrective work for payment.

714.04.02 Durable Pavement Markings, Type I. The Department will measure for payment by the units listed in the Quantity Summary. The Department will not measure sampling, testing, surface preparation, pre-marking, and binder application for payment and will consider them incidental to the pavement marking bid items. Corrective work will not be measured for payment.

714.04.03 Pavement Striping Removal. When listed as a bid item, the Department will measure for payment by the units listed in the Quantity Summary. The Department will not measure for payment the removal of existing pavement markings that have not been authorized by the Engineer. When the Contract does not list a bid item, the Department will consider existing pavement marking removal incidental to the

other pavement marking bid items. The Department will not measure for payment any corrective work required due to the removal work.

714.05 PAYMENT. The Department will make payment for the complete and accepted quantities under the following:

ACCEPTANCE PAY SCHEDULE FOR THERMOPLASTIC		
Pay Value	White mcd/lux/square meter	Yellow mcd/lux/square meter
1.00	300	175
0.50	200-299	100-174
Remove and Replace	< 200	< 100

Code	Pay Item	Pay Unit
6540-6547	Pavement Striping - Thermoplastic, width, color	Linear Foot
6554-6561	Pavement Striping - Durable Type I Tape, width, color	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 715 ¾ PANEL TRAFFIC SIGNS

715.01 DESCRIPTION. Furnish and install extruded panel traffic signs. Traffic signs include ground mounted, overhead structure mounted, or bridge mounted signs.

715.02 MATERIALS.

715.02.01 Panel Signs. Conform to Section 833.

715.02.02 Concrete. Conform to Subsection 601.02 and 601.03.

715.02.03 Steel Reinforcement. Conform to Section 602.

715.02.04 Structural Steel. Conform to Section 812.

715.02.05 Miscellaneous Metals. Conform to Section 813.

715.02.06 Retroreflective Materials. Conform to Section 830.

715.02.07 "Pop" Fasteners. Use corrosion resistant protruding head "pop" rivets with a minimum diameter of 1/8 inch. Obtain the Engineer's approval before use.

715.03 CONSTRUCTION. The Department may inspect fabrication and erection work. The Department will perform a day and night inspection after the installation is complete.

If a manufacturer provides a warranty on any materials covered under these specifications, furnish the same warranty to the State. Perform the work according to the requirements specified in the following publications:

- MUTCD
- AASHTO Specifications for Design and Construction of Structural Supports for Highway Signs
- Federal Standard 595, Standard Highway Sign Colors
- Standard Highway Signs

Use Class A concrete according to Subsection 601.03.

715.03.01 Location. Use the Plans as general guidance for the extent and general arrangement of signs. Consider sign locations specified in the Plans as approximate only. Determine the exact location for each sign and obtain the Engineer's approval. When it is necessary to relocate any sign more than 25 feet from the station listed, obtain the Division of Traffic's approval. Center overhead signs over the lane or lanes to which they apply. Allow for differences in elevation across the full shoulder width, as specified in the Plans, in maintaining the required 18-foot minimum vertical clearance to the bottom of the lowest parts of the signs or supports for overhead signs. Submit all proposed revisions in writing to the Engineer for written approval.

715.03.02 Messages. Sign messages specified in the Plans are the final messages. Due to construction phasing, the Engineer may make changes in some messages. If the Engineer changes a message before the sign installation store the final message copy on the project. Conform message spacing to the applicable requirements of the previously cited publications for guide signs, and the manufacturer's recommendations for sign sizes indicated, as the Engineer approves. Center message copy over the lane or lanes to which they apply.

715.03.03 Attachment. Attach letters, symbols, numbers, and borders to sign faces with "pop" fasteners ("pop" rivets).

715.03.04 Shields. For panel sign mounted route markers, use a retroreflectorized white cut-out for the US shield and KY round shape, omitting the black background of the standard rectangular shapes. Do not use borders on the cut-out shapes. Use the dimensions shown in the Standard Highway Signs Manual. Space route markers evenly across the panel sign face.

715.03.05 Covering. Cover sign faces only when absolutely necessary and keep covered only as long as necessary. Do not use tape, paper, plastic, or sheet metal covers. Replace any signs damaged as a result of being covered at no expense to the Department.

715.03.06 Shop Drawings. Submit 5 complete sets of detailed shop drawings to the Engineer for written approval before fabricating signs. Before installation, obtain the Engineer's written approval of drawings, descriptions, manufacturer's cuts, etc. covering all materials to be used. Submit mill test reports for I-beams, wide flange beams, aluminum or steel panels, and each different gauge of aluminum or steel sheeting used to the Engineer for approval before installation.

715.03.07 Fabrication. Hot dip galvanize all steel components after completing fabrication. Regalvanize or paint all abraded or damaged surfaces with 2 coats of commercially available zinc rich paint.

Ensure that sign structures are free from kinks, twists, or bends and are uniform in appearance. Assemble completed sections in the shop and check them for straightness, alignment, and dimensions. Correct any irregularities.

Consider sign post lengths as approximate only. Conform to the applicable requirements contained in AWS for welded fabrication.

715.03.08 Footings, Bases, and Pedestals. Provide protection for traffic during construction of concrete bases for overhead sign structures.

Exercise caution during any excavation to prevent damaging existing utilities whether specified or not specified in the Plans. Repair or replace any utilities that are disturbed or damaged during construction at no additional expense to the Department. Provide the Engineer the opportunity to inspect repairs to damaged utilities before covering the repairs.

Construct footings and bases according to Subsection 601.03. The Department will allow construction of footings against undisturbed earth without forms, unless otherwise directed. Slope top surfaces of bases and pedestals to provide for drainage. Provide an ordinary surface finish for all exposed concrete. Construct a rustication groove in all pedestals. Cure concrete according to Subsection 601.03.17.

Remove beam sign supports concurrently with the relocation of affected signs to new supports. Grade, to the existing slope, any areas disturbed by removing existing signs or constructing new signs, and reseed as the Engineer directs.

715.03.09 Sign Beams and Supports. Use beams of sufficient length to extend from the top of the sign to the required base embedment. Use either Type A (standard beam installation) or Type B (break-away beam installation) as specified in the Plans. Embed beams in concrete to a depth equal to the dimension "A" shown for each sign.

Wait 7 calendar days after placing concrete before mounting beams and supports to the bases or pedestals. Where aluminum is in contact with concrete, thoroughly coat the contacting surface with alumilastic compound or an approved equal in order to completely insulate the aluminum from the concrete. Where bond between the aluminum and concrete is desired, coat the aluminum with commercially available zinc chromate paint, and allow it to dry before installation.

A) Type A Beam Alternates.

1) Alternate I. Furnish A 36 steel beams galvanized according to ASTM A 123.
2) Alternate II. Furnish 6061-T6 (ASTM B 221). When aluminum beam size

is not indicated, use Alternate I.

B) Type B Beam. Specifications for Type B beams are listed on the break-away detail sheet.

For break-away assemblies, assemble the posts to stub with bolts and with one flat washer on each bolt between plates. Use shims to plumb the posts. Then tighten bolts to the maximum possible by use of a 12 to 15-inch wrench in order to bed washers and shims and to clean bolt threads. Then loosen all bolts, and in turn retighten them in a systematic order to the prescribed torque specified in the Plans.

715.03.10 Bridge Mounting for Signs. Do not install brackets for support of bridge mounted signs within 6 inches of open joints in concrete handrail plinths. The Department will allow moving of supports to clear handrail posts. Place sign brackets on 4-foot maximum centers with a 2-foot maximum sign overhang.

When necessary, remove existing handrails to drill anchor bolt holes. Reinstall handrails after drilling. Locate bolt holes drilled in prestressed concrete beams to not interfere with steel strands. Drill holes for concrete beams with a rotary type core drill. Do not use impact type drills. Install bolts with expansion plugs and lock washers in the holes and fill the void between the plug and face of the concrete with non-shrinking grout.

715.03.11 Mounting Signs. Install new concrete bases, support beams, etc. before dismantling any existing sign. When existing signs are to be out of service for more than one work shift, install temporary signing of the proper color, shape, and with copy of similar configuration to existing signs at the same approximate station as the out of service sign. Install sign panels on sign structures, beams, or bridge mounted brackets as specified in the Plans. Delay installation as long as possible to avoid any damage to the sign. Replace all damaged signs.

715.04 MEASUREMENT.

715.04.01 Concrete. The Department will measure according to Subsection 601.04.

715.04.02 Steel Reinforcement. The Department will measure according to Subsection 602.04.

715.04.03 Sign Supports. The Department will measure the quantity by each individual unit.

The Department will not measure clearing and grubbing, excavation, electrical conduit and ground rods located in support bases, and temporary panel signing for payment and will consider them incidental to this item of work.

715.04.04 Beams. The Department will measure the quantity in pounds.

715.04.05 Bridge Mounted Sign Fixtures. The Department will measure the quantity by each individual unit. A unit is as all material necessary for mounting a bridge mounted sign of given size.

715.04.06 Sign Panels. The Department will measure the quantity in square feet for each size and type.

715.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
6490	Class A Concrete for Signs	See Subsection 601.05

6491	Steel Reinforcement for Signs	See Subsection 602.05
6416-6426, 6436, 6438, 6443, 6445	Sign Supports, Size and Type	Each
6400, 6402, 6440	Sign Beams, Type	Pound
6448	Bridge Mounting Fixtures, Size and Type Sign	Each
6405-6409	Sign Panels, Type and Size	Square Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 716 ¾ ROADWAY LIGHTING SYSTEMS

716.01 DESCRIPTION. Furnish, install, and connect roadway lighting systems, with accessories according to the Contract.

716.02 MATERIALS.

716.02.01 Roadway Lighting Materials. Conform to Section 834. Obtain the Engineer's approval for all materials before installation. Submit for material approval 7 copies of descriptive literature, drawings, and any requested design data. Do not make substitutions for approved materials without written permission as described above.

716.02.02 Paint. Conform to Sections 821 and 834.

716.02.03 Concrete. Conform to Subsection 601.02 and 601.03.

716.03 CONSTRUCTION. Perform the work according to:

1) the Contract,
2) National Electrical Code,
3) AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 1994 edition,
4) AASHTO Roadside Design Guide,
5) AASHTO An Informational Guide for Roadway Lighting, 1984 edition,
6) Manual on Uniform Traffic Control Devices for Streets and Highways, and
7) the standards of the utility company servicing the installation.

Before ordering materials, confirm the type and location of the service available from the utility company.

After completing the installation and before the electrical service is connected, obtain a certificate of compliance from the Kentucky Department of Housing, Buildings and Construction, Electrical Inspection Division.

The Plans indicate the extent and general arrangement of the lighting circuits and equipment and are for general guidance. Advise the Engineer in writing and obtain written approval for any necessary modifications.

Stake pole locations and obtain the Engineer's approval. Use Class A concrete according to Subsection 601.03.

716.03.01 Wiring. Where installing more than one circuit within the same conduit, affix permanent circuit identification numbers to the wires wherever the wiring emerges, including junction boxes, transformer bases, and control cabinets.

716.03.02 Conduit Installation. Provide rigid steel conduit encasement for all conductors except as specified in the Plans. The Department will allow bonded slip joints for joining rigid conduit to junction boxes. When a standard coupling cannot be used, use an approved threaded union coupling. Ream all conduit ends to remove burrs and sharp edges. Paint damaged portions of galvanized surfaces and untreated threads resulting from field cuts with an Engineer approved rust prohibitive paint. Ensure that conduit bends have a radius of not less than 12 times the nominal diameter of the conduit.

Lay conduit not subjected to traffic to a depth of no less than 18 inches. Lay ducted cables to a depth of 2 feet. On transverse crossings under roadway surfaces and shoulders, place the conduit at a depth of no less than 2 feet below grade. Likewise, run ducted cables inside rigid steel conduits, or other Engineer approved methods, when crossing roadways. Make all pavement crossings by placing conduit in the subgrade before paving or by boring and jacking under existing pavements. When it is necessary to bore under roadways and ramps, obtain the Engineer's

approval of the boring procedure. Do not cut any pavement without obtaining the Engineer's prior approval. Before starting backfilling, allow the Engineer to inspect the conduit installation. Place and compact the backfill materials in lifts of 9 inches or less. Restore all disturbed areas as a result of the Contractor's operations to the Engineer's satisfaction. Bond together conduits, junction boxes, metal poles, and control boxes throughout the lighting system to all ground rods by using grounding bushings on the conduit ends. Bond these conduits to the electrical system ground.

Install underground utility warning tape immediately above the circuit cables. Bury the tape at a depth of 6 to 10 inches. Use a durable and colorfast tape conforming with the APWA-ULCC National Color Code with black lettering on red that continuously reads "CAUTION: ELECTRIC LINE BURIED BELOW" alternating with a no digging symbol.

716.03.03 Splicing. When the Engineer allows splicing, splice only in junction boxes, in transformer bases, or in pole bases when no transformer base is provided. Make butt splices, soldered and encased in waterproof resin filled splicing kits. Use copper of the correct wire range, 3M Scotchcast splicing kits or approved equal, and Scotchcast #4 resin or approved equal. Encase each conductor, including the ground, in a separate splice kit. Make splices for connecting leads from multiple circuit conductors to ballast terminals with approved field applied connector kits.

716.03.04 Painting. Clean ungalvanized or damaged surfaces of exposed junction boxes, pull boxes, control panels, poles, and similar equipment, and apply one coat of an inhibiting paint and two coats of aluminum paint, inside and out, after completing installation. For items fabricated from galvanized or nonferrous alloys, which are inherently rust resistant, paint only on damaged surfaces with an application of inorganic zinc rich primer or aluminum paint, as applicable.

716.03.05 Lighting Standard Installation. Ensure that concrete bases for lighting standards, up to 50 feet high, have a minimum depth of 6 1/2 feet and a minimum diameter of 2 feet. Construct a level base, with no more than a 3/8-inch gap existing between the concrete base and the transformer base when the pole is plumbed. The Department will allow steel plates or washers between the nuts and the transformer base or pole for stabilization and shims to plumb the pole for gaps up to 1/4 inch.

For breakaway supports, conform to Section 7 of the Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Grade the surrounding surface appropriately to meet the 4-inch breakaway support stub height.

716.03.06 Marker Installation. When specified in the Plans, mark the position of buried circuits with concrete slab markers. Install cable markers immediately above the cable. Place the markers with the top exposed approximately 2 inches above ground. Mark each cable run at approximately 100-yard increments between junction boxes and/or light poles, with additional markers at each change of direction. Install concrete slab markers at the end of the conduits crossing a roadway if a junction box is not present.

Impress the word "LIGHTING", appropriate directional arrows, and appropriate circuit identification number on each marking slab. Use letters that are approximately 3 inches high and 2 inches wide. Ensure that the stroke is 1/2 inch wide and 1/4 inch deep.

716.03.07 Drawings. Before final inspection of the roadway lighting system, provide a complete set of reproducible as-built drawings that show the arrangement and locations of all equipment and circuits. Include each duct or conduit pavement crossing with distances to permanent markers, such as structures and curb lines. Keep a daily record of all conduit placed in trenches, showing the distance from the pavement edge, the depth, and the length of runs, and indicate these on the as-built drawings.

716.03.08 Testing. After completing the service and equipment installations, conduct an operating test. Demonstrate that the system operates according to the Contract. Ensure that circuits test free of shorts and unauthorized grounds and have an insulating resistance of no less than 10 megohms when tested with 500 volt direct current potential in a reasonably dry atmosphere between conductors and ground. The Department will also conduct its own tests with its own equipment before final acceptance.

716.04 MEASUREMENT.

716.04.01 Roadway Lighting Systems. The Department will measure the work in the units specified in the Contract.

The Department will consider any costs associated with securing service and required certificates and providing as-built drawings incidental to this item of work.

716.04.02 Trenching and Backfilling. The Department will measure the quantity in linear feet.

716.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Roadway Lighting, Contract Items	Contract Units
4820	Trenching and Backfilling	Linear Foot

The Department will consider payment as full compensation for installing and placing the complete roadway lighting systems in satisfactory operation.

SECTION 717 ¾ THERMOPLASTIC INTERSECTION MARKINGS

717.01 DESCRIPTION. Furnish and install thermoplastic intersection markings (Stop Bars, Crosswalks, Turn Arrows, etc.) by either a machine applied, screed extrusion process or by applying preformed thermoplastic intersection marking material.

717.02 MATERIALS AND EQUIPMENT.

717.02.01 Preformed Thermoplastic Intersection Marking Material. Select from the Department's List of Approved Materials.

717.02.02 Extruded Thermoplastic Pavement Marking Material. Conform to Section 837.

717.02.03 Binder. Conform to Subsection 714.02.03

717.02.04 Drop On Glass Beads. Conform to Subsection 839.

717.02.05 Extruded Thermoplastic Application Equipment. Provide equipment with a shaping die that simultaneously deposits and shapes lines at a minimum thickness of 90 mils on the pavement surface. Do not use spray and ribbon gun applicators.

Ensure the application equipment conforms to the following:

1) Capable of providing continuous and uniform heat to maintain the material between 400 and 440 °F throughout the mixing, conveying, and dispensing.
2) The kettle is capable of continuous agitation during mixing and heated storage and is equipped with an automatic thermostat control device and material thermometer.
3) Equipped with a cutoff device that provides clean, square stripe ends.
4) Equipped with an automatic bead dispenser.

717.03 CONSTRUCTION.

717.03.01 Layout. On resurfacing, pavement restoration, and pavement rehabilitation projects, prepare and keep a written record of the locations of existing pavement markings, and furnish a copy to the Engineer before removing or obliterating the markings. The Engineer will notify you of any changes to the existing markings.

On new construction, the Department will provide more detailed information for each intersection prior to beginning work. This information will consist of plans, a drawing of each intersection, or an inspector to work with each crew to layout the markings in the field.

Before applying the pavement marking material, pre-mark the pavement surface and obtain the Engineer's approval of the proposed location, alignment, and control guides.

717.03.02 Surface Preparation. Clean all grease, oil, mud, dust, dirt, grass, loose gravel, or other deleterious material from the surface where pavement markings are to be applied as directed by, and by methods acceptable to, the Engineer.

On concrete surfaces and as the Engineer directs on older asphalt pavements, apply binder to the area where placing pavement marking material. Ensure that all solvents have evaporated from the binder before applying the marking material. On new concrete pavement surfaces, remove the curing compound from the pavement surface before applying the binder and the pavement marking material.

717.03.03 Application. Install extruded thermoplastic at a minimum thickness of 90 mils on the pavement surface in a melted state at a temperature from 400 and 440 °F. Install preformed thermoplastic according to manufacturer's instructions at a minimum thickness of 125 mils. Apply additional glass beads by a drop-on method at a rate that satisfies the retroreflectivity requirements of Subsection 717.03.05.

When installing symbols and legends (turn arrows, the word "ONLY" etc.) by the extrusion process, ensure that the finished markings conform to the standard size and shape in the Manual on Uniform Traffic Control Devices.

Verify the adhesion of the thermoplastic to asphalt pavements by performing bond checks as follows. Approximately 60 to 120 seconds after applying the thermoplastic material cut and lift approximately a 6-inch section. The thermoplastic is successfully bonding to the pavement surface if a layer of asphalt clings to the removed thermoplastic and the pavement surface under the removed section is shiny and black.

Ensure that finished markings are continuous and uniform in shape having clear and sharp edges with uniform bead distribution across the entire width and length of the line, symbol, or legend.

717.03.04 Restrictions. Do not apply the pavement marking material when air and pavement temperatures are below 50 °F.

Do not apply the pavement marking material when the surface of the pavement contains evidence of moisture in amounts significant enough to prevent the pavement marking material from bonding to the pavement. Significant amounts of moisture can be caused by heavy dew or very humid nights as well as from rainfall.

If encountering significant amounts of moisture while applying the thermoplastic, the Contractor, at his own risk, may attempt to apply the thermoplastic material subject to the following restrictions. Heat the thermoplastic material to the upper temperature limit specified by the manufacturer, and apply a test line on the pavement. Perform a bond check according to Subsection 717.03.03. If the thermoplastic successfully bonds to the pavement continue to apply thermoplastic material, provided there is evidence that the moisture is escaping through the surface of the material, as indicated by very small pinholes. If there is excessive moisture, as indicated by larger sized holes or bubbles on the surface of the material, do not apply thermoplastic until the moisture can be effectively dealt with. Perform a sufficient number of bond checks to ensure that the thermoplastic is bonding to the pavement.

717.03.05 Proving Period. A proving period of 180 days will follow the application of the durable markings. During this period, the Engineer will make such observations as are necessary to determine if the markings are acceptable. The proving period begins when the facility is opened to traffic.

A) Requirements. During the proving period, ensure that the material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, loss of retroreflectivity, vehicular damage and normal wear.

The minimum retroreflectivity requirements at the end of the proving period, as measured with a LTL2000, are as follows:

White: 300 mcd/lux/square meter
Yellow: 175 mcd/lux/square meter

The Department will take these measurements between 30 and 60 days after the start of the proving period, with acceptance based on KM 201. If the Department determines that the markings are acceptable, the installation of the markings will be considered complete.

B) Failure. The Department will consider any marking defective when the readings for that marking do not satisfy the retroreflectivity requirements or

more than 10 percent of the material fails to meet the other requirements of A) above. The Department will consider each marking separately.

C) Corrective Work. If any marking is found to be defective, repair or remove and replace the marking. Perform pavement marking replacement according to the requirements specified in this subsection for the initial application. The corrective work will be subject to a proving period as listed above.

717.03.06 Marking Removal. Remove all markings made in error or not conforming to the traffic operation in use. Remove markings by either an abrasion or burning process to the satisfaction of the Engineer. Do not paint with asphalt binder or other material to obliterate the markings.

717.03.07 Acceptance of Non-Specification Markings. When reasonably acceptable work has been produced but retroreflectivity requirements are not met, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the markings may be left in place, the Department will accept them at a reduction in the Contract unit bid price according to Acceptance Pay Schedule for Thermoplastic. The Department will not consider these procedures a means to continue accepting non-specification markings.

717.04 MEASUREMENT. The Department will measure the intersection markings on a per unit basis for items listed in the Quantity Summary.

The Department will not measure the removal of existing markings, layout, surface preparation, binder, glass beads, or testing for payment and will consider them incidental to the installation of the new marking. The Department will exclude the gaps when measuring dotted lane line extensions.

717.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

ACCEPTANCE PAY SCHEDULE		
Pay Value	White mcd/lux/square meter	Yellow mcd/lux/square meter
1.00	300	175
0.50	200-299	100-174
Remove and replace	<200	<100

Code	Pay Item	Pay Unit
6565, 6566	Pavement Marking, Thermoplastic X-Walk, Size	Linear Foot
6567, 6568	Pavement Marking, Thermoplastic Stop Bar, Size	Linear Foot
6569	Pavement Marking, Thermoplastic Cross Hatch	Square Foot
6572	Pavement Marking, Dotted Lane Extension	Linear Foot
6573-6575	Pavement Marking, Thermoplastic Arrow, Type	Each
6576	Pavement Marking, Thermoplastic “ONLY”	Each
----	Pavement Marking, Thermoplastic U-Turn Arrow	Each
----	Pavement Marking, U-Turn/Curved Arrow	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 718 ¾ BRIDGE END OBJECT MARKERS

718.01 DESCRIPTION. Furnishing and place Type 2 Object Markers at bridge ends. See page 3C-3 of the MUTCD for a general description.

718.02 MATERIAL. The Type 2 Object Marker has a vertical dimension of one foot and a horizontal dimension of 6 inches, and consists of reflective materials on an aluminum sheet.

718.02.01 Retroreflective Sheeting. Provide yellow sheeting conforming to Section 830.

718.02.02 Aluminum Substrate. Conform to Section 833.

718.03 CONSTRUCTION. Prepare the aluminum sheeting and the reflective material applied according to the manufacturer's recommendations.

Mount the object marker on a post meeting the requirements for Type II in Section 832. The minimum length of post is 8 feet. The Contractor is responsible for determining the actual length necessary at each location.

Install the object markers as near each bridge end as practical. Ensure the inside edge of the marker is in line with the inner edge of the bridge wall. Drive the post 3 feet, with one foot behind the marker and the remaining length as necessary to provide a mounting height to the bottom of the marker of 4 feet above the surface of the nearest traffic lane.

718.04 MEASUREMENT. The Department will measure the quantity of Object Marker Type 2 by each individual unit. The Department considers a unit to include all materials, including the post, necessary to acceptably furnish and install the marker.

718.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2565	Object Marker, Type 2	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 719 ¾ GUARDRAIL

719.01 DESCRIPTION. Furnish and install or remove all necessary material for each type of guardrail, end treatment, terminal section, and guardrail bridge end connector. Remove and relocate, or remove and reset, all necessary material for each type of guardrail. Adjust guardrail, including replacement of existing offset blocks, with new modified offset blocks. Furnish additional new hardware as needed to complete the adjustment.

719.02 MATERIALS.

719.02.01 Guardrail Systems. Conform to Section 814.

719.02.02 Concrete. Use Class A concrete conforming to Subsection 601.02 and 601.03.

719.02.03 Reinforcement Steel. Conform to Section 811.

719.02.04 Grout. Conform to Subsection 601.02.

When used in placement on a curve having a radius of 150 feet or less, curve guardrail in shop. Mark the radius of curvature on each of the curved elements. Furnish rail elements that have a nominal length of 13 1/2 feet.

Use the same type of posts, fastenings, and accessories throughout the project.

719.03 CONSTRUCTION. Do not leave uncompleted guardrail, bridge end connectors, terminal sections, or end treatments exposed to the traveling public. Construct guardrail, end treatments, bridge end connectors, and terminal sections behind lane closures or shoulder closures.

Construct guardrail 27 inches, with a tolerance of plus or minus one inch, above the true theoretical pavement elevations. Compute these elevations from the proposed pavement edge elevations or from other methods to ensure construction of the guardrail to the true gradient and with no sags.

Paint all damaged galvanizing with 2 coats of zinc dust-zinc oxide paint conforming to Federal Specification TT-P-641.

Provide permanent or temporary guardrail where it presently exists throughout the winter close-down periods of the Contract as the Engineer directs.

719.03.01 Setting Posts. Install posts according to the Contract without damaging the road or shoulder. Provide extra length posts when the Engineer directs to do so. Do not damage any portion of the driven posts. If damage occurs, discontinue driving and set remainder of the posts in excavated holes. Remove damaged portions of posts after installation.

Ram bottoms of dug post holes to provide a stable foundation. When encountering rock or rock fill, drill and grout posts in holes 2 feet in depth and slightly larger than the post sections. Proportion grout according to Subsection 601.03. Set posts vertically with the rail faces in a straight line, or when on a curve, at a uniform distance from the pavement. Backfill post holes in layers not to exceed 6 inches, and compact until the post is solid, firm, and in true alignment. Cut and set timber post tops to correct grade, and bevel according to the Standard Drawings. Bore holes at proper places to attach the rails. Anchor posts according to the Standard Drawings. Repair all damaged pavement.

Do not drive guardrail posts within one foot of the outlet pipe for pavement edgedrains. Repair all damage to the outlet pipe for pavement edgedrains caused by guardrail installations. If repair is not possible, remove and replace damaged outlet pipe.

719.03.02 Placing Rail. Construct the guardrail to the alignment and at the locations shown in the Contract. Splice rail element by lapping in the direction of traffic. Bolt rail element to each post through the holes provided in the rail. Where the holes are slotted for expansion, erect rail with the bolt in the center of the slot. Install nuts on the backside of all bolts, either through splices or through rail and posts. Draw bolts tightly. Extend the bolt at least 1/4 inch beyond the nut. Do not tighten bolts so tightly through expansion members that they prevent functioning of the members.

Erect rail so it appears smooth, uniform, continuous, and closely parallels the line and grade of the pavement.

Provide the type of end treatments, terminal sections, and guardrail bridge end connectors specified in the Contract. The Department will not allow field cutting, punching, burning, or welding.

719.03.03 Remove Rail. Remove the existing guardrail system, which includes bridge end connectors, terminal sections, or guardrail end treatments including all associated concrete, components, and incidentals. Fill all voids left from pulling guardrail posts with dry sand. Do not damage guardrail.

719.03.04 Relocate the Existing Guardrail System. Relocate the existing rail and posts to the alignment and at the locations shown in the Contract. Spot paint edges of all holes punched in the existing rail and posts that are to be reused. Spot paint all scratches or marred areas in completed installations where the galvanizing has been damaged. Spot paint with 2 coats of zinc dust-zinc oxide paint conforming to Federal Specification TT-P-641.

Do not intermix new pieces of guardrail with pieces of existing rail at any installation. Add new pieces, as needed, on one or both ends of an installation.

The Department will retain ownership of all items in the existing system not suitable for reconstruction, except concrete. Remove and dispose of existing concrete off the right-of-way.

If additional guardrail is needed to replace damaged guardrail, furnish and install new guardrail.

719.03.05 Adjust Existing Guardrail. Adjust existing guardrail to the alignment and at the locations shown in the Contract. Remove existing rail elements and offset blocks from the existing posts. Install new modified offset blocks. Reinstall rail elements. Realign guardrail both vertically and horizontally at the raised elevation.

When new end treatments, terminal sections, or bridge connectors are not specified, connect adjusted rail to the existing installation in a smooth transition. When new end treatments, terminal sections, or bridge connectors are specified, construct at new shoulder elevation or new grade condition.

719.03.06 Temporary Guardrail. Conform to the same construction requirements for temporary guardrail as for permanent guardrail. The Department will show temporary guardrail locations in the Contract. Maintain the temporary guardrail system for the duration of its use. Retain ownership of damaged or surplus components. The Contractor may use undamaged components in permanent installations.

719.03.07 Salvaged Material. The Department will retain ownership of the existing guardrail, guardrail post, and hardware. Stack W-beam rail 45 per bundle (3 wide, 15 high, overlapped). Stack and band metal posts 50 per bundle (5 wide, 10 high, overlapped). Bag nuts, bolts, and washers. Salvage a minimum of 80 percent of the nuts, bolts, and washers. Deliver existing guardrail and components to the nearest State maintenance facility. Obtain from the Engineer the designated area within the maintenance facility for storing these items. Dispose of all removed concrete off the right-of-way.

719.04 MEASUREMENT.

719.04.01 Guardrail. The Department will measure the quantity in linear feet along the actual length of the rail between the limits for end treatments, terminal sections and bridge end connections, and crash cushions. The Department will measure the quantity of shop curved guardrail in linear feet at 1.3 times the actual length.

719.04.02 Guardrail Terminal Sections. The Department will measure the quantity by each individual unit.

719.04.03 Extra Length Post. The Department will measure the quantity by each individual unit. The Department will still measure guardrail at locations where extra length post are required as this item represents only the added work and material required by the extra length.

719.04.04 Guardrail End Treatment. The Department will measure the quantity by each individual unit that is not a part of the guardrail.

719.04.05 Crash Cushion. The Department will measure the quantity by each individual unit that is not a part of the guardrail.

719.04.06 Guardrail Bridge End Connector. The Department will measure the quantity by each individual unit, including their end treatment.

719.04.07 Guardrail Connector to Concrete Median Barrier. The Department will measure the quantity, by each individual unit, according to Standard Drawing RBC-100.

719.04.08 Remove Guardrail. The Department will measure the quantity in linear feet. The Department will not measure the delivery and stacking of guardrail, posts, and its hardware for payment and will consider it incidental to this item of work.

719.04.09 Relocate Guardrail System. The Department will measure the quantity in linear feet.

719.04.10 Adjust Guardrail. The Department will measure the quantity in linear feet.

719.04.11 Temporary Guardrail. The Department will measure the quantity in linear feet. The Department will not measure maintenance and removal for payment and will consider it incidental to this item of work.

719.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2351, 2355	Guardrail, Single Face	Linear Foot
2353	Guardrail, Single Face, Install	Linear Foot
2352	Guardrail, Double Face	Linear Foot
2360, 2361, 2364, 2366	Guardrail Terminal Section, Type	Each
2399	Extra Length Post	Each
2367-2371, 2373, 2391, 2393	Guardrail End Treatment, Type	Each
2365, 2878, 2885-2890, 2894, 2920-2925, 2929-2931	Crash Cushion, Type	Each
2374-2380, 2382, 2386-2389	Guardrail Bridge End Connector, Type	Each
2359	Guardrail Connector to Concrete	Each

	Median Barrier	
2381	Remove Guardrail	Linear Foot
2385	Relocate Guardrail System	Linear Foot
2350	Adjust Guardrail	Linear Foot
2397	Temporary Guardrail	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 720 ¾ METAL HANDRAILS

720.01 DESCRIPTION. Furnish and install metal handrails.

720.02 MATERIALS.

720.02.01 Handrails. For materials for metal handrails for bridges conform to the requirements specified in the Contract. For other handrails, conform to the following subsections:

Handrail, Type A	810.05.04
Handrail, Type B	813.13.01
Handrail, Type C	813.13.02

720.02.02 Chain Link Fence. When constructed as part of the handrail, conform to Section 817, Type A, using aluminum coated steel fabric and tension wire.

720.02.03 Paint. Conform to Section 821.

720.03 CONSTRUCTION. Fabricate all handrails according to the details specified in the Plans or on Standard Drawings. When erected, ensure that all posts, except on bridges, are vertical and the rails are true to the alignment indicated.

Set bridge railing posts at right angles to the fascia line, perpendicular to grade, and erect tubing parallel to the fascia line. Use washer shims not exceeding 1/8 inch in thickness between the concrete and post base to obtain post or tubing alignment.

Fasten railing to the concrete as specified in the Plans.

Where aluminum is in contact with concrete, thoroughly coat the contacting surfaces with alumilastic compound or approved equal so as to completely insulate the aluminum from the concrete; or where bond between aluminum and concrete is desired, coat the aluminum with commercially available zinc chromate paint, and allow it to dry before installing it.

Paint plain steel handrail according to Subsection 607.03.23.

The Department will not require painting of galvanized handrail, except paint all exposed threads as required for plain handrail.

The Department will not require painting of aluminum handrail.

720.04 MEASUREMENT. The Department will measure the quantity of each type in linear feet along the top of the rail from center to center of end posts. The Department will not measure posts, pipe, channel, pickets, fittings, chain link fence, or painting for payment and will consider them incidental to this item of work.

720.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2611-2616, 2619, 2620, 8232, 8255-8257	Handrail, Type	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 721 ¾ FENCE

721.01 DESCRIPTION. Furnish and erect fence and gates of the height and type specified in the Plans, supported by steel, concrete, or timber posts along the inside limits of the right-of-way or at other locations shown or otherwise designated and at grades designated during construction.

721.02 MATERIALS.

721.02.01 Woven Wire Fencing. Conform to Section 816.

721.02.02 Chain Link Fencing. Conform to Section 817.

721.02.03 Concrete. Conform to Subsection 601.02 and 601.03.

721.03 CONSTRUCTION. Before starting fencing operations, remove all brush, stumps, logs, and debris that will interfere with the proper construction of the fence. Remove or trim sound standing trees in the fence line as directed.

Construct fence with new materials according to the Standard Drawings and as specified in this section. Install fence as one of the first construction operations. Where it is impractical to install fence initially in its final form or location, obtain written permission from adjacent property owners either to permit construction of a suitable temporary fence or to delay fence erection until such time as the permanent fence may be erected. Where tying fence to a new structure, erect a temporary fence until such time as the structure is complete and the permanent fence can be anchored to the structure in the manner specified in the Plans.

Install fence 9 inches inside the right-of-way line or in other locations specifically indicated.

Install fence facing the property owner except on horizontal curves. On horizontal curves install the fence to pull against all posts. Apply sufficient tension between pull posts to make the fence stock tight. Install pull posts at all breaks in horizontal alignment of the fence, and at sharp breaks in vertical alignment. For tangents and curves up to one degree, space pull posts a maximum of 500 feet on centers; ensure that curves over one degree to 4 degrees have pull posts spaced a maximum of 250 feet on centers; and curves over 4 degrees have pull posts installed each time the angle of deflection increases 5 degrees.

Use any Class concrete according to Subsection 601.03.

721.03.01 Setting Posts. Set all posts at the required depths and intervals designated in the Contract. Set posts plumb and in true alignment on the side where the wire is attached. Dig holes for posts to full depth and with sufficient diameter to allow proper tamping and compaction of the backfill. Use sound earth for the backfill and tamp it in place until the post is firm and rigid in its position. Set wood posts with the butt end down.

When encountering solid rock at grade or below, drill a hole one foot deep and slightly larger than the outside dimensions of the post or brace in the rock, and grout in the post. At line posts where top of rock is 8 inches or less below grade, remove the anchor plate. Backfill all excavation above rock, below grade, in 4 to 6-inch layers and tamp each layer thoroughly in place. Field cut posts and braces to fit maximum depth whenever encountering solid rock.

Set all end, gate, corner, and pull posts, and anchor them in concrete placed to the top of the ground, finished smooth, and sloped to drain.

Brace all end, gate, and corner posts. Brace pull posts in 2 directions. Brace corner posts in the direction of each line of the fence. Anchor the metal braces from the metal posts in concrete that is crowned at the top to shed water. Brace wood or concrete posts with a pole or bar of the same type of material as the post. When using wood posts, notch the braced post and adjacent line posts one inch deep at one foot from the top of the finished post to receive the brace pole. Secure the brace pole to

the posts by spiking or other means. Loop galvanized smooth wire having a minimum diameter of 0.148 inch around the braced post near the ground, and then loop it around the line post at 12 inches below its top continuing between the posts until 4 strands of wire are in place and the ends of the wire are securely fastened together. Then twist the strands of wire together until the brace pole is in compression. Do not allow the compression to be great enough to cause lateral springing in the brace pole.

Allow concrete anchors to cure for at least 5 days before erecting the fence.

721.03.02 Fencing. Tie any intersecting fence to an independent pull post.

Stretch woven wire fabric taut and securely fasten it to each post. Accomplish stretching with a stretcher that will produce equal tension in each line wire. Stretch fabric until the tension is just below the point of producing displacement in the tension crimps. At each end, corner, or gate post, cut and turn each strand of line wire around the post and tie it back to itself with no less than 3 turns.

When it is necessary to splice 2 sections of fence, make the splice by placing together the end stay wires of each section, and twist the end of each line wire around the stay wires and back onto itself with no less than 3 turns; or splice the fence by using Engineer approved splicing sleeves designed for that purpose.

Attach the fence to each wood post with a staple for each line wire and as many additional staples as necessary to firmly secure the wire. Furnish galvanized staples having a nominal diameter of 0.148 inch and a length of no less than one inch in length, for hardwood posts. When using treated softwood posts, furnish staples that are 1 1/2 inches long. Securely attach the woven wire fabric as shown on the Standard Drawings.

Use tension wires and rails in erection of chain link fences as shown on the Standard Drawings. When shown on the Standard Drawings, place, stretch taut, and secure at ends the top or bottom tension wires to all posts in a manner before placing fabric. When a top rail is required, secure the bar at each end before stretching and tying the fabric. Secure ends of the fabric with stretcher bars threaded through the loops of the fabric and secured to the posts by means of clamps with bolts and nuts. Use the number of clamps as indicated.

Place the fabric by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. Fasten the fabric to the line posts and to the top tension wire or to the top rail, with tie wires or bands as called for in Section 817 or as the Contract designates.

Determine the number of tension bands required per post of chain link fence by taking the height of the fence in feet and subtracting one. Space tie wires for attaching chain link fence to the top tension wire or top rail on 24-inch centers. Space tie wires for attaching chain link fence to intermediate or line posts on 14-inch centers. Space tie wires on chain link gates on 24-inch centers. Install the chain link fence around utility installations facing the highway with the barbed wire arms at a 45 degree angle extending toward the highway. Design and install post caps for all tubular posts so as to exclude moisture from inside the posts, and install socket type brace end connections so as to exclude moisture from inside the rails.

721.03.03 Gates. Erect gates at locations specified in the Plans or as the Engineer directs. Erect the gate plumb with its hinges firmly attached to the post and to the gate. Allow the gate to swing freely when opened. Install the latch so it works easily and secures the gate when closed.

Furnish water gates of the specified type that conform to the Plans and Standard Drawings.

721.03.04 Finishing. Ensure that the tops of all posts are at a uniform height above the ground or at a uniform distance above the top of the woven wire fabric. After erecting the fence, saw the tops of wood posts uniformly at least 2 inches above the strand of barbed wire. Make the cut at an angle of 60 degrees to the vertical on the side of the post away from the wire.

Ensure that the finished fence is true to line, taut, and solid at all points. Dispose of all surplus excavated material and other debris resulting from construction and leave

the fence line with a neat and orderly appearance.

721.04 MEASUREMENT.

721.04.01 Fence. The Department will measure the quantity of each type and height in linear feet along the top of the fence from outside to outside of end posts of fence installed, with deductions for all gates.

The Department will not measure material removal and disposal, drilling, excavating, or backfilling, installation or removal of temporary fences, or for connections to abutments or other structures for payment and will consider it incidental to this item of work.

721.04.02 Gates. The Department will measure the quantity by each individual unit.

The Department will not measure excavation or concrete for water gates for payment and will consider it incidental to this item of work.

721.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2259, 2261-2263, 2273-2275, 8710-8716	Fence, Type and Height	Linear Foot
2281, 2282, 2286-2289	Gate, Type	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 722 ¾ REMOVING, RESETTING, OR REPLACING FENCE

722.01 DESCRIPTION. Remove, remove and reset, or remove and replace fences (except masonry fences).

722.02 MATERIALS.

722.02.01 Posts. Use the same type of posts existing in the original fence, and comply with applicable requirements.

722.02.02 Woven Wire Fencing. Conform to Section 816.

722.02.03 Chain Link Fencing. Conform to Section 817.

722.02.04 Concrete. Conform to Section 601.02 and 601.03. Select any class concrete specified in Section 601.03.

722.03 CONSTRUCTION.

722.03.01 Resetting Fence. Reset the fence to the location designated in the Contract, using material from the original fence, and leave all fences in as good condition as before removal. Reset all posts using the same type of construction that was used on the original fence, and furnish any new material necessary to set these posts in the manner used on the original fence. Where any posts are set in concrete, reconstruct the fence in the same manner. Ensure that reconstructed fences are true to line and vertical. Ensure that all wires are taut and well stapled. Remove and restore gates for service at the new location. Repair or replace fence and gates damaged during moving or resetting.

722.03.02 Remove Fence. When listed as a bid item, remove the designated fence and dispose of the materials off the right-of-way.

722.03.03 Removing and Replacing Fence. Remove the fence as described above. Replace the fence according to Section 721.

722.04 MEASUREMENT. The Department will not measure repair or replacement of fence or gates damaged during moving or resetting for payment and will consider it incidental to the work item being performed.

The Department will not measure concrete or new material necessary to set posts in the manner used on the original fence for payment and will consider it incidental to Resetting Fence and Replacing Fence.

722.04.01 Removing and Resetting Fence. The Department will measure the quantity, including gates, in linear feet along the top of the fence and gates from outside to outside of end posts for each continuous run of fence.

722.04.02 Removing Fence. The Department will measure the quantity, including gates, in linear feet along the top of the fence and gates before removal from outside to outside of end posts for each continuous run of fence.

722.04.03 Resetting Fence. The Department will measure the quantity, including gates, in linear feet along the top of the fence and gates from outside to outside of end posts for each continuous run of fence.

722.04.04 Removing and Replacing Fence. The Department will measure the quantity, including gates, in linear feet along the top of the fence and gates from outside to outside of end posts for each continuous run of fence.

722.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2256, 2267	Removing and Resetting (Type) Fence	Linear Foot
2255, 2265	Removing (Type) Fence	Linear Foot
2266	Resetting (Type) Fence	Linear Foot
2268	Removing and Replacing (Type) Fence	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 723 — RIGHT-OF-WAY MARKERS

723.01 DESCRIPTION. Furnish and place right-of-way markers of the type provided or directed.

723.02 MATERIALS.

723.02.01 Casting. Provide castings as specified on the Standard Drawing. Conform to ASTM B 26, Aluminum Alloy 319.1.

723.02.02 Concrete Markers. Provide markers as specified on the Standard Drawing. Ensure all lettering is recessed and painted black. Ensure all exposed surfaces have a normal surface finish.

723.02.03 Concrete. Conform to Subsection 601.02 and 601.03.

723.02.04 Steel Reinforcement. Conform to Section 811.

723.02.05 Miscellaneous Metal. Conform to Subsection 813.07.

723.03 CONSTRUCTION. When practical, install right-of-way markers as one of the first construction operations.

Firmly set Type 1, 2, and 3 right-of-way markers in the ground to the depth specified on the Standard Drawing and at locations specified in the Plans.

Mount Type IA markers flush with the mounting surface. When installing on concrete surfaces, drill a one inch hole and epoxy into the existing concrete.

After the Engineer has set the right-of-way limits with hubs and tacks (see Subsection 201.03), set right-of-way markers within 12 inches of each hub and tack. When there is an obstacle, such as a tree, offset the right-of-way marker as the Engineer directs. The Engineer will record the station and offset distance from the centerline and record the new location on the as-built plans.

Use Class A or D concrete according to Subsection 601.03.

723.04 MEASUREMENT. The Department will measure the quantity by each individual unit.

723.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
2433-2440	Right-of-Way Marker, Kind and Type	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 724 ¾ PLANTING VINES, SHRUBS, AND TREES

724.01 DESCRIPTION. Furnish and plant trees, shrubs, vines, seedlings, and other materials in the areas and in the arrangement specified in the Plans or as the Engineer directs. Dig and prepare beds and planting holes, prune plants, furnish and place backfill, fertilize, mulch, water, brace, and perform all other incidentals required for planting.

Additionally, care for plants during the period required to demonstrate the plants have become established in a healthy growing condition, replace plants found defective as prescribed, and perform all other incidentals necessary to complete the work as specified in the Contract and as provided in this section.

724.02 MATERIALS.

724.02.01 Plants. Conform to the requirements of the American Standard for Nursery Stock as published by the American Association of Nurserymen. Provide 30 calendar days notice before obtaining nursery stock vines, shrubs, or trees to allow Department personnel to inspect the stock at the source. The Department will inspect all vines, shrubs, and trees at the work site. Obtain the Engineer's approval of the plants before planting.

724.02.02 Mulch. Conform to Subsection 827.05.

724.03 CONSTRUCTION.

724.03.01 Times Permissible for Planting. Perform the initial planting operation between the dates of November 1 and April 1. Perform initial planting when the temperature is a minimum of 35 °F and the ground is not frozen. Regardless of the calendar date, plants must be dormant when they are dug at the nursery source and when they arrive at the project site.

Perform the replacement planting operation between the dates of November 1 and May 15.

724.03.02 Transportation. Transport all plants from the nursery sources to the project site by covered vehicle.

724.03.03 Layout of Planting. Before digging of planting holes or beds, lay out, by suitable staking, the location of all planting holes and beds, and obtain the Engineer's approval.

When the Contract specifies planting at locations that will not sustain healthy growth, submit a written request to the Engineer for approval to relocate the plants. If the Engineer cannot find a suitable site to relocate the plants, they will be deleted from the Contract.

724.03.04 Backfill for Planting. Backfill with the best available material from the site. When desired, use topsoil from an off-site source. Exclude any soil with significant amounts of rock, shale, or clay material.

724.03.05 Surplus Excavation. Dispose of surplus excavation from the planting holes as the Engineer directs.

724.03.06 Mulching. Use either hardwood wood chips or shredded bark for mulching material, and place it around the plants as quickly as possible after planting. Apply it uniformly over the planting area to a depth of 4 inches and to a distance of one foot outside the periphery of the plant hole or planting bed.

724.03.07 Bracing. Brace evergreens and shade trees. The Department will not require bracing on other plants except when the Engineer directs. When bracing is

required, brace according to the Standard Drawings.

724.03.08 Period of Establishment. The Department will require a period of establishment to follow the completion of the initial planting. During this time perform the following maintenance items to ensure that optimum growing conditions for the plant material are maintained during the life of the contract. These maintenance items include but are not limited to the following: weeding beds, mowing perimeter of beds, watering plants, insect and disease control, periodic bracing adjustments.

When the total of the combined plant materials would constitute a major item, the Department will require a 3 growing season period of establishment. When the total of the combined plant materials would not constitute a major item, the Department will require a one growing season period of establishment. The Department will require a one growing season period of establishment for plant material used along channel changes regardless of total.

724.03.09 Inspection Schedule. When all planting is complete, notify the Engineer and the Initial Inspection will be made. The Department will make Replacement Inspections by September 15th following each growing season to determine if replacement planting is required. Perform all required replacement planting before April 15. When all replacement planting is complete, notify the Engineer. If no replacement plantings are required at the last Replacement Inspection, the Department will consider the Replacement Inspection to be the Final Inspection.

724.03.10 Replacement Planting. Ensure the plant materials remain in a healthy growing and vigorous condition at all times throughout the life of the period of establishment. The Department will consider plant materials to be unacceptable when any of the following conditions occur:

1) Plants are dead or missing from the planting site.
2) Plants that have experienced injury and show obvious signs of damage from drought, sun scald, insects, or disease.
3) Dieback of central leader and or lateral branches which disfigures the plant rendering it unacceptable.
4) Plants that have been damaged by physical or mechanical injury.

For 24-inch or shorter trees, perform replacement planting when the number of acceptable trees of that species and size falls below 75 percent. Ensure the replacement plantings raise the quantity of acceptable trees of that species and size to at least 85 percent.

For all other plant materials, perform replacement planting when the number of acceptable plants of that species and size falls below 95 percent. Ensure the replacement plantings raise the quantity of acceptable trees of that species and size to 100 percent.

724.03.11 Removal of Stakes, Tags, and Bracing. Remove stakes, tags, and bracing materials after the first Replacement Inspection and no later than 18 months after initial planting. Dispose of removed material off of the right-of-way.

724.03.12 Restoring Disturbed Areas. Restore all disturbed areas.

724.04 MEASUREMENT. The Department will measure the quantity of Plants, Vines, Shrubs, and Trees by each individual unit.

The Department will not measure bracing, mulching, furnishing topsoil, or maintenance for payment and will consider it incidental to the plant.

The Department will not measure replacement planting, including that necessitated by a third party, for payment and will consider it incidental to the plant.

724.05 PAYMENT. The Department will make payment for the completed and accepted quantities according to the Warranty Payment Schedule under the following:

Code	Pay Item	Pay Unit
----	Plants, Vines, and Shrubs; Species and Size	Each
----	Trees, Species and Size	Each

Warranty Payment Schedule
(one growing season)

		Completion Date	Payment
—	Initial Inspection		70%
Sept 15	1st Year Replacement Inspection	April 30	30%

Warranty Payment Schedule
(3 growing seasons)

		Completion Date	Payment
—	Initial Inspection		70%
Sept 15	1st Year Replacement Inspection	April 30	10%
Sept 15	2nd Year Replacement Inspection	April 30	10%
Sept 15	Final Inspection		10%

Any replacement work not done by the scheduled completion date and all work found unacceptable during final inspection shall receive full deduction of its unit bid price from the payment.

The Department will consider payment as full compensation for all work required under this section.

DIVISION 800

MATERIALS DETAILS

SECTION 801 ¾ CEMENT

801.01 REQUIREMENTS. Provide portland cement from approved mills listed in the Department's List of Approved Materials. Mills obtain approval by furnishing the Department samples and certified mill test data developed over the previous 6 months. Approved cement mill laboratories are AASHTO accredited in ASTM C150 test methods.

Conform to the following requirements for cement:

1) Type I, II, III, and IV conforms to ASTM C 150. State, in writing, the nature, amount, and identity of any processing addition and its compliance with ASTM C 465.
2) Type K conforms to ASTM C 845.
3) Type IP or Type IPA conforms to ASTM C 595, and the following additional requirements to Type IP and IPA:

    a) The pozzolan constituent shall be fly ash. Ensure that the loss on ignition of the fly ash does not exceed 3.0 percent.
    b) Ensure that the fly ash does not exceed 20 percent of the portland-pozzolan cement, by weight. The cement manufacturer shall furnish a statement to the Engineer stating the actual fly ash content in each shipment.
    c) The cement manufacturer shall furnish to the Engineer reports showing the results of tests performed on the fly ash used in the manufacture of the Type IP cement shipped to the project. The tests shall cover the chemical and physical properties listed in ASTM C 618.
    d) The cement manufacturer shall have a qualified technical representative readily available for consultations on the project at any time the Engineer deems necessary, at no expense to the Department.
    e) Use only one brand of Type IP cement throughout the project, unless the Engineer approves a change in brand in writing.

Even when tested and approved, do not mix cement from different mills in individual batches or use cement from different mills in alternate batches of concrete. Subject to the above restrictions, the Engineer may allow the use of cements from different mills for any structure or individual elements of a structure, provided color contrasts resulting from their usage is minimal or is otherwise unobjectionable and identification of the location of concrete containing the different cements is satisfactorily maintained.

Store cement to prevent damage from the elements. Provide weatherproof storage facilities with sufficient storage capacity that cements from different mills or of different types will not become intermixed.

Provide an acceptable means for obtaining samples, from either the cement silo, weigh hopper, or truck.

The Engineer will reject cement that for any reason has become damaged through contamination, partial set, or which contains lumps of caked cement. The Engineer may reject the entire contents of a container when it contains damaged cement.

The Engineer may accept cement producing an air content of mortar between 12 and 16 percent when it is to be used in air-entraining concrete and the air content of the concrete is controlled at the mixer.

801.02 NON-SPECIFICATION CEMENT. The Department accepts cement on the basis of manufacturer's certification attesting to type and conformance to the applicable ASTM specification. The Engineer will take check samples. When the check samples do not conform to these specifications, the Department will make deductions as shown in the following table. When a sample fails more than one test, the Department will make the total deduction as the sum of deductions up to a maximum of 100 percent.

TEST	MAXIMUM DEVIATION FROM REQUIREMENT (PERCENT)	DEDUCTION RATE BASED ON INVOICE COST OF CEMENT
Autoclave Expansion	0.08	12.5% per 0.01% deviation
Fineness by air permeability	10	20% per 2% deviation
Air Content for Air Entrained Cement	± 4	25% per 1% deviation
Air Content for Non-Air Entrained Cement	± 8	0-4 free, thereafter 25% Per 1% Deviation
Compressive Strength	15	20% per 3% deviation
Time of Set	20	25% per 5% deviation
Magnesium Oxide (MgO)	0.3	33.3% per 0.1% deviation
Sulfur Trioxide (SO_3)	0.4	0.1% free and then 33.3% per 0.1% deviation
Loss on Ignition	0.75	20.0% per 0.15% deviation
Insoluble Residue	0.75	20.0% per 0.15% deviation
Tricalcium Aluminate (C_3A)	1.5	33.3% per 0.5% deviation
Silicon Dioxide (SiO_2)	3.0	33.3% per 1% deviation
Aluminum Oxide ($A1_2O_3$)	1.0	20.0% per 0.2% deviation
Ferric Oxide (Fe_20_3)	1.0	20.0% per 0.2% deviation

SECTION 802 ¾ ADMIXTURES FOR CONCRETE

802.01 REQUIREMENTS. Provide admixtures conforming to the following requirements:

802.01.01 Air-Entraining. AASHTO M 154, except the chloride content (as Cl) shall not exceed one percent by weight. The Department may require tests for bleeding, time of setting, and length change.

802.01.02 Water-Reducing and Retarding. AASHTO M 194, Type D, except the relative durability factor shall not be less than 90 and the chloride content (as Cl) shall not exceed one percent by weight.

802.01.03 Water-Reducing. AASHTO M 194, Type A, except the relative durability factor shall not be less than 90 and the chloride content (as Cl) shall not exceed one percent by weight.

802.01.04 Water-Reducing and Accelerating. AASHTO M 194, Type E, except the relative durability factor shall not be less than 90 and the chloride content (as Cl) shall not exceed one percent by weight. Use water reducing and accelerating admixture only when the Engineer has reviewed proposed procedures for mixing, handling, and placing the concrete, and has given written permission to proceed.

802.01.05 Water-Reducing, High Range. AASHTO M 194, Type F, except the relative durability factor shall not be less than 90 and the chloride content (as Cl) shall not exceed one percent by weight.

802.01.06 Water-Reducing, High Range and Retarding. AASHTO M 194, Type G, except the relative durability factor shall not be less than 90 and the chloride content (as Cl) shall not exceed one percent by weight.

802.01.07 Accelerating. AASHTO M 194, Type C, except the relative durability factor shall not be less than 90 and the chloride content (as C1) shall not exceed one percent by weight.

802.02 APPROVAL. Select admixtures from the Department's List of Approved Materials. The Department places admixtures on the list based on evidence of compliance with requirements when determined by either tests performed by the Department; certified test data furnished by a recognized laboratory providing such laboratory shall be one regularly inspected by the Cement and Concrete Reference Laboratory of ASTM; for air-entraining admixtures that are aqueous solutions of Vinsol Resin, manufacturer's shall submit a certification in the following form:

> *This is to certify that the product* (trade name) *as manufactured and sold by* (company*) is an aqueous solution of Vinsol Resin that has been neutralized with sodium hydroxide. The ratio of sodium hydroxide to Vinsol Resin is one part of sodium hydroxide to* (number) *parts of Vinsol Resin. The percentage of solids based on the residue dried at 105 ♀C is* (number). *No other additive or chemical agent is present in this solution.*

The Engineer will not require testing of admixtures included on the Department's List of Approved Materials at the time of their use unless there is indication in actual field use of harmful effects on the properties of the concrete or when the Engineer considers testing necessary for other reasons.

The Department will continue to include an admixture on the list contingent upon satisfactory performance in actual project use and an annual certification containing the following information:

1) A statement that the admixture to be furnished during the particular calendar year is of the same composition as that previously approved for inclusion on the approved list.
2) A statement that the admixture conforms to the appropriate requirements of AASHTO M 194 or AASHTO M 154, as applicable.
3) A statement that the chloride content (as Cl) does not exceed one percent by weight.
4) A statement that notification will be made to the Division of Materials of any changes in composition before furnishing the material to projects.

The Department provides the specific details governing verification and documenting approved status of admixtures at the time of use in the Department's Manual of Field Sampling and Testing Practices.

SECTION 803 ¾ WATER

803.01 GENERAL. Use water for mixing or curing concrete, emulsified asphalt, or other similar materials that is reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. The Engineer may test the water at any time for its suitability for a particular use.

The Engineer will ordinarily accept water supplied by public distribution systems without testing.

The Engineer will require testing of mixing water for use in concrete when not from a public distribution system.

Provide water that when tested by KM 64-226 does not contain impurities in excess of the following limits:

Acidity or Alkalinity Calculated in terms of Calcium Carbonate	0.05 Percent
Total Organic Solids	0.10 Percent
Total Inorganic Solids	0.10 Percent
Chloride Content (as Cl)	1,000 parts per million

SECTION 804 ¾ FINE AGGREGATES

804.01 GENERAL. Fine aggregates include, but at the discretion of the Engineer are not limited to, natural sand, crushed sand, conglomerate sand, mortar sand, mineral filler, and lightweight aggregates where permitted.

The Department's List of Approved Materials includes the Aggregate Source List and the list of Class A and Class B Polish-Resistant Aggregate Sources.

804.01.01 Natural Sand. Provide fine granular material resulting from the natural disintegration of rock.

804.01.02 Crushed Sand. Provide fine granular material resulting from crushing of stone or gravel. Includes slag where permitted.

804.01.03 Conglomerate Sand. Provide natural materials primarily processed to the desired sizes, without crushing. Conglomerate sand may include some crushed natural material.

804.01.04 Mortar Sand. Provide natural, crushed, or conglomerate sand suitable for use in cement mortar.

804.01.05 Mineral Filler. Provide limestone dust, cement, fly ash, or other inert mineral matter.

804.02 APPROVAL. Provide fine aggregates from sources included on the Aggregate Source List meeting the description and requirements specified in this section.

The Department will consider a source for inclusion on the Aggregate Source List when the aggregate producer provides the following:

1) A Quality Control Plan.
2) A satisfactory laboratory facility with all necessary testing equipment.
3) A Qualified Aggregate Technician to perform the required testing.

When a supplier wishes to supply sand only for asphalt mixtures, Items 1, 2 and 3 above will be waived. The Department may add the source to the Aggregate Source List and restrict its use to asphalt mixtures.

Obtain the Department's approval before furnishing aggregate from sources not on the Aggregate Source List. The Department will sample the aggregate during stockpiling and test according to the Department's Manual of Field Testing and Sampling Practices.

The Department will reject aggregate when excessive variation of gradation or physical properties cause unworkable mixtures, mixture control problems, or non-conformance to the finished product or mixture requirements.

The Department will reject contaminated aggregate when the Engineer deems it could be detrimental to the finished product.

804.03 CONCRETE. Provide natural, crushed, or conglomerate sand. The Department will allow any combination of natural, crushed, or conglomerate sand when the combination is achieved in the concrete plant weigh hopper. The Engineer may allow other sands.

Use natural or conglomerate sands as fine aggregates in concrete intended as a wearing surface for traffic.

Conform to the following:

1) Sand Equivalent - 80 (minimum).
2) Soundness - 10% loss (maximum).
3) Friable Particles - 1.0% (maximum).

4) Coal plus Lignite - 0.50% (maximum).
5) Uncompacted Voids[(1)] - 47% (maximum).
6) Organic Impurities - Not darker than the standard.
7) Mortar Strength[(2)] - 95% at 7 calendar days (minimum).
8) Gradation[(1)]:

Sieve Size	Percent Passing
3/8 inch	100
No. 4	90-100
No. 16	45-85
No. 50	5-25
No. 100	0-8

[(1)] *The Department will permit fine aggregates exceeding when they are used in a combination that meets requirements.*
[(2)] *The Department will require testing for mortar strength only for sand not passing the test for organic impurities and will supersede the requirement for organic impurities.*

The Department will waive the requirements for gradation, sand equivalent, and uncompacted voids for precast reinforced concrete box culvert sections, concrete pipe, and pipe arches.

804.04 ASPHALT MIXTURES. Provide natural, crushed, conglomerate, and slag sand, with the addition of filler as necessary, to meet gradation requirements. The Department will allow any combination of natural, crushed, conglomerate, and slag sand when the combination is achieved using cold feeds at the plant.

804.04.01 Sand for Mixtures.

1) Gradation - 100 percent passing the 3/8 inch sieve with more than 50 percent passing the No. 4 sieve.
2) Coal Plus Lignite - 5.0 percent maximum.
3) Soundness - 15 percent maximum.

804.04.02 Mineral Filler. Ensure 100 percent passes the No. 16 sieve and at least 30 percent passes the No. 200 sieve.

804.04.03 Polish-Resistant Aggregate. Provide fine aggregates required for polish-resistant applications from a Class A Polish-Resistant Aggregate Source. In addition to these listed sources, the Department will consider natural sand, conglomerate sand, and crushed gravel sand meeting the requirements of Section 804 to be polish-resistant.

804.04.04 Requirements for Combined Aggregates.

A) Uncompacted Voids. Provide aggregates for Superpave mixtures meeting the minimum voids content as listed in the Superpave Fine Aggregate Consensus Property Requirements table.

B) Sand Equivalent. Provide aggregate having a sand equivalent value of 45 or greater for the portion of the total combined aggregates passing the No. 4 sieve. Provide aggregates for Superpave mixtures meeting the minimum sand equivalent limits as listed in the Superpave Fine Aggregate Consensus Property Requirements table.

The sand equivalent limits specified in this section apply to aggregates in the final mixture. The Department will normally take samples from stockpiled aggregates or aggregate cold feeds, including mineral filler, for acceptance testing. When these tests do not meet the required values, make trial runs through the plant to provide material for sampling which is intended for the final mixture.

Except for Superpave mixtures, the Department may waive the sand equivalent requirement provided the portion of the combined aggregate passing the No. 40 sieve is non-plastic according to AASHTO T 90.

SUPERPAVE FINE AGGREGATE CONSENSUS PROPERTY REQUIREMENTS				
ESAL Class	Design ESALs (millions)	Uncompacted Void Content of Fine Aggregate (Percent),[1] Minimum (Depth From Surface)		Sand Equivalent (Percent), Minimum
		≤ 100 mm	> 100 mm	
1	< 0.3	-	-	45
2	0.3 to < 3	40	40	45
3	3 to < 30	45	40	45
4	≥ 30	45	45	50

[1] *Performed according to AASHTO T 304, Method A.*

C) Friable Particles. Limit friable particles, excluding sandstone, to a maximum of 1.0 percent of the total combined aggregates.

D) Absorption. Provide aggregates having a water absorption of no more than 3.0 percent for each aggregate type. When slag is used, provide total combined aggregates having a water absorption of no more than 4.0 percent.

804.05 MORTAR SAND. Provide natural sand, crushed sand, or conglomerate sand conforming to Subsection 804.03 with the exception of Uncompacted Voids and Gradation. Conform to the following gradation:

Sieve Size	Percent Passing
No. 8	100
No. 50	10-40
No. 100	0-10

804.06 EPOXY SEAL COATS. Provide either natural or conglomerate sand having an insoluble content of 90 percent or greater. Conform to the following gradation:

Sieve Size	Percent Passing
No. 16	100
No. 50	10-40
No. 100	0-5

804.07 EPOXY SAND SLURRY. Provide silica sand containing no less than 90 percent insolubles. Ensure the sand is rounded to subangular, clean, dry and non-friable. Conform to the following gradation:

Sieve Size	Percent Passing
No. 8	100
No. 50	0-40
No. 100	0-5

The Department may allow material not meeting this gradation if it produces a workable mixture and an acceptable slurry seal.

804.08 PIPE BEDDING. Provide natural, crushed, or conglomerate sand having a sand equivalent of 20 or greater. The Department may waive the sand equivalent requirement when the portion passing the No. 40 sieve is non-plastic according to

AASHTO T 90. Conform to the following gradation:

Sieve Size	Percent Passing
3/8 inch	100
No. 100	0-15

804.09 UNDERDRAINS, EMBANKMENT DRAINAGE BLANKET, AND NATURAL SAND FOR DRAINAGE AND BACKFILL. Provide natural sand having a sand equivalent of 70 or greater. Conform to the following gradation:

Sieve Size	Percent Passing
3/8 inch	100
No. 4	75-100
No. 100	0-8

804.10 GRADATION ACCEPTANCE OF NON-SPECIFICATION FINE AGGREGATE. When reasonably acceptable work has been produced using the aggregate in question, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the aggregate not conforming to gradation requirements may be left in place, the Department will accept the aggregate at a reduction in the Contract unit bid price for the work containing the aggregate according to the following procedures. The Department will not consider these procedures a means to continue accepting non-specification aggregates.

The Department will base the reduction on the invoice price for the aggregate at the source. When satisfactory invoices are not furnished, the Department will use current bin prices for that source on file with the Cabinet's Division of Purchases. The maximum deduction for non-specification material, which is allowed to remain in place, is 50 percent.

When aggregate fails to conform to gradation on more than one sieve, the Department will apply the largest payment reduction.

The Department will define a lot based on the smallest definable quantity of material represented by acceptance test results, either passing results or failing results, or both. Normally, the Department will average all test results for the lot to determine the test result for payment according to the deduction tables. However, when test results are not reasonably uniform the Department will not average the high and low test results within a lot. The Department will assign each test result to equal quantities in new smaller lots in proportion to the number of tests representing the original lot. When daily tests are performed, the lot will be a day's production unless the Department defines a smaller lot.

When 2 consecutive lots contain non-specification material, discontinue the use of the aggregate until the Department makes a decision concerning the overall acceptability of the aggregate from that source.

The Department will not impose a reduction in payment for quantities less than 50 tons unless the Engineer deems it necessary.

GRADATION - CONCRETE SAND					
Payment Reduction	Sieve Size-Percent Passing				
	3/8 inch	No. 4	No. 16	No. 50	No. 100
0%	100	90-100	45-85	5-25	0-8
10%			43-44	3-4	
10%	98-99	88-89	86-87	26-27	9
20%			42	2	
20%	97	87	88	28	10
30%			41	1	
30%	96	86	89	29	11
50%			40	0	
50%	95	85	90	30	12

GRADATION - MINERAL FILLER		
Payment Reduction	Sieve Size-Percent Passing	
	No. 16	No. 200
0%	100	30 minimum
10%	98-99	29
20%	97	28
30%	96	27
50%	95	26

GRADATION - MORTAR SAND			
Payment Reduction	Sieve Size-Percent Passing		
	No. 8	No. 50	No. 100
0%	100	10-40	0-10
10%		8-9	
10%	98-99	41-42	11
20%		7	
20%	97	43	12
30%		6	
30%	96	44	13
50%		5	
50%	95	45	14

GRADATION - SAND FOR EPOXY SEAL COAT			
Payment Reduction	Sieve Size-Percent Passing		
	No. 16	No. 50	No. 100
0%	100	10-40	0-5
10%		8-9	
10%	98-99	41-42	6
20%		7	
20%	97	43	7
30%		6	
30%	96	44	8
50%		5	
50%	95	45	9

GRADATION - PIPE BEDDING		
Payment Reduction	Sieve Size-Percent Passing	
	3/8 inch	No. 100
0%	100	0-15
10%	98-99	16
20%	97	17
30%	96	18
50%	95	19

GRADATION - UNDERDRAINS, EMBANKMENT DRAINAGE BLANKET, AND NATURAL SAND FOR DRAINAGE AND BACKFILL			
Payment Reduction	Sieve Size-Percent Passing		
	3/8 inch	No. 4	No. 100
0%	100	75-100	0-8
10%	98-99	73-74	9
20%	97	72	10
30%	96	71	11
50%	95	70	12

804.11 SAMPLING AND TESTING. The Department will sample and test according to the following methods when applicable:

Absorption (Fine Aggregate)	AASHTO T 84
Coal and Lignite	KM 64-615
Dry Sieve Analysis	AASHTO T 27
Friable Particles	AASHTO T 112
Insoluble Content (Fine Aggregate)	KM 64-224
Mortar Strength	AASHTO T 71
Organic Impurities	AASHTO T 21
Plastic Limit and Plasticity Index	AASHTO T 90
Sampling	AASHTO T 2
Sand Equivalent	AASHTO T 176
Sieve Analysis of Mineral Filler	AASHTO T 37
Soundness	KM 64-610
Uncompacted Voids (Method A)	AASHTO T 304
Wet Sieve Analysis	KM 64-620 or AASHTO T 27

SECTION 805 ¾ COARSE AGGREGATES

805.01 GENERAL. Coarse aggregates include, but at the discretion of the Engineer are not limited to, crushed stone and crushed or uncrushed gravel. Includes lightweight aggregates or slag where permitted.

The Department's List of Approved Materials includes the Aggregate Source List and the list of Class A and Class B Polish-Resistant Aggregate Sources.

805.02 APPROVAL. Provide coarse aggregates from sources included on the Aggregate Source List meeting the description and requirements specified in this section.

The Department will consider a source for inclusion on the Aggregate Source List when the aggregate producer provides the following:

1) A Quality Control Plan.
2) A satisfactory laboratory facility with all necessary testing equipment.
3) A Qualified Aggregate Technician to perform the required testing.

Obtain the Department's approval before furnishing aggregate from sources not on the Aggregate Source List. The Department will sample the aggregate during stockpiling and test according to the Department's Manual of Field Testing and Sampling Practices.

The Department will reject aggregate when excessive variation of gradation or physical properties cause unworkable mixtures, mixture control problems, or non-conformance to the finished product or mixture requirements.

Coarse aggregates are subject to preliminary source approval.

805.03 GENERAL REQUIREMENTS. Provide coarse aggregates that are free of objectionable amounts of clay lumps, dirt coatings, and foreign material. The Department will reject contaminated aggregate when the Engineer deems it could be detrimental to the finished product.

805.03.01 Soundness and Shale. Conform to the following:

AGGREGATE USE	SHALE PERMITTED[1] (Maximum %)	SOUNDNESS REQUIREMENT (Maximum %)
Portland Cement Concrete Mixtures		
Class AA, Class S and Bridge Deck Overlays	1.0	9
All Other Concrete Classes and Uses	2.0	12
Asphalt Mixtures		
Aggregate for Polish Resistant Surfaces and Asphalt Surface Under OGFC:		
Limestone and Dolomite	1.0	9
Other Aggregate Types	2.0	12
All Other Asphalt Mixtures	2.0	15
Other Uses		
Sizes No. 610 or 710 When Used for Aggregate Surfacing, Traffic Bound Base, and Maintenance	5.0	18
Riprap and Channel Lining	2.0	12
All Other Uses	2.0	15

[1] *The Department will determine shale quantity by visual estimation for Riprap and Channel Lining and according to KM 64-604 for all other aggregate.*

805.03.02 Physical Properties. Conform to the following:

Wear (Except Slag and Sandstone)	40% (maximum)
Wear (Sandstone)	50% (maximum)
Wear (Slag)	60% (maximum)
Friable Particles	1.0% (maximum)
Unit Weight (Slag)	70 lbs/ft^3 (minimum)

805.03.03 Gradation. Where the Department specifies or permits designated sizes of coarse aggregates, provide aggregates meeting the grading limits indicated for the various sizes listed in the Sizes of Coarse Aggregates table. When the Contract does not specify sizes or combinations of aggregate for various types of construction, furnish aggregate according to the Aggregate Size Use table. The Department will allow blending of same source/same type aggregate to achieve designated sizes when precise procedures are used such as cold feeds, belts, or equivalent.

805.04 CONCRETE. Provide crushed stone or crushed or uncrushed gravel. The Department will allow any combination of crushed stone, crushed or uncrushed gravel when the combination is achieved in the concrete plant weigh hopper. Conform to the following:

	Max. Pct. by Wt.
Friable Particles	0.25
Finer than No. 200	2.0
Coal and Lignite	0.5
Lightweight particles (Gravel) [(1)] (Sp. Gr. Less than 2.40)	4.0
Lightweight particles (Limestone) (Sp. Gr. Less than 2.40)	1.0

[(1)] *The permissible lightweight particle content of gravel coarse aggregate for reinforced concrete box culvert sections, concrete pipe, pipe arches, or for use only in concrete that will be permanently protected from freezing by 2 feet or more of cover is 10.0 percent.*

The Department will waive the requirements for gradation and finer than No. 200 for precast reinforced concrete box culvert sections, concrete pipe, and pipe arches.

Do not use aggregate produced from an individual production lift until the Department obtains the finished product results from the Concrete Beam Expansion Test Method AASHTO T 160. If beam expansion is greater than 0.06 percent at 6 months, the Department will reject the production lift for use in concrete applications.

The Department will not require tests for Concrete Beam Expansion from an individual production lift if the individual ledges are accessible for hand sampling and the lift is acceptable based on petrographic examination of the hand samples. The Department will accept a production lift if no more than 20 percent of the total lift footage is considered potentially alkali carbonate reactive upon petrographic inspection.

805.04.01 PCC Base, PCC Pavement, PCC Shoulders and Concrete for Bridge Decks. The Department will subject coarse aggregates that are to be used in PCC base, PCC pavement, PCC shoulders, and bridge decks to freeze-thaw testing according to KM 64-626. The Department will allow sources having expansions of 0.06 percent or less to supply any size coarse aggregate listed in the Aggregate Size Use table, providing that size or a larger size has tested satisfactorily. When sources have expansions of more than 0.06 percent the Department will:

1) Reject the material.
2) Limit to the permitted sizes determined from acceptable freeze-thaw testing.

3) Allow the submittal of a proposal to the Engineer for production of acceptable coarse aggregate. The Department will require acceptable freeze-thaw tests results before approving any proposal.

805.04.02 Lightweight Aggregate. When the Department allows lightweight aggregate conform to the following:

1) Dry Loose Unit Weight. As appropriate or as specified, AASHTO M 195, Table 2.
2) Gradation (by weight). Provide size specified, AASHTO M 195, Table 1.
3) Finer than No. 200. 3.0 percent maximum.
4) Wear. 50 percent maximum.
5) Soundness. 9 percent loss maximum.
6) Friable Particles. 1.0 percent maximum.
7) Deleterious Particles. 1.0 percent maximum.
8) Freeze-Thaw Resistance. 85 percent minimum durability factor and 0.06 percent maximum length change according to KM 64-626.
9) Provide creep, shrinkage, and tensile splitting strength test data made on concrete produced from the lightweight aggregate when the Engineer requests.
10) If lightweight aggregate from an unapproved source is proposed for use, notify the Engineer of the aggregate source and proposed concrete mix design at least 10 weeks before any lightweight aggregate concrete is placed, so the Department may subject the lightweight aggregate to testing as outlined above, plus any additional testing as deemed necessary and indicated in AASHTO M 195. At the Departments option, suitable documentation of such testing by an independent testing laboratory may be accepted.

805.05 ASPHALT MIXTURES AND SEALS. Provide crushed stone, crushed gravel, or blast furnace slag. The Department will allow any combination of crushed stone, crushed gravel, or blast furnace slag when the combination is achieved using cold feeds at the asphalt plant. The Engineer may allow other coarse aggregates.

805.05.01 Absorption. Provide aggregates having a water absorption of no more than 3.0 percent for each size and type. When blast furnace slag slag is used, provide total combined aggregates having a water absorption of no more than 4.0 percent.

805.05.02 Crushed Particles. Applies to the total combined aggregates retained on a No. 4 sieve, including the material from the fine aggregate. Conform to the following:

A) Superpave Mixtures. Minimum percent crushed requirements as listed in the Superpave Coarse Aggregate Consensus Property Requirements table.
B) Open-Graded Friction Courses. Minimum 95 percent one or more crushed faces and 75 percent 2 or more crushed faces.
C) Seal Coats. Minimum 90 percent one or more crushed faces.
D) Other Mixtures. Unless otherwise specified, minimum 75 percent one or more crushed faces.

SUPERPAVE COARSE AGGREGATE CONSENSUS PROPERTY REQUIREMENTS				
ESAL Class	Design ESALs (millions)	Coarse Aggregate Angularity (Percent), Minimum (Depth From Surface)		Flat and Elongated[1] (Percent), maximum
		≤ 100 mm	> 100 mm	
1	< 0.3	75/-	75/-	10
2	0.3 to < 3	75/-	75/-	10
3	3 to < 30	95/90	80/75	10
4	≥ 30	100/100	100/100	10

[1] *Criterion based on a 5:1 maximum-to-minimum ratio.*

805.05.03 Flat and Elongated. Provide aggregates for Superpave mixtures not exceeding the flat and elongated maximum as listed in the Superpave Coarse Aggregate Consensus Property Requirements table.

805.05.04 Finer Than No. 200 (Seals). Provide coarse aggregates having no more than 3.0 percent passing the No. 200 sieve.

805.05.05 Polish-Resistant Aggregate. Provide coarse aggregates required for polish-resistant applications from a Class A or Class B Polish-Resistant Aggregate Source, as applicable, based on mixture designation of aggregate type.

805.06 DENSE GRADED AGGREGATE (DGA) AND CRUSHED STONE BASE (CSB). Provide crushed stone having a sand equivalent value of 30 or greater with mineral filler as needed to meet gradation requirements. The Department may waive the sand equivalent requirement when the portion passing the No. 40 sieve has a plasticity index of 4 or less according to AASHTO T 90.

805.07 FREE DRAINING BEDDING AND BACKFILL. Provide crushed stone or crushed or uncrushed gravel. The Department will allow a shale content of 5 percent providing the combined shale, friable particles, and minus No. 200 content does not exceed 5 percent. Conform to the following gradation:

Sieve Size	Percent Passing
1 1/2 inch	100
No. 4	0-30

805.08 COARSE AGGREGATES FOR UNDERDRAINS. Furnish crushed or uncrushed aggregate, including pea gravel meeting the quality requirements of Section 805 with the following exception: The Department will allow a shale content of 5 percent providing the combined shale, friable particles, and minus No. 200 content does not exceed 5 percent. Conform to the following gradation:

Sieve Size	Percent Passing
1/2	100
No. 4	0-30
No. 100	0-5

805.09 COARSE AGGREGATE FOR ROCK DRAINAGE BLANKET. Provide crushed or uncrushed aggregate, including pea gravel, meeting the quality requirements of this section with the following additional requirement: Ensure the

minus No. 200 content does not exceed 5 percent. When the material includes a significant amount of individual fragments greater than 1 1/2 inches, the Engineer may accept the minus No. 200 portion based on visual inspection. Conform to the following gradation:

Sieve Size	Percent Passing
4 inch	100
No. 4	0-30

805.10 GRANULAR EMBANKMENT. Provide granular material up to 2 1/2-inch maximum size with a maximum shale content of 5 percent. Use either:

1) Engineer approved shot limestone or sandstone from roadway excavation.
2) Crushed stone, crushed or uncrushed gravel, or crushed or natural sand meeting general requirements of Section 804 and this section, with a minus No. 200 content not exceeding 10.0 percent.

805.11 STRUCTURE GRANULAR BACKFILL. Conform to Subsection 805.09.

805.12 REINFORCED FILL MATERIAL. Obtain the Engineer's approval for material quality before use. Ensure the material is reasonably free of shale or other deleterious material. Conform to the following:

A) Gradation. The Engineer may accept the material by visual inspection when it includes a significant amount of individual fragments greater than 1 1/2 inches.

Sieve Size	Percent Passing
4 inch	100
No. 200	5

B) Resistivity. Greater than 3,000 ohm-cm (Applicable only when granular fill has more than 50 percent passing the No. 4 sieve).

C) PH. Between 5-10.

D) Chlorides. Less than 200 parts per million.

E) Sulfates. Less than 1,000 parts per million.

F) Angle of Internal Friction. Greater than or equal to 34 degrees. When providing gap-graded materials, single-size aggregates, natural sand, uncrushed gravel, or blends including uncrushed gravel, furnish a test report showing the 34 degree minimum internal friction angle is met. Test according to AASHTO T 236 using a sample of the material compacted to 95 percent of AASHTO T 99 Methods C or D (with oversize correction as outlined in Note 7) at optimum moisture content. When such materials are approved, the Engineer will perform sampling and testing on the project as necessary to assure that the material furnished is closely similar to that approved. The Department will not normally require testing on other aggregate types.

G) Erodible or Unstable Material. Treat as applicable. The Department considers Size No. 57 or larger aggregate, except crushed or uncrushed gravel, non erodible. The Department considers the following materials to be erodible or unstable:

1) Friable sandstone. The Engineer determines when sandstone is friable or non-friable.
2) Crushed or uncrushed gravel, any size.
3) Crushed coarse aggregate (other than gravel) smaller than Size No. 57.

4) Any material with 50 percent or more passing the No. 4 sieve.

805.13 SLOPE PROTECTION AND CHANNEL LINING.

805.13.01 Cyclopean Stone Riprap and Channel Lining Class III. Provide material meeting the general requirements of Section 805. No less than 80 percent, by volume, of individual stones that range in size from 1/4 to 1 1/2 cubic feet. The Department will allow stones of smaller sizes for filling voids in the upper surface and dressing to the proper slope.

805.13.02 Crushed Aggregate Slope Protection. Furnish aggregate meeting the general requirements of Section 805. Conform to the following gradation (Coarse aggregate sizes No. 1 and No. 2 conform to this requirement):

Sieve Size	Percent Passing
4 inch	100
2 1/2 inch	25-100
1 1/2 inch	0-15

805.13.03 Channel Lining, Class IA. Provide limestone meeting the general requirements of this section. Use a crusher, grizzly, or sieve with openings to produce a grading that 100 percent passes the 5 inch sieve, no more than 20 percent of the finished product passes through square openings 1 1/2 by 1 1/2 inches.

805.13.04 Channel Lining, Class II. Provide limestone meeting the general requirements of this section. Use a crusher, grizzly, or sieve with openings to produce a grading that 100 percent passes the 9 inch sieve, and no more than 20 percent of the finished product passes through square openings 5 by 5 inches.

805.13.05 Channel Lining, Class IV. Provide material excavated and prepared according to Section 204.

805.13.06 Stone for Gabions. Provide aggregate meeting the general requirements of this section and be of such gradation that 100 percent passes through a square opening of 12 by 12 inches and 100 percent is retained on a 4 inch sieve.

805.14 AGGREGATE SURFACING, TRAFFIC-BOUND BASE, AND MAINTENANCE. When providing size No. 610 or 710 coarse aggregate for aggregate surfacing (shoulders, entrances, mailbox turn outs, or similar items), traffic bound base and maintenance operations; furnish aggregate meeting the grading requirements in Sizes of Coarse Aggregates table, with no more than 12 percent finer than a No. 200 sieve.

When providing DGA for aggregate surfacing, traffic bound base, and maintenance operations conform to the grading requirement in Sizes of Coarse Aggregates table.

805.15 GRADATION ACCEPTANCE OF NON-SPECIFICATION COARSE AGGREGATE. It is intended that all aggregate purchased for Department work meet the requirements of this section. When reasonably acceptable work has been produced using the aggregate in question, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the aggregate not conforming to gradation requirements may be left in place, the Department will accept the aggregate at a reduction in the Contract unit bid price for the work containing the aggregate according to the following procedures. The Department will not consider these procedures a means to continue accepting non-specification aggregates.

The Department will base the reduction on the invoice price for the aggregate at the source. When satisfactory invoices are not furnished, the Department will use current bin prices for that source on file with the Cabinet's Division of Purchases. The

maximum deduction for non-specification material which is allowed to remain in place is 50 percent. When aggregate fails to conform to gradation on more than one sieve, the Department will apply the largest payment reduction.

The Department will define a lot based on the smallest definable quantity of material represented by acceptance test results, either passing results or failing results, or both. Normally, the Department will average all test results for the lot to determine the test result for payment according to the deduction tables. However, when test results are not reasonably uniform the Department will not average the high and low test results within a lot. The Department will assign each test result to equal quantities in new smaller lots in proportion to the number of tests representing the original lot. When daily tests are performed, the lot will be a day's production unless the Department defines a smaller lot.

When 2 consecutive lots contain non-specification material, discontinue the use of the aggregate until the Department makes a decision concerning the overall acceptability of the aggregate from that source.

The Department will not impose a reduction in payment for quantities less than 50 tons unless the Engineer deems it necessary.

GRADATION - SIZE NO. 1					
Payment	Sieve Size-Percent Passing				
Reduction	4 inch	3 1/2 inch	2 1/2 inch	1 1/2 inch	3/4 inch
0%	100	90-100	25-60	0-15	0-5
10%			61-62		
10%	98-99	88-89	23-24	16-17	6-7
20%			22		
20%	97	87	63	18	8
30%			21		
30%	96	86	64	19	9
50%			20		
50%	95	85	65	20	10

GRADATION - SIZE NO. 2					
Payment	Sieve Size-Percent Passing				
Reduction	3 inch	2 1/2 inch	2 inch	1 1/2 inch	3/4 inch
0%	100	90-100	35-70	0-15	0-5
10%			33-34		
10%	98-99	88-89	71-72	16-17	6-7
20%			32		
20%	97	87	73	18	8
30%			31		
30%	96	86	74	19	9
50%			30		
50%	95	85	75	20	10

GRADATION - SIZE NO. 23				
Payment Reduction	Sieve Size-Percent Passing			
	3 inch	2 inch	1 inch	1/2 inch
0%	100	40-90	0-15	0-5
10%		38-39		
10%	98-99	91-92	16-17	6-7
20%		37		
20%	97	93	18	8
30%		36		
30%	96	94	19	9
50%		35		
50%	95	95	20	10

GRADATION - SIZE NO. 3					
Payment Reduction	Sieve Size-Percent Passing				
	2 1/2 inch	2 inch	1 1/2 inch	1 inch	1/2 inch
0%	100	90-100	35-70	0-15	0-5
10%			33-34		
10%	98-99	88-89	71-72	16-17	6-7
20%			32		
20%	97	87	73	18	8
30%			31		
30%	96	86	74	19	9
50%			30		
50%	95	85	75	20	10

GRADATION - SIZE NO. 357					
Payment Reduction	Sieve Size-Percent Passing				
	2 1/2 inch	2 inch	1 inch	1/2 inch	No. 4
0%	100	95-100	35-70	10-30	0-5
10%			33-34	8-9	
10%	98-99	93-94	71-72	31-32	6-7
20%			32	7	
20%	97	92	73	33	8
30%			31	6	
30%	96	91	74	34	9
50%			30	5	
50%	95	90	75	35	10

GRADATION - SIZE NO. 4					
Payment	Sieve Size-Percent Passing				
Reduction	2 inch	1 1/2 inch	1 inch	3/4 inch	3/8 inch
0%	100	90-100	20-55	0-15	0-5
10%			18-19		
10%	98-99	88-89	56-57	16-17	6-7
20%			17		
20%	97	87	58	18	8
30%			16		
30%	96	86	59	19	9
50%			15		
50%	95	85	60	20	10

GRADATION - SIZE NO. 467					
Payment	Sieve Size-Percent Passing				
Reduction	2 inch	1 1/2 inch	3/4 inch	3/8 inch	No. 4
0%	100	95-100	35-70	10-30	0-5
10%			33-34	8-9	
10%	98-99	93-94	71-72	31-32	6-7
20%			32	7	
20%	97	92	73	33	8
30%			31	6	
30%	96	91	74	34	9
50%			30	5	
50%	95	90	75	35	10

GRADATION - SIZE NO. 5					
Payment	Sieve Size-Percent Passing				
Reduction	1 1/2 inch	1 inch	3/4 inch	1/2 inch	3/8 inch
0%	100	90-100	20-55	0-10	0-5
10%			18-19		
10%	98-99	88-89	56-57	11-12	6-7
20%			17		
20%	97	87	58	13	8
30%			16		
30%	96	86	59	14	9
50%			15		
50%	95	85	60	15	10

GRADATION - SIZE NO. 57					
Payment	Sieve Size-Percent Passing				
Reduction	1 1/2 inch	1 inch	1/2 inch	No. 4	No. 8
0%	100	95-100	25-60	0-10	0-5
10%			23-24		
10%	98-99	93-94	61-62	11-12	6-7
20%			22		
20%	97	92	63	13	8
30%			21		
30%	96	91	64	14	9
50%			20		
50%	95	90	65	15	10

GRADATION - SIZE NO. 610				
Payment	Sieve Size-Percent Passing			
Reduction	1 1/2 inch	1 inch	1/2 inch	No. 4
0%	100	85-100	40-75	15-40
10%			38-39	13-14
10%	98-99	83-84	76-77	41-42
20%			37	12
20%	97	82	78	43
30%			36	11
30%	96	81	79	44
50%			35	10
50%	95	80	80	45

GRADATION - SIZE NO. 67					
Payment	Sieve Size-Percent Passing				
Reduction	1 inch	3/4 inch	3/8 inch	No. 4	No. 8
0%	100	90-100	20-55	0-10	0-5
10%			18-19		
10%	98-99	88-89	56-57	11-12	6-7
20%			17		
20%	97	87	58	13	8
30%			16		
30%	96	86	59	14	9
50%			15		
50%	95	85	60	15	10

GRADATION - SIZE NO. 68						
Payment	Sieve Size-Percent Passing					
Reduction	1 inch	3/4 inch	3/8 inch	No. 4	No. 8	No. 16
0%	100	90-100	30-65	5-25	0-10	0-5
10%			28-29	3-4		
10%	98-99	88-89	66-67	26-27	11-12	6-7
20%			27	2		
20%	97	87	68	28	13	8
30%			26	1		
30%	96	86	69	29	14	9
50%			25	0		
50%	95	85	70	30	15	10

GRADATION - SIZE NO. 710				
Payment	Sieve Size-Percent Passing			
Reduction	1 inch	3/4 inch	3/8 inch	No. 4
0%	100	80-100	30-75	0-30
10%			28-29	
10%	98-99	78-79	76-77	31-32
20%			27	
20%	97	77	78	33
30%			26	
30%	96	76	79	34
50%			25	
50%	95	75	80	35

GRADATION - SIZE NO. 78						
Payment	Sieve Size-Percent Passing					
Reduction	3/4 inch	1/2 inch	3/8 inch	No. 4	No. 8	No. 16
0%	100	90-100	40-75	5-25	0-10	0-5
10%			38-39	3-4		
10%	98-99	88-89	76-77	26-27	11-12	6-7
20%			37	2		
20%	97	87	78	28	13	8
30%			36	1		
30%	96	86	79	29	14	9
50%			35	0		
50%	95	85	80	30	15	10

GRADATION - SIZE NO. 8					
Payment	Sieve Size-Percent Passing				
Reduction	1/2 inch	3/8 inch	No. 4	No. 8	No. 16
0%	100	85-100	10-30	0-10	0-5
10%			8-9		
10%	98-99	83-84	31-32	11-12	6-7
20%			7		
20%	97	82	33	13	8
30%			6		
30%	96	81	34	14	9
50%			5		
50%	95	80	35	15	10

GRADATION - SIZE NO. 9-M				
Payment	Sieve Size-Percent Passing			
Reduction	1/2 inch	3/8 inch	No. 4	No. 8
0%	100	75-100	0-25	0-5
10%	98-99	73-74	26-27	6-7
20%	97	72	28	8
30%	96	71	29	9
50%	95	70	30	10

GRADATION - SIZE NO. 10			
Payment	Sieve Size-Percent Passing		
Reduction	3/8 inch	No. 4	No. 100
0%	100	85-100	10-30
10%			8-9
10%	98-99	83-84	31-32
20%			7
20%	97	82	33
30%			6
30%	96	81	34
50%			5
50%	95	80	35

GRADATION - SIZE NO. 11				
Payment	Sieve Size-Percent Passing			
Reduction	3/8 inch	No. 4	No. 8	No. 100
0%	100	40-90	10-40	0-5
10%		38-39	8-9	
10%	98-99	91-92	41-42	6-7
20%		37	7	
20%	97	93	43	8
30%		36	6	
30%	96	94	44	9
50%		35	5	
50%	95	95	45	10

GRADATION - DENSE GRADED AGGREGATE						
Payment	Sieve Size-Percent Passing					
Reduction	1 inch	3/4 inch	3/8 inch	No. 4	No. 30	No. 200
0%	100	70-100	50-80	30-65	10-40	4-13
5%		68-69	48-49	28-29		
5%	98-99		81-82	66-67	41-42	14
10%		66-67	46-47	26-27	9	
10%	96-97		83-84	68-69	43-44	15
20%	95	65	45	25		3
20%			85	70	45	16
30%		64	44	24	8	2
30%	94		86	71	46	17

GRADATION - CRUSHED STONE BASE							
Payment	Sieve Size-Percent Passing						
Reduction	2 1/2 inch	1 1/2 inch	3/4 inch	3/8 inch	No. 4	No. 30	No. 200
0%	100	90-100	60-95	30-70	15-55	5-20	0-8
5%		88-89	58-59	28-29	13-14	3-4	
5%	98-99		96-97	71-72	56-57	21-22	
10%		86-87	56-57	26-27	11-12	1-2	
10%	96-97		98	73	58	23	9
20%		84-85	54-55	24-25	9-10	0	
20%	95		99	74	59	24	10
30%		83	53	23	8		
30%	94		100	75	60	25	11

GRADATION - FREE DRAINING BEDDING AND BACKFILL		
Payment Reduction	Sieve Size-Percent Passing	
	1 1/2 inch	No. 4
0%	100	0-30
10%	98-99	31-32
20%	97	33
30%	96	34
50%	95	35

GRADATION - COARSE AGGREGATES FOR UNDERDRAINS			
Payment Reduction	Sieve Size-Percent Passing		
	1 1/2 inch	No. 4	No. 200
0%	100	0-30	0-5
10%	98-99	31-32	6
20%	97	33	7
30%	96	34	8
50%	95	35	9

GRADATION - COARSE AGGREGATE FOR ROCK DRAINAGE BLANKET		
Payment Reduction	Sieve Size-Percent Passing	
	4 inch	No. 4
0%	100	0-30
10%	98-99	31-32
20%	97	33
30%	96	34
50%	95	35

GRADATION - CRUSHED AGGREGATE SLOPE PROTECTION			
Payment Reduction	Sieve Size-Percent Passing		
	4 inch	2 1/2 inch	1 1/2 inch
0%	100	25-100	0-15
10%	98-99	23-24	16-17
20%	97	22	18
30%	96	21	19
50%	95	20	20

SIZES OF COARSE AGGREGATES

	Sieve	AMOUNTS FINER THAN EACH LABORATORY SIEVE (SQUARE OPENINGS) PERCENTAGE BY WEIGHT															
Size	Size (mm)	4 inch	3 1/2 inch	3 inch	2 1/2 inch	2 inch	1 1/2 inch	1 inch	3/4 inch	1/2 inch	3/8 inch	No. 4	No. 8	No. 16	No. 30	No. 100	No. 200
1	3 1/2 inch	100	90-100		25-60		0-15		0-5								
2	2 1/2 inch			100	90-100	35-70	0-15		0-5								
23	2 1/2 inch			100		40-90		0-15		0-5							
3	2 inch				100	90-100	35-70	0-15		0-5							
357	2 inch				100	95-100		35-70		10-30		0-5					
4	1 1/2 inch					100	90-100	20-55	0-15		0-5						
467	1 1/2 inch					100	95-100		35-70		10-30	0-5					
5	1 inch						100	90-100	20-55	0-10	0-5						
57	1 inch						100	95-100		25-60		0-10	0-5				
610	1 inch						100	85-100		40-75		15-40					
67	3/4 inch							100	90-100		20-55	0-10	0-5				
68	3/4 inch							100	90-100		30-65	5-25	0-10	0-5			
710	3/4 inch							100	80-100		30-75	0-30					
78	1/2 inch								100	90-100	40-75	5-25	0-10	0-5			
8	3/8 inch									100	85-100	10-30	0-10	0-5			
9-M	3/8 inch									100	75-100	0-25	0-5				
10[(2)]	No. 4										100	85-100				10-30	
11[(2)]	No. 4										100	40-90	10-40			0-5	
DENSE GRADED AGGREGATE [(1)]	3/4 inch							100	70-100		50-80	30-65			10-40		4-13
CRUSHED STONE BASE [(1)]	2 inch				100		90-100		60-95		30-70	15-55			5-20		0-8

[(1)] Gradation performed by wet sieve KM 64-420
[(2)] Sizes shown for convenience and are not to be considered as coarse aggregates.

Note: The Department will allow blending of same source/same type aggregate when precise procedures are used such as cold feed, belt, or equivalent and combining of sizes or types of aggregate using the weigh hopper at concrete plants or controlled feed belts at the pugmill to obtain designated sizes.

AGGREGATE SIZE USE	
Type of Construction	Sizes to be Used
Asphalt Mixtures	See Subsection 403.03
Traffic-Bound Base	57, 610, 710, or DGA
PCC Base and Class P Concrete	57, 67, 68, 78, 8, or 9M with fine aggregate as specified in Section 804
Cement Concrete Structures and Incidental Construction	57, 67, 68, 78, 8, 9M for Classes “A”, “AA”, “D”, “D” Modified, “S”, and “B” (3&57, 4&67, 357, 467 also for Class B); 67, 68, 78, 8, 9M for Classes “M1”, “M2”, “AAA”, “A” Modified; with fine aggregate as specified in Section 804

805.16 SAMPLING AND TESTING. The Department will sample and test coarse aggregates at locations and frequencies that the Engineer determines. The Department will sample and test according to the following methods when applicable:

Absorption (Coarse Aggregate)	AASHTO T 85
Chlorides	Calif. DOT 422
Clay Lumps	AASHTO T 112
Coal and Lignite	KM 64-615
Concrete Beam Expansion Test	AASHTO T 160
Dry Sieve Analysis	AASHTO T 27
Finer Than No. 200	KM 64-606 or AASHTO T 11 (Procedure B)
Flat and Elongated Particles	ASTM D 4791
Freeze/Thaw	KM 64-626
Friable Particles	AASHTO T 112
Insoluble Residue	ASTM D 3042
Lightweight Particles	AASHTO T 113
Percent Crushed Particles	ASTM D 5821
pH	Calif. DOT 643
Plastic Limit and Plasticity Index	AASHTO T 90
Pore Index	KM 64-623
Resistivity	Calif. DOT 643
Sampling	AASHTO T 2
Sand Equivalent	AASHTO T 176
Shale	KM 64-604
Soundness (5 Cycles)	KM 64-610
Sulfates	Calif. DOT 417
Unit Weight	AASHTO T 19
Wear	AASHTO T 96
Wet Sieve Analysis	KM 64-620 or AASHTO T 27

SECTION 806 ¾ ASPHALT MATERIALS

806.01 GENERAL. Asphalt materials include performance-graded (PG) binders, emulsified asphalts, cut-back asphalts, and liquid asphalt for cold-patching mixtures. Provide asphalt materials of the specified grade conforming to the requirements specified in this section from suppliers listed in the Department's List of Approved Materials. Inclusion on the list of approved suppliers is obtained by following the guidelines of the Approved Supplier Certification (ASC) program contained in Kentucky Method (KM) 64-444. The guidelines of the Emulsified Asphalt Supplier Certification (EASC) program are contained in KM 64-445.

806.02 ACCEPTANCE. The Department will normally perform quality acceptance testing on samples obtained at the project site or Contractor's storage facility. When required by the Department, the asphalt supplier shall send, at his expense, representative samples of materials stored at the source terminal or refinery to the Department's Division of Materials.

When the Department accepts asphalt materials by pretesting and certification, the supplier shall provide 2 copies of the required certification of quality and compliance, contained on the supplier's bill-of-lading/load ticket, with each hauling unit for presentation to the Contractor and Department's representative at the point of delivery. Also, forward a copy of the bill-of-lading/load ticket directly to the Department's Division of Materials as soon as practical following shipments.

On the bill-of-lading/load ticket, include a statement of the quantity of materials within each load by weight and volume.

Do not use asphalt materials that are not properly covered by certification or otherwise tested and approved by the Department. When asphalt materials not of the specified grade, not appropriately certified, or not conforming to requirements when tested, become incorporated into projects, the Engineer will, according to Section 105, evaluate the work affected and require adjustment of pay quantities or corrective work as deemed appropriate.

806.02.01 Acceptance of Non-Specification Asphalt Materials. Furnish asphalt materials purchased for Department work conforming to the requirements of this section. The Department will apply the following procedures only when reasonably acceptable work has been produced using the material in question, as provided in Subsection 105.04. When use of non-specification material results in an inferior or unsatisfactory product, remove and replace the material at no expense to the Department, or at the Vendor's expense when materials are purchased directly by the Cabinet.

The Department may accept, at a reduced Contract price, asphalt materials not of the specified grade, not appropriately certified, or not conforming to specification requirements when check-tested, after an evaluation of the work. However, the Department will not consider these procedures a means to continue accepting non-specification material.

The Department will determine the price adjustment based on the delivered cost of the material.

When the material is not of the specified grade or not appropriately certified, the Department may deduct the full cost of the material.

When the material fails to conform to the specification requirements, the Department will normally make deductions according to the following schedules. As provided in Subsection 806.03, the Department has established field tolerances for determining the acceptability of failing material at no price deduction. The Department will determine the frequency of check-sampling and testing on pretested material. The Department will make deductions for failing test results based on the average of 2 check samples representing the material in question. When a sample fails on 2 or more tests, the Department may add the deductions, but the total deduction will not exceed 100 percent.

PG BINDER PRICE ADJUSTMENT SCHEDULE						
Test	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[1]
Original Binder						
Dynamic Shear, G*/∗ Test Temp. at 10 rad/s, °C	1.00 kPa Min.	1.00-0.95	0.94-0.90	0.89-0.85	0.84-0.80	< 0.80
RTFO Residue						
Mass Loss, %	1.00 Max.	1.01-1.10	1.11-1.20	1.21-1.30	1.31-1.40	> 1.40
Dynamic Shear, G*/∗ Test Temp. at 10 rad/s, °C	2.20 kPa Min.	2.20-2.00	1.99-1.70	1.69-1.50	1.49-1.30	< 1.30
PAV Aging						
Creep Stiffness S, Test Temp. at 60 s, °C m-value, Test Temp at 60 s, °C	 300 MPa Max. 0.300 Min.	 300-315 0.300-0.285	 316-330 0.284-0.280	 331-345 0.279-0.275	 346-360 0.274-0.270	 > 360 < 0.270
Dynamic Shear, G*/∗ Test Temp. at 10 rad/s, °C	5,000 kPa Max.	5,000-5,500	5,501-5,800	5,801-5 900	5,901-6 000	> 6,000
Elastic Recovery, %	75 Min.	□ 70	69-65	64-60	59-55	< 55

[1] *If allowed to remain in place, the Department will review materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

POLYMER ASPHALT EMULSION PRICE ADJUSTMENT SCHEDULE							
Test	Grade	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[2]
Viscosity @ 122 ºF, SFS[1]	RS-2P, CRS-2P, & HFMS-2P	60-400[1]	55-480[1]	50-54[1]	45-49[1]	40-44[1]	≤ 39[1]
				80-84	70-79	60-69	≤ 59
Viscosity @ 122 ºF, SFS	RS-2P, CRS-2P, & HFMS-2P	100-400	85-480	481-520	521-560	561-600	≥ 601
Distillation: % Oil	RS-2P, CRS-2P, & HFMS-2P	0-3.0	0-5.0	5.5-8.0	8.5-10.0	10.5-12.0	≥ 12.5
% Residue	RS-2P, CRS-2P, & HFMS-2P	≥ 65	≥ 63	60.0-62.9	57.0-59.9	55.0-56.9	≤ 54.9
Sieve, %	RS-2P, CRS-2P, & HFMS-2P	≤ 0.1	≤ 0.35	0.36-0.50	0.51-0.70	0.71-0.90	≥ 0.91
Residue Penetration @ 77 ºF	RS-2P, CRS-2P, & HFMS-2P			80-84	75-79	70-74	≤ 69
	RS-2P, CRS-2P, & HFMS-2P	100-200	85-230	231-240	241-250	251-260	≥ 261
Residue Ductility @ 77 ºF, cm	RS-2P, CRS-2P, & HFMS-2P	≥ 50	≥ 45	40-44	35-39	30-34	≤ 29
Residue Ductility @ 39 ºF, cm	RS-2P, CRS-2P, & HFMS-2P	≥ 15	≥ 13	11.0-12.9	9.0-10.9	7.0-8.9	≤ 6.9
Recovery @ 39 ºF	RS-2P, CRS-2P, & HFMS-2P	≥ 55%	≥ 50%	45.0-49.9%	35.0-44.9%	25.0-34.9%	≤ 24.9%
Storage Stability	RS-2P, CRS-2P, & HFMS-2P	≤ 1.0	≤ 2.0	2.1-3.5	3.6-5.5	5.6-7.5	≥ 7.6
Demulsibility: 0.02N $CaCl_2$	RS-2P	≥ 60%	≥ 53%	47-52%	41-46%	36-40%	≤ 35%
0.8% Sodium Dioctyl	HFMS-2P	≥ 30%	≥ 27%	24-26%	21-23%	18-20%	≤ 17%
Sulfosuccinate	CRS-2P	≥ 40%	≥ 35%	32-34%	29-31%	26-28%	≤ 25%
Float @ 140 ºF, s	HFMS-2P	≥ 1200	≥ 1100	900-1099	700-899	500-699	≤ 499
Solubility, %	RS-2P,CRS-2P, & HFMS-2P	≥ 97.5	≥ 97.0	96.5-96.9	96.0-96.4	95.5-95.9	≤ 95.4
Softening Point of Residue, ºF	RS-2P, CRS-2P, & HFMS-2P	> 100	> 97	95-97	91-94	88-90	≤ 87

[1] *Applies only if the residue from distillation is 72% or more.*

[2] *If allowed to remain in place, the Department will review materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

EMULSIFIED ASPHALT PRICE ADJUSTMENT SCHEDULE							
Test	Grade	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[1]
Viscosity,	CSS-1h, RS-1,			15-17	12-14	9-11	≤ 8
Saybolt	SS-1, SS-1h	20-100	18-110	111-120	121-130	131-140	≥ 141
Furol @	AE-60, HFMS-2	≥ 100	≥ 90	80-89	70-79	60-69	≤ 59
77 ºF, s	AE-200	≥ 50	≥ 45	40-44	35-39	30-34	≤ 29
				40-44	35-39	30-34	≤ 29
@ 122 ºF, s	MS-3, MS-C3	50-500	45-550	551-555	556-560	561-565	≥ 566
	RS-2,			60-64	55-59	50-54	≤ 49
	HFRS-2	75-400	65-440	441-480	481-520	521-560	≥ 561
				85-89	80-84	75-79	≤ 74
	CRS-2	100-400	90-440	441-480	481-520	521-560	≥ 561
Residue by	SS-1, SS-1h,						
Distillation, %	CSS-1h	≥ 57	≥ 56	53-55	50-52	47-49	≤ 46
	RS-1	≥ 55	≥ 54	51-53	48-50	45-47	≤ 44
	MS-3, MS-3C,						
	CRS-2, HFMS-2	≥ 65	≥ 64	61-63	58-60	55-57	≤ 54
	RS-2,						
	HFRS-2	≥ 63	≥ 62	59-61	56-58	53-55	≤ 52
	AE-60	≥ 68	≥ 67	64-66	61-63	58-60	≤ 57
	AE-200	≥ 60	≥ 59	56-58	53-55	50-52	≤ 49
Oil	CRS-2	0-5	0-6	7-10	11-14	15-18	≥ 19
Distillates	AE-60, AE-200	0-6	0-7	8-10	11-13	14-16	≥ 17
	MS-3, MS-3C	2-7	1.5-8.0	1.2-1.4	0.9-1.1	0.5-0.8	≤ 0.4
				8.1-10.0	10.1-12.0	12.1-14.0	≥ 14.1
Demulsibility,	RS-1, RS-2,						
%	HFRS-2	≥ 60	≥ 57	51-56	45-50	39-44	≤ 38
	CRS-2	≥ 40	≥ 38	34-37	30-33	26-29	≤ 25
Residue	SS-1h,			34-36	31-33	28-30	≤ 27
Penetration	CSS-1h	40-100	37-108	109-120	121-130	131-140	≥ 141
	SS-1, RS-1,						
	RS-2, HFRS-2,			87-91	82-86	77-81	≤ 76
	HFMS-2	100-200	92-216	217-225	226-235	236-245	≥ 246
				87-91	82-86	77-81	≤ 76
	CRS-2	100-250	92-270	271-275	276-280	281-285	≥ 286
			37-39	34-36	31-33	28-30	≤ 27
	AE-60	40-90	37-97	98-110	111-120	121-130	≥ 131

[1] *If allowed to remain in place, the Department will review materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

EMULSIFIED ASPHALT PRICE ADJUSTMENT SCHEDULE

(CONTINUED)

Test	Grade	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[1]
Cement Mixing	SS-1. SS-1h. CSS-1h	2.0 Max.	≤ 2.2	2.3-4.0	4.1-6.0	6.1-8.0	≥ 8.1
Particle Charge	CSS-1h, CRS-2, MS-3C	Positive	Not Applicable - Determines Only That Emulsion is Cationic				
Float Test @ 140 ºF, s	MS-3, MS-3C	20-120	18-130	16-17 131-140	14-15 141-150	12-13 151-160	≤ 11 ≥ 161
	AE-200, HFRS-2, HFMS-2	≥ 1,200	≥ 1,100	800-1099	500-799	300-499	≤ 299
Coating Test, %	MS-3C, MS-3, AE-200, HFMS-2	≥ 95	≥ 90	85-89	80-84	75-79	≤ 74
Storage Stability	SS-1, SS-1h, CSS-1h, RS-1 RS-2, RS-2C, MS-3, HFRS-2 MS-3C, AE-60, AE-200	≤ 1.5	≤ 2.0	2.1-3.5	3.6-5.5	5.6-7.5	≥ 7.6
Solubility in Trichloroethylene, %	SS-1, SS-1h, CSS-1h RS-1, RS-2, CRS-2, MS-3, HFRS-2 MS-3C, AE-60, AE-200	≥ 97.5	≥ 97.4	97.1-97.3	96.8-97.0	96.5-96.7	≤ 96.4
Sieve, %	MS-3C, MS-3, RS-1, RS-2, HFRS-2 CRS-2, CSS-1h, SS-1h SS-1	≤ 0.10	≤ 0.30	0.31-0.45	0.46-0.60	0.61-0.75	≥ 0.76
Ductility @ 77 ºF	SS-1, SS-1h, CSS-1h RS-2, CRS-2, RS-1, HFRS-2, HFMS-2	≥ 40	≥ 38	35-37	32-34	29-31	≤ 28
pH	MS-3	≥ 7.0	Not Applicable - Determines Only That Emulsion is Anionic				

[1] *If allowed to remain in place, the Department will review materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

CUTBACK ASPHALT EMULSION PRICE ADJUSTMENT SCHEDULE PRIMER L						
Test	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[(1)]
Viscositv. Savbolt Furol, 77 ºF	30-100	27-110	21-26 111-120	16-20 121-130	11-15 131-140	≤ 10 ≥ 141
Water Content	3-8	2.0-9	1.5-1.9 10-11	1-1.4 12-13	0.5-0.9 14-15	≤ 0.4 ≥ 16
Asphalt Content	≥ 45	≥ 44	40-43	36-39	32-35	≤ 31
Coating	100%	100%	95%	90%	85%	≤ 80%
Residue Test, Float @ 122 ºF, s	≥ 80	≥ 75	70-74	60-69	50-59	≤ 49
Solubility in Trichloroethylene	≥ 97.5	≥ 97.4	97.1-97.3	96.8-97.0	96.5-96.7	≤ 96.4

[(1)] *If allowed to remain in place, the Department will review materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

806.03 FIELD TOLERANCES. The Department will allow field tolerances for asphalt materials, sampled subsequent to delivery for either approval or check-testing, outside the specified property limits according to the Department's established criteria.

806.04 TIME LIMITATION ON APPROVALS. The Department will retest materials in storage at the terminal as deemed necessary. Additionally, the Department will retest for approval to use materials delivered, but not incorporated into the work, within one month (2 months for PG binders) from date of shipment. Request resampling and retesting for approval.

806.05 SAMPLING. The Department will sample all asphalt materials according to KM 64-404.

806.06 PG BINDERS. The Department will accept PG binders prepared by the refining of petroleum in the following grades:

- PG 58-22
- PG 64-22
- PG 70-22
- PG 76-22

For specialized applications, the Department may specify other binders. The Department's Division of Materials may approve binders not conforming to the above grades on an experimental basis.

806.06.01 Modification. Use only organic, non-particulate modifiers. All binders are to be homogeneous blends. Include a statement of the type of modification and refining process with all samples submitted to the Division of Materials for testing and certification.

Do not use plant-site or in-line blending.

Circulate or agitate the modified asphalt binders in the storage tank as specified in the Supplier's handling procedures. Obtain the Engineer's approval for the means of circulation.

806.06.02 Requirements. Submit written instructions to the Division of Materials for handling requirements. Submit the Supplier's written instructions and requirements for the proper use and handling of the asphalt binder to the Engineer. Include tank requirements, construction equipment requirements, and storage and mixing temperature requirements. Submit material test data and a certification of conformance prior to shipping material.

1) Provide binders with a minimum solubility of 99.0 percent when tested according to AASHTO T 44.
2) The Department will accept PG binders according to AASHTO MP 1.
3) Provide PG 76-22 binders that have a minimum elastic recovery of 75% when tested on material aged in accordance with AASHTO T 240 and tested in accordance with KM 64-440.

806.07 EMULSIFIED ASPHALTS. This subsection covers emulsified asphalts of the following grades:

- RS-1
- CSS-1
- AE-200
- HFMS-2
- RS-2
- CSS-1h
- MS-3
- MS-3C
- SS-1
- CRS-1
- HFRS-2
- SS-1h
- AE-60
- CRS-2

806.07.01 General Requirements. Furnish emulsified asphalts that are homogeneous, showing no separation of asphalt during normal handling or storage. The Engineer will reject emulsified asphalt which has been frozen.

806.07.02 Specific Requirements for Grades RS-1, RS-2, SS-1, HFRS-2, HFMS-2, and SS-1h. Conform to AASHTO M 140 with the following exceptions:

1) The cement-mixing test is not required.
2) The penetration of grade SS-1h residue is not to exceed 100.
3) The storage stability of emulsions is not to exceed 1.5 percent.

806.07.03 Testing of Grades RS-1, RS-2, SS-1, HFRS-2, HFMS-2, and SS-1h. Perform tests according to AASHTO T 59. Use Tyrone Formation Limestone as the reference aggregate for the coating test.

806.07.04 Specific Requirements for Grades CSS-1, CSS-1h, and CRS-1. Conform to AASHTO M 208 (cationic emulsions) with the following exceptions:

1) The cement-mixing test is not required.
2) The penetration of grade CSS-1h residue is not to exceed 100.
3) The storage stability of emulsions is not to exceed 1.5 percent.

806.07.05 Testing of Grades CSS-1, CSS-1h, and CRS-1. Perform tests according to the methods referenced by AASHTO M 208, with the exception of performing the particle charge test as specified in Note 3 of the Emulsified Asphalt Requirements table. Use gravel aggregate as the reference aggregate for the coating test.

806.07.06 Specific Requirements for Grades AE-60, AE-200, MS-3, CRS-2, and MS-3C. Conform to the Emulsified Asphalt Requirements table.

806.07.07 Testing of Grades AE-60, AE-200, MS-3, CRS-2, and MS-3C. Perform tests according to AASHTO T 59 except as otherwise provided.

EMULSIFIED ASPHALT REQUIREMENTS					
Test	AE-60	AE-200	MS-3	CRS-2	MS-3C
Viscosity, Saybolt-Furol,					
at 77 ºF, no less than s	100	50	-	-	-
at 122 ºF, s	-	-	50-500	100-400	50-500
Residue by Distillation, % min.	68	60	65	65	65
Sieve Test, retained on 850-µm (No. 20) mesh, % max.	-	-	0.10	0.40	0.10
Settlement, 5 days, % max. (1)	5.0	5.0	5.0	5.0	5.0
Storage Stability Test, one day, % max. (2)	1.5	1.5	1.5	1.5	1.5
Oil Distillate, %, by vol.	0-6	0-6	2-7	0-5	2-7
Particle Charge	-	-	-	Positive	Positive
pH (ASTM E70)	-	-	> 7.0	-	-
Coating Test, % coated, min. (3)	-	95	95	-	95
Demulsibility, 35 ml. 0.8 pct., Sodium Dioctyl					
Sulfosuccinate, % min.	-	-	-	40	-
Tests on Residue From Distillation:					
Penetration at 77 °F, 100 g, 5 s	40-90	-	-	100-250	-
Float Test at 140 °F, s (4)	-	> 1200	20-120	-	20-120
Solubility in Trichloroethylene, % min.	97.5	97.5	97.5	97.5	97.5
Ductility at 77 °F, % min.	-	-	-	-	40

(1) The Department will waive the test requirement for settlement when the emulsified asphalt is used in less than 5 calendar days from the date of shipment.
(2) The Department will allow the use of the 24-hour (one-day) storage stability test in place of the 5-day settlement test.
(3) Coating Test for MS-3 and MS-3C. Perform according to AASHTO T59. Use Tyrone Formation limestone as the standard reference aggregate for MS-3 and crushed pit gravel from Carroll County, Kentucky, as the standard reference aggregate for MS-3C.
(4) Float Test. Perform according to AASHTO T 50, except pour the residue into the float collar from the transfer container (usually an 8-ounce tin cup) while hot, immediately after completion of the distillation test. For AE-200 only, the minimum variation of 4 seconds for 2 determinations will not be required. Any sample passes this test when both determinations are more than 1,200 seconds.

806.08 CUT-BACK ASPHALT EMULSION PRIMER (WATER-IMMISCIBLE TYPE). Prepare Cut-Back Asphalt Emulsion Primer, designated herein as Primer L, by compounding a suitable solvent and water with a petroleum asphalt.

806.08.01 Requirements. Furnish Primer L that is of such consistency that it can be spread uniformly with a pressure distributor and that it will adhere to all types of aggregates or asphalt bases, even in the presence of water. Ensure that the material is capable of penetrating the existing surfaces so as to plug capillary voids, to coat and bond dust and loose mineral particles, and thus harden or toughen the surface and promote adhesion between it and the superimposed treatment or construction. In addition, ensure that Primer L complies with the following requirements:

PRIMER L REQUIREMENTS	
Viscosity, Saybolt-Furol (AASHTO T 59) at 77 °F, s	30-100
Water Content (AASHTO T 55 Using Xylen), %	3-8
Asphalt Content (AASHTO T 78 Using Residue From Water Content Determination and Results of Water Content Test), %	≥ 45
Tests on Residue From Distillation-Float Test (AASHTO T 50) at 122 °F, s	≥ 80
Wet Stone Coating Test (AASHTO T 59)	Pass
Solubility in Trichloroethylene (AASHTO T 44), %	≥ 97.5
Recommended Application Temperature, °F	60-120

806.09 LIQUID (CUT-BACK) ASPHALTS. This section covers liquid (cut-back) asphalts of the rapid-curing types, grades RC-70, RC-250, RC-800, and RC-3000, and medium-curing types, grades MC-30, MC-70, MC-250, MC-800, and MC-3000.

806.09.01 Requirements. For rapid-curing and medium-curing types, conform to AASHTO M 81 and M 82, respectively.

806.09.02 Testing. Perform tests according to the applicable methods referenced by AASHTO M 81 and M 82.

806.10 POLYMER ASPHALT EMULSIONS. These materials are designed to be used in seal coats and stress-absorbing membrane interlayers (SAMI).

Make the polymer modification to the base asphalt before the emulsification process. Ensure that polymer-modified asphalt emulsions conform to the requirements in the following table.

POLYMER ASPHALT EMULSIONS						
Test on Emulsion	CRS-2P		RS-2P		HFMS-2P	
(Test according to AASHTO T 59, except as noted)	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity at 122 °F, SFS [(1)]	100	400	100	400	100	400
Storage Stability, 24-hr., % [(2)]	-	1	-	1	-	1
Sieve, 850-µm (No. 20 mesh, % retained)	-	0.1	-	0.1	-	0.1
Particle Charge	Positive	-	-	-	-	-
Demulsibility: 0.02 N $CaCl_2$, %	-	-	60	-	30	-
0.8% Sodium Dioctyl Sulfosuccinate, %	40	-	-	-	-	-
Asphalt Res. From Distillation, % [(1) (3)]	65	-	65	-	65	-
Oil Distillate by Vol. of Emulsion, %	-	3.0	-	3.0	-	3.0
Test on Residue From Distillation %						
Penetration at 77 °F, 100 g, 5 s	100	200	100	200	100	200
Float at 140 °F, s	-	-	-	-	1200	-
Ductility at 77 °F, 5 cm/minute	50	-	50	-	50	-
Ductility at 39 ± 2 °F, 5 cm/minute	15	-	15	-	15	-
Recovery at 39 ± 2 °F, 1 hr, % [(4)]	55	-	55	-	55	-
Softening Point (AASHTO T 53), °F	100	-	100	-	100	-
Solubility in Trichloroethylene, %	97.5	-	97.5	-	97.5	-

[(1)] *If the asphalt residue from distillation is at least 72%, the minimum viscosity at 122 °F may be reduced to 60 SFS.*

[(2)] *Provide a material that, after standing undisturbed for 24 hours, shows a uniform brown color throughout.*

[(3)] *Modify AASHTO T 59 to provide a maximum temperature of 400 ± 5 °F for at least 20 minutes.*

[(4)] *This method is a variation of AASHTO T 51. Prepare the specimens in the same manner, except condition the specimens and ductilometer at the test temperature of 39 ± 2 °F. Immediately after conditioning, place the specimen in the ductilometer and elongate it to 10 cm at the rate of 5 cm/min. Stop the ductilometer at 10 cm, and clip the specimen at the approximate mid-point of the elongated area with scissors or other suitable cutting device. Let the specimen remain undisturbed in the ductilometer at 39 ± 2 °F for one hour. After one hour, retract the specimen until the cut ends touch. At this point, note the ductilometer reading to the closest 0.5 cm. Calculate the percent recovery by the following formula:*

$$\% \text{ Recovery} = \frac{10-A}{10} \times 100$$

A = Observed elongation in cm after rejoining of the specimen.

806.11 ASPHALT COATING AND PAVING FOR METAL PIPE, PIPE ARCHES, AND ARCHES. These requirements apply to all corrugated metal pipe, pipe arches, and arches that are required to be asphalt-coated or coated and paved, except pave field-assembled structural plate pipe and pipe arches as specified in Section 612.

806.11.01 Asphalt Coating Material. Furnish asphalt coating material conforming to AASHTO M 190 and, in addition, the following physical properties:

1) Penetration at 32 °F, ASTM D 5 or AASHTO T 49 - 20 minimum at 200 g for 60 seconds.
2) Penetration at 77 °F, ASTM D 5 or AASHTO T 49 - 35 to 55 at 100 g for 5 seconds.
3) Flash Point, ASTM D 92 or AASHTO T 48 - 450 °F minimum.
4) Specific Gravity, ASTM D 70 or AASHTO T 229 - 0.98 minimum.
5) Softening Point, ASTM D 36 or AASHTO T 53 - 200 °F minimum/230 °F maximum.

The Department will obtain random samples of the asphalt coating material for analysis. The Department will reject all material not conforming to AASHTO M 190 and this subsection.

806.11.02 Application of Coating. Ensure that the pipe or structural plate is clean and free of all dirt, grease, and water prior to coating. Lightly sandblast or chemically etch aluminum pipe before coating to provide a good surface profile.

Immerse the pipe or structural plate in asphalt material at 400 ± 5 °F according to the following schedule:

Thickness (inch)	Minimum Immersion Time (minutes)
0.052	2.0
0.064	2.5
0.079	3.0
0.109	5.0
0.138	6.5
0.168	8.0

These immersion times apply when the temperatures of the metal before application is 41 °F or higher. When the metal temperature is below 41 °F, increase the immersion time as necessary to stabilize the metal temperature and produce a satisfactory coating properly bonded to the metal.

Dip the pipe or structural plate a second time for a sufficient time to obtain a minimum coating thickness of 0.050 inch.

806.11.03 Application of Paving. Pour asphalt material into the pipe invert with dams constructed at the ends in order to cover all corrugations and provide a smooth invert. Ensure that the asphalt depth above the crests of the corrugations is at least 0.125 inch. Ensure that the minimum asphalt temperature during the casting operations is 200 °F. Pave the required percentage of the circumference of the pipe according to AASHTO M 190.

806.11.04 Acceptance of Coated Pipe or Structural Plates. Ensure that each shipment of asphalt-coated metal pipe or structural plates is accompanied by a certification that all material furnished complies with the applicable specifications and that the asphalt coating was applied in accordance with this section.

The Department reserves the right to sample and test pipe, structural plates, or coating materials, or inspect coating procedures at the plant, at any time. The Department may reject material or coating not conforming to contract requirements whether it is in place or not.

806.12 LIQUID ASPHALT FOR COLD-PATCHING MIXTURES. Ensure that the liquid asphalt material furnished under this section provides satisfactory coating properties, workability, and adherence characteristics for patching during cold and damp weather in either asphalt or concrete pavement surfaces. Furnish patching

mixtures made with the liquid asphalt, KP-2 or KP-4, that is capable of being stored for at least 6 months before being used and that is readily workable at all ambient temperatures above 25 °F.

Provide with each shipment of material the certified test results showing that the materials furnished conform to the following KP-2 or KP-4 Requirements table. Additionally, take a one-gallon sample from one transport. Ship the sample to the Division of Materials by any expedient means of transport. Obtain the Division of Materials' approval before using the liquid asphalt.

KP-2 REQUIREMENTS		
Property	Test Method	Value
Flash Point	AASHTO T 79	200 °F minimum
Kinematic Viscosity at 140 °F	AASHTO T 201	300 – 4,000
Water	AASHTO T 55	0.2% maximum
Distillate Test: (volume of the original sample)	ASTM D 402	
to 437 °F		None
to 500 °F		0 - 5%
to 600 °F		0 - 25%
Residue From Distillate at 680 °F	ASTM D 402	72 - 95%
Residue Tests:		
Absolute Viscosity at 140 °F	ASTM D 2171	125 - 425
Penetration	ASTM D 5	200 minimum
Ductility at 39 °F at one cm/min.	ASTM D 113	100 minimum
Solubility in Trichloroethylene	ASTM D 2042	99% minimum
Stripping Test Uncoated	AASHTO T 182	5% maximum

KP-4 REQUIREMENTS		
Property	Test Method	Value
Flash Point	AASHTO T 79	200 °F minimum
Viscosity, Saybolt Furol at 122 °F, s	AASHTO T 72	100-500[1]
Coating Test	AASHTO T 182	95.0% minimum
Residue From Distillate	AASHTO T 59	72.0% minimum
Oil Distillate	AASHTO T 59	3.0 - 7.0%
Penetration	ASTM D 5	200
Solubility in Trichloroethylene	ASTM D 2042	98% minimum

[1] *The Department may accept higher values if the material is pumpable.*

SECTION 807 ¾ JOINT MATERIALS

807.01 DESCRIPTION. This section covers joint sealers and joint fillers of various types. The Department may approve other types of joint materials provided they conform to the requirements of the type specified in the Contract.

807.02 JOINT SEALERS.

807.02.01 Hot-Poured, Elastic Joint Sealers. Furnish hot-poured, elastic joint sealers that conform to ASTM D 3405. Ensure that the materials supplier furnishes, to the Department's Division of Materials, a sample of approximately 10 pounds of sealer for test purposes. Submit the sample at least 30 calendar days before the date of intended use.

807.02.02 Preformed, Compression Joint Sealers With Lubricant Adhesive. Furnish preformed, compression joint sealers of approved shapes and sizes for the applicable joints to be sealed.

Furnish sealers and lubricant adhesives that conform to the following applicable requirements and that are available for sampling at least 30 calendar days before the date of intended use.

A) Sealers. Furnish sealers that conform to ASTM D 2628 with the following exceptions and additions:

1) The Department's Division of Materials and Division of Bridge Design will approve the shape or configuration of sealers. Provide sealers from the Department's List of Approved Materials. Obtain the Department's approval for sealers not on the List of Approved Materials before shipping to the project.
2) Furnish sealers of a design and cross section that are substantially solid when fully compressed. The point at which a sealer is defined as being fully compressed is also defined as closure of the sealer. Provide closure of a sealer within a deflection range of 50 to 70 percent of the original width of the sealer.
3) Ensure that the manufacturer provides sealers accurately marked at 12-inch intervals to determine elongation after installation.
4) Ensure that sealers are designed so that, when compressed, the center portion of the top surfaces will not protrude upward above the original elevation of the sealer.
5) The Department will subject sealers to a compression-deflection test in conformity with KM 64-409. Ensure that the sealer displays a minimum force per unit area of 3 psi at 15 percent deflection and a maximum force per unit area of 40 psi at 50 percent deflection.
6) The Department will subject sealers to a compression-shear test in conformity with KM 64-410. Ensure that the sealers display a minimum resistive force of 0.5 pound per cubic inch to breaking away from the plates and a minimum resistive force of 1.0 pound per cubic inch to vertical displacement.
7) Use sealers for the various joint widths of the sizes as follows:

    a) Ensure that the sizes of sealers used in PCC pavement comply with the applicable Standard Drawing.
    b) Ensure that the uncompressed depth of all sealers is at least equal to the uncompressed sealer width, unless the design of the sealer prevents twisting or misalignment of the sealer during or after installation.

c) The listing of approved sealers includes products available for sealing the following joint sizes:

3/16"	1"	1 7/8"
1/4"	1 1/4"	2"
3/8"	1 1/2"	2 1/4"
1/2"	1 5/8"	2 1/2"
3/4"	1 3/4"	

8) Ensure that sealers are accompanied by a manufacturer's certification of test results covering each size and lot number.
9) Use sealers that have been tested and approved before use on each project. The Department will either pretest or test each size, configuration, and lot of sealers, from samples obtained after delivery to the project, according to the Manual of Field Sampling and Testing Practices. When the supplier delivers sealers to projects without pretesting, include at least 6 linear feet of additional sealer (not precut) for each size, configuration, and lot to allow for testing by the Department.

B) Lubricant Adhesive. Provide lubricant adhesive that is compatible with the sealer, concrete, and steel. Use a compatible lubricant adhesive recommended by the sealer manufacturer and conforming to ASTM D 2835.

807.02.03 Joint Sealer for Rigid Pipe.

A) Asphalt Mastic. Furnish asphalt mastic joint sealing material of a smooth, uniform mixture of asphalt material, solvent, and filler. Use a filler that consists essentially of cellulose fiber. Ensure that the mixture is applicable, by means of a trowel or caulking gun, without pulling or drawing, and does not sag or flow when applied to metal, concrete, or vitrified clay surfaces.

Furnish compound capable of withstanding freezing and not exhibiting any tendency to separate or otherwise deteriorate while in storage.

When applied to a tinned panel or glass plate, in a layer 1/16 to 1/8-inch thick, and cured at room temperature for 24 hours, ensure that the compound sets to a tough, plastic coating and does not shrink, crack, or loosen from the surface.

In addition, furnish material conforming to the following table:

	Minimum	Maximum
Grease Cone Penetration (ASTM D 217, Unworked, 150 g, 77 °F, 5 s) 0.10 mm	175	250
Weight per gallon, lbs	9.75	-
Non-Volatile (10 g, 221 °F - 230 °F, 24 h), %	75	-
Ash (by Ignition), %	25	45

B) Rubber Gaskets. Furnish rubber gaskets conforming to the materials, manufacture, and physical requirements for gaskets in AASHTO M 198, Section 6.2.

C) Flexible Plastic Gaskets. Furnish flexible plastic gaskets conforming to the materials, manufacture and physical requirements for gaskets in AASHTO M 315, Section 6.1. Use only products from the Department's List of Approved Materials.

807.02.04 Silicone Rubber Sealant.

A) Non-Sag, Silicone Sealant. Furnish the sealant in a one-part silicone formulation which does not require a primer for bonding to concrete. Use a

compound that is compatible with the surface to which it is applied. Do not use acid-cure sealants on concrete. Apply the sealant with a pressure applicator that forces it into the joint. Ensure that silicone rubber joint seals exhibit an adequate bond to concrete when subjected to testing by the Department.

Use non-sag silicone sealant conforming to the following table:

SILICONE SEALANT REQUIREMENTS		
Item	Requirement	Test Method
Flow	0.3 in. max.	KM 64-430
Extrusion Rate	75 - 350 g/minute	KM 64-430
Tack Free Time at 77 °F ± 3 °F	20 - 90 minutes	KM 64-430
Specific Gravity	1.010 - 1.515	ASTM D 792, Method A
Durometer Hardness, Shore A (7 Days Cured at 77 °F ± 3 °F and 45-55% Relative Humidity)	10-25	ASTM D 2240
Tensile Stress at 150% Elongation (7 Days Cured at 77 °F ± 3 °F and 45-55% Relative Humidity)	45 psi max.	ASTM D 412 (Die C)
Elongation (7 Days Cured at 77 °F ± 3 °F and 45-55% Relative Humidity)	600% min.	ASTM D 412 (Die C)
Ozone and UV Resistance	No chalking, cracking, or bond loss after 5,000 hours	ASTM D 793 and D 1149
Movement Capability and Adhesion	+100% and -50%; respectively; No adhesive or cohesive failure after 10 cycles at 0 °F	(1)
Shelf Life	6 months from date of shipment from the manufacturer	

(1) *Movement Capability and Adhesion: Prepare one by one by one-inch concrete blocks according to ASTM C 719. Use a sawed face for the bond surface. Seal 2 inches of the block leaving 1/2 inch on each end of the specimen unsealed. Ensure that the depth of sealant is 3/8 inch and the width is 1 inch. Subject the sealant to the movement according to ASTM C 719. Ensure that the magnitude of the movement is as specified, and the rate of extension or compression is 1/8 inch per hour.*

NON-SAG, SILICONE SEALANT PRICE ADJUSTMENT SCHEDULE						
Test	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[1]
Tack-Free Time at 77 °F ± 3 °F	20-90 minutes	15-95	12-14 96-98	9-11 99-101	6-8 102-104	≤ 5 ≥ 105
Specific Gravity	1.010-1.515	1.000-1.525	0.995-0.999 1.526-1.530	0.990-0.994 1.531-1.535	0.985-0.989 1.536-1.540	≤ 0.984 ≥ 1.541
Durometer Hardness, Shore A (7 Days Cured at 77 °F ± 3 °F and 45-55% Relative Humidity)	10-25	8-27	7 28	6 29	5 30	≤ 4 ≥ 31
Tensile Stress at 150% Elongation (7 Days Cured at 77 °F ± 3 °F and 45-55% Relative Humidity)	45 psi max.	46-50	51-53	54-56	57-59	≥ 60
Elongation (7 Days Cured at 77 °F ± 3 °F and 45-55% Relative Humidity)	600% min.	≥ 550	525-549	500-524	475-499	≤ 474

[1] *If allowed to remain in place, the Department will review the materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

B) Self-Leveling, Silicone Sealant. Furnish the sealant in a one-part, cold-applied, self-leveling silicone formulation that cures to an ultra-low-modulus silicone rubber which remains flexible over a wide temperature range and is suitable for use in concrete to asphalt and concrete to concrete joints. This material is recommended for joints of one-inch width or less.

Use self-leveling, silicone sealant conforming to the following table:

MATERIAL REQUIREMENTS FOR ONE-PART, SELF-LEVELING, SILICONE JOINT SEALANT		
Test	Material Requirements as Supplied	Test Method
Appearance	Smooth, homogeneous, non-grainy mixture	CTM[1] 0176
Extrusion Rate (g/minute)	275 - 550	MIL-S-8802
Specific Gravity	1.26 - 1.34	ASTM D 792
Non-Volatile Content (% minimum)	96	CTM 0208
Skin-Over Time (minutes maximum)	60	CTM 0098
Upon Complete of Cure		
Joint Modulus[2] (psi maximum)	45	ASTM D 412
Elongation[2] (% minimum)	600	ASTM D 412 (Die C, Modified)
Adhesion: Asphalt-to- (minimum % elongation)	600	ASTM D 3583 (Section 14, Modified)
Performance		
Movement (10 cycles at +100% and -50%)	No failure	ASTM C 719
Accelerated Weathering (5,000 hours)	No cracks, blisters, or bond loss	ASTM C 793

[1]In most cases, Corporate Test Methods (CTM) correspond to ASTM standard tests. Copies of CTM procedures are available upon request.

[2]Sample cured 21 days at 77 ± 3 °F and 50 ± 5 percent relative humidity.

SELF-LEVELING, SILICONE SEALANT PRICE ADJUSTMENT SCHEDULE						
Test	Specification	100% Pay	90% Pay	80% Pay	70% Pay	50% Pay[1]
Specific Gravity	1.26-1.34	1.22-1.38	1.20-1.21 1.39-1.40	1.18-1.19 1.41-1.42	1.16-1.17 1.43-1.44	≤ 1.15 ≥ 1.45
Skin-Over Time	60 minutes max.	61-65	66-68	69-71	72-74	≥ 75
Joint Modulus	45 psi max.	46-50	51-53	54-56	57-59	≥ 60
Elongation	600% min.	≥ 550	525-549	500-524	475-499	≤ 474

[1] *If allowed to remain in place, the Department will review the materials performing in this range on a project-by-project basis to determine if removal of the material is warranted.*

C) Rapid-Cure Silicone Sealant. Use sealant that is furnished as a two-part, rapid-cure, cold-applied, ultra-low-modulus, self-leveling, 100 percent silicone rubber sealant which remains flexible over a wide temperature range and is suitable for use in concrete-to-concrete, concrete-to-steel, and steel-to-steel joints.

Use rapid-cure silicone sealant conforming to the following table:

As Supplied:

RAPID-CURE SILICONE JOINT SEALANT		
Test	Requirement	Test Method
Extrusion Rate (g/minute)	200 - 550	MIL S 8802
Specific Gravity	1.25 - 1.35	ASTM D 792
Non-Volatile Content (% minimum)	93	CTM 0208

As Installed: 77 °F and 50% Relative Humidity after 48 hours cure (does not pertain to skin-over time)

Test	Requirement	Test Method
Skin-Over Time (minutes maximum)	20	CTM 0098
Joint Elongation (% minimum)	600	ASTM D 412 [(1) (2)]
Joint Modulus, psi (at 100% elongation)	3-20	ASTM D 412 [(1) (2)]

[(1)] Pull rate of 2 inch/minute and joint size.
[(2)] Joint Size = 0.5 by 0.5 by 2 inches.

D) Accessory Items. Use a closed-cell, polyethylene foam, back-up rod that is compatible with the sealant. Do not allow any bond or reaction to occur between the back-up rod and sealant.

E) Approvals. A silicone sealant manufacturer shall have the product and the testing program evaluated before incorporating the sealant into a project. For qualified manufacturers, the Department may accept sealant for immediate use on the basis of manufacturer-certified test results indicating the material conforms to the requirements. Ensure that each lot of sealant is delivered in containers plainly marked with the manufacturer's name or trademark and a lot number. Ensure that the manufacturer furnishes certified test results of each lot of joint sealant shipped to each project (the Department does not require tests for ozone and UV resistance, or movement capability and adhesion, on every lot, but ensure that every lot is accompanied by certified results of the latest tests performed). Ensure that the manufacturer indicates the date of shipment on each lot. Do not use material after 6 months from the date of shipment from the manufacturer without first having the material sampled and tested. The Department will take routine check samples of silicone sealant during application and test it to verify the material's acceptability. Provide equipment suitable for obtaining representative check samples from the silicone sealant at a frequency determined by the Division of Material's Manual of Field Sampling and Testing Practices.

The Engineer may accept the foam back-up rod on the project by visual inspection.

807.03 JOINT FILLERS.

807.03.01 General. Furnish preformed fillers in a single piece for the full depth

and width required for the joint unless otherwise authorized. When the Engineer authorizes the use of more than one piece for a joint, fasten the abutting ends securely, and hold them accurately to shape.

807.03.02 Preformed Sponge Rubber and Cork Expansion Joint Fillers. Furnish preformed sponge rubber and cork joint fillers that conform to AASHTO M 153 for Type I (sponge rubber), Type II (cork), or Type III (self-expanding cork) as specified.

807.03.03 Preformed Asphalt Expansion Joint Fillers. Furnish preformed asphalt joint fillers that conform to AASHTO M 213.

807.03.04 Oil Asphalt Joint Fillers. Furnish oil asphalt joint fillers that conform to the following requirements:

1) Flash Point (AASHTO T 48) - 446 °F minimum;
2) Softening Point (AASHTO T 53) - 167 - 185 °F;
3) Penetration (AASHTO T 49):
   - at 77 °F, 100 g, 5 s - 30 – 45,
   - at 32 °F, 200 g, 60 s - 10 minimum,
   - at 115 °F, 50 g, 5 s - 90 maximum;
4) Loss on Heating (AASHTO T 47) - 1.0 percent, maximum;
5) Penetration (AASHTO T 49) at 77 °F, 100 g, 5 s, of residue from evaporation loss compared to original penetration before heating - 80 percent minimum;
6) Ductility (AASHTO T 51) at 77 °F - 30 mm minimum;
7) Matter Soluble in Trichloroethylene (AASHTO T 44) - 99.0 percent minimum; and
8) Ensure that the asphalt filler is free from water and does not foam when heated to the flash point.

SECTION 808 ¾ WATERPROOFING MATERIALS

808.01 DESCRIPTION. These specifications cover materials for use in waterproofing.

808.02 ASPHALT PRIMER. Conform to ASTM D 41.

808.03 FIBERGLASS WATERPROOFING MEMBRANE. Furnish a fiberglass waterproofing membrane that is a one-step waterproofing and reflective-crack suppression system for bridge decks. The one-step system is comprised of a high strength fiberglass reinforcement factory coating with an asphalt polymer and a strongly bonding contact adhesive on one side that bonds to the surface being treated.

Ensure that the fiberglass waterproofing membrane conforms to the following physical properties:

Property	Test Method	Specification Value
Tensile Strength	ASTM D 146	44 lbf/in (longitudinal and transverse)
Pliability	ASTM D 146	Pass at 32 ºF
Moisture	ASTM D 146	1% maximum
Permeability	ASTM E 96	10 Perms maximum

SECTION 809 ¾ STRUCTURAL PLATES FOR PIPES, PIPE ARCHES, AND ARCHES

809.01 CORRUGATED STEEL STRUCTURAL PLATE AND ACCESSORIES. Conform to AASHTO M 167. Coat with asphalt material conforming to Subsection 806.11. The Department will sample and test the material according to its current practices.

809.02 ALUMINUM ALLOY STRUCTURAL PLATE AND ACCESSORIES. Conform to AASHTO M 219. The Department will sample and test the material according to its current practices.

SECTION 810 ¾ PIPE AND PIPE ARCHES

810.01 DESCRIPTION. This section covers the various types of pipe and pipe arches for use on highway projects.

810.02 APPROVAL. Select pipe or pipe arches supplied by a producer that is listed on the List of Approved Materials. All producers of pipe and pipe arches must conform to KM 114. These requirements may be obtained from the Division of Materials.

810.03 REINFORCED CONCRETE PIPE.

810.03.01 Pipe Class.

A) Circular. Furnish circular reinforced concrete pipe conforming to AASHTO M 170 for Class I, Class II, Class III, Class IV, and Class V. Furnish a D-load pipe conforming to AASHTO M 242 when specified in the Contract.

B) Elliptical. Furnish horizontal and vertical elliptical reinforced concrete pipe conforming to AASHTO M 207 for Class HE-A, Class HE-I, Class HE-II, Class HE-III, Class HE-IV, Class VE-V, Class VE-VI, Class V-II, Class VE-III, and Class VE-IV.

C) Arch. Furnish reinforced concrete pipe arch conforming to AASHTO M 206 for Class A-II, Class A-III, and Class A-IV.

810.03.02 Aggregates. Conform to Section 804 and 805.

810.03.03 Cement. Use any type conforming to Section 801.

810.03.04 Extra Protection. Furnish concrete pipe with extra protection to inhibit corrosion when required by the Standard Drawings for culvert pipe, storm sewer pipe, and entrance pipe. Furnish concrete pipe with extra protection for all other types of pipe when specified in the Contract. Use reinforced concrete pipe conforming to Subsection 810.03.01 A) for Classes III, IV, and V; Subsection 810.03.01 B) for Classes HE-II, HE-III, HE-IV, VE-II, VE-III, and VE-IV; and Subsection 810.03.01 C) for Classes A-II, A-III, and A-IV. Use concrete having a minimum compressive strength of 6,000 psi at the time of acceptance. Use Wall B or Wall C as necessary.

When using one line of reinforcement, place it 1/2 of the shell thickness from the inner surface of the pipe. When using 2 lines of reinforcement, place each line so that the nominal protective covering of concrete is one inch from the outer surface of the pipe and 1 3/4 mm from the inner surface. The Department will allow a variation tolerance of □ 1/2 inch with a minimum protective covering of one inch from the inner surface in all cases.

810.03.05 Identification and Markings. Mark pipe sections according to AASHTO M 170 or M 207 as applicable for identification. Additionally, mark "EP" on each section of pipe manufactured by the extra protection requirements. When the manufacturer has more than one plant, include the plant letter assigned by the Division of Materials after the date of manufacture as follows:

L-Louisville
N-London

Provide shipment approval form containing the following information:

1) Project Number and county.
2) Name of Contractor.
3) The size, class, and quantity of pipe shipped.
4) The dates of manufacture of the pipe.
5) A signed statement that the pipe is from a tested and approved lot.

The Department will not require the certification on the shipment approval form to be notarized. The Department will not require the information under "Pipe Data" on the approval form when the manufacturer's shipment ticket is attached and contains the necessary information.

The Engineer will check pipe joints to determine if the information on the approval form or shipping ticket corresponds to the pipe actually received. Correct all discrepancies before using pipe.

810.03.06 Defects. The Department will reject pipe for any of the following reasons.

1) Exposed steel in walls, fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
2) Defects that indicate imperfect proportioning, mixing, or molding.
3) Surface defects indicating honey-combed or open texture.
4) Damaged or cracked ends that prevent a satisfactory joint.
5) A continuous crack, regardless of its position in the wall of the pipe, having a surface width of 0.01-inch or more and extending 12 inches or more.

810.04 CORRUGATED METAL PIPE.

810.04.01 Coating Requirements. Use asphalt coating and paving as extra protection to inhibit corrosion for the pH values shown on the Standard Drawings for culvert pipe, storm sewer pipe and entrance pipe. Coat and pave sanitary sewer pipe and all other pipe when specified in the Contract. Coat and pave the invert according to Subsection 806.11. Use asphalt material conforming to Subsection 806.11. Coat and pave the pipe according to AASHTO M 190.

Use polymer precoated galvanized corrugate metal pipe when the pH is greater than 9 or less than 5 according to the Standard Drawings. Manufacture according to AASHTO M 246, with a minimum grade of 10/10. Fabricate the sheets into pipe sections according to AASHTO M 36. Use asphalt material conforming to Subsection 806.11. Coat and pave the pipe according to AASHTO M 190.

The Department will allow exceptions for coating on storm sewer pipe and entrance pipe as specified in the Standard Drawings.

810.04.02 Inlet and Outlet Requirements. Finish all pipe ends in a neat manner to allow safe handling and contact with the pipe. Unless the pipe is asphalt coated, paint the ends with inorganic zinc primer. When using 14 gauge or thinner sheets to fabricate helical lockseam or welded seam pipe, reroll the inlet and outlet end with at least 2 complete corrugations.

810.04.03 Pipe Type. Furnish steel pipe conforming to AASHTO M 36 and aluminum alloy pipe conforming to AASHTO M 196 for types shown below:

A) Circular. Type I or Type IR.
B) Arch. Type II or Type IIR.
C) Underdrain. Type III.

810.04.04 Coupling Bands. Furnish bands with annular or helical corrugation conforming to AASHTO M 36 and the requirements of 701.03.05.

810.04.05 Slotted Drain Pipe. Furnish pipe according to Subsection 810.04.03 A) with the addition of a grate assembly to provide openings in the top of the pipe as specified in the Plans. Apply asphalt coating after slotted drain pipe is fabricated. Provide material for slotted drain pipe from a supplier on the Department's List of Approved Materials. Furnish one of the following types of grate assemblies:

A) Type I. The grate assembly is fabricated from structural steel, galvanized according to AASHTO M 111 after fabrication, and forms a continuous drain

slot when 2 or more joints of pipe are bounded together.

B) Type II. The grate assembly is fabricated from 14 gauge steel, galvanized according to AASHTO M 218, and laterally supported by a minimum of one foot, measured laterally, of concrete on each side.

810.04.06 Defects. The Department will reject pipe for any of the following reasons.

1) Variation from centerline.
2) Elliptical shape in pipe intended to be round.
3) Dents or bends in the metal.
4) Lack of rigidity.
5) Low asphalt coating thickness on coated pipe.
6) Cracks or lack of coating adhesion on coated pipe.
7) Insufficient coating to provide a smooth level flow line on fully lined pipe and pipe with a paved invert.
8) Paved sections with less than 25 percent coverage of the pipe circumference.

810.05 SMOOTH METAL PIPE.

810.05.01 Cast Iron Pressure Pipe. Conform to ASTM A 377.

810.05.02 Welded and Seamless Steel Pipe for Bridge Floor Drains. Furnish 6-inch diameter round standard weight pipe conforming to ASTM A 53, ASTM A 500, or ASTM A 501 with a minimum wall thickness of 0.28 inches.

810.05.03 Black and Hot-Dipped Galvanized Welded and Seamless Steel Pipe for Ordinary Uses. Furnish pipe conforming to ASTM A 53 of the size and weight specified in the Contract. The Department will allow plain or threaded end finish.

810.05.04 Aluminum Alloy Extruded Structural Pipe. For pipe with internal connections, conform to ASTM B 221, Schedule 40, Alloy 6063-T52 for railing and ASTM B210, Schedule 40, Alloy 6063-T832 for posts.

For pipe with welded connections, conform to ASTM B221, Schedule 40, Alloy 6061-T6 or ASTM B210, Schedule 40, Alloy 6061-T6.

810.06 Thermoplastic Pipe.

810.06.01 Polyvinyl Chloride (PVC) Pipe.

A) Pipe Underdrain. Furnish perforated pipe for underdrains conforming to AASHTO M 304. Ensure all fittings and pipe are made from the same base material. Submit a manufacturer's certification that the pipe conforms to AASHTO M 304 to the Division of Materials annually. Use integral bell and spigot type joints with elastomeric seal joints and smooth inner walls.

B) Culvert and Entrance Pipe. Furnish pipe and pipe fittings conforming to AASHTO M 304. Manufacture from low filler PVC plastic having a minimum ASTM 1784 cell classification of 12454. Use pipe fittings furnished by the pipe manufacturer.

C) Sliplining Pipe (Rehabilitation). Furnish pipe conforming to ASTM F949. Manufacture from low filler PVC plastic having a minimum ASTM 1784 cell classification of 12454. Use integral bell and spigot type joints with a STAB-JOINT bell coupler filling flush with the outer wall surface.

810.06.02 Corrugated High Density Polyethylene (HDPE) Pipe.

A) Pipe Underdrain. Furnish perforated pipe for underdrains conforming to AASHTO M 252. Use only Type S for edge drain outlet pipe. Use caps,

bands, and other fittings that are of the same material as the pipe. Submit a manufacturer's certification that the pipe conforms to AASHTO M 252 to the Division of Materials annually. Use a length that minimizes the number of joints in a run or line and facilitates shipment, handling, and installation. Use snap-in-place bands or a split band taped in place with polyethylene tape for pipe-to-pipe connections as the Engineer directs. Cap remote ends with a snap-in-place cap. Use non-perforated pipe when specified in the Contract or when the Engineer directs.

B) Culvert Pipe, Storm Sewer, and Entrance Pipe. Furnish pipe and pipe fittings conforming to AASHTO M 294, Type S or D. Use pipe fittings furnished by the pipe manufacturer. Use pipe couplings conforming to AASHTO M 294 and that are Department approved. When corrugations are spiral, use match marks, specially cut ends, or other acceptable methods to facilitate alignment of the corrugations at connections. Provide a minimum gap between adjacent sections of pipe. Submit a manufacturer's certification that the pipe conforms to resin requirements of AASHTO M 294 to the Division of Materials annually. Provide certification from the manufacturer with each shipment that the pipe conforms to AASHTO M 294. Use only Department approved pipe. The Department will perform all sampling and testing deemed necessary, either at the plant or on the project.

SECTION 811 ¾ STEEL REINFORCEMENT

811.01 CLASSIFICATION AND CONDITION. This specification covers bars, welded steel wire fabrics, bar mats, steel wire, prestressing strands, and load transfer assemblies. Ensure that these materials, when incorporated into the work, are reasonably free from dirt, paint, oil, grease, loose-thick rust, or other foreign substance and, when deemed necessary, are cleaned to the satisfaction of the Engineer. The Department will not require cleaning when these materials exhibit tight, thin, or powdery rust.

Reject reinforcement rusted sufficiently to cause it to fail specified physical properties or prestressing strands displaying pits visible to the naked eye.

811.02 BARS. For all bar reinforcement use Grade 60 deformed bars except as indicated for the following items:

A) PCC Pavement Tie Bars, Paved Ditches, Steps, Flume Inlets, Integral Curb, Right-of-Way Markers, Transverse Bars for Bar Mats, Piles, Cribbing, Small Drainage Structures, Pipe Headwalls, or Manhole Tops. Use Grade 40, 50, or 60 deformed bars.

B) Steel Piling Encasement and Spiral Reinforcement for Precast (non-prestressed) Piling. Use Grade 40, 50 or 60 plain or deformed bars.

C) Spiral Reinforcement (excluding piles). Use Grade 60 deformed or plain bars.

811.02.01 Requirements. Furnish bar reinforcement for bridges, cast-in-place culverts, and cast-in-place retaining walls that conform to ASTM A 615 (billet) or ASTM A 616 (rail). Do not weld rail steel bar reinforcement. The Engineer will accept rail steel bar reinforcement in straight lengths only. Do not use rail steel bar reinforcement where field bending is allowed or required.

Furnish bar reinforcement for other uses that conform to either ASTM A 615 (billet), ASTM A 616 (rail), or ASTM A 617 (axle).

811.02.02 Testing and Acceptance. Identify all shipments of steel reinforcement by the producer's heat or test identification numbers. Obtain bar reinforcement from manufacturers included on the Department's List of Approved Materials. To be included on this list, Fabricators shall conform to KM 64-101.

811.03 HOOK BOLTS AND ANCHOR BOLTS. Conform to the design and dimensions provided in the Standard Drawings. Furnish hook tie-bolts that, when assembled as a unit, are capable of sustaining an axial load of 14,000 pounds or greater.

811.04 WELDED STEEL WIRE FABRIC (WWF). Conform to AASHTO M 55.

811.05 WELDED DEFORMED STEEL WIRE FABRIC. Conform to AASHTO M 221.

811.06 BAR MATS. Conform to ASTM A 184 and fabricate by welding deformed Grade 60 billet bars.

811.07 STEEL WIRE. Conform to AASHTO M 32.

811.08 PRESTRESSING STRANDS. Ensure that Uncoated Seven-Wire Stress Relieved Strand for Prestressed Concrete conforms to AASHTO M 203, Grade 270 or low relaxation strand Grade 270 as specified.

811.09 LOAD TRANSFER ASSEMBLIES (CONTRACTION AND EXPANSION). The Department will approve the design of assemblies before delivery to the project. The Department will approve assemblies incorporating the typical features depicted by

the Standard Drawings. The Department will reject assemblies at any time that deviate from previously approved designs and manufacturing procedures. Shop fabricate all assemblies.

Where chair bars fit over ends of dowel bars, form them to obtain a snug fit over the end of the dowel bar not welded to the chair bar.

Control welding to prevent a significant reduction in the areas of the dowel bars or the wires. Modify the load-transfer assemblies furnished for slip form construction to allow for approximately 4 inches of clearance between the assemblies and the slip forms. Accomplish this by welding the outer leg of the chair at an angle of approximately 90 degrees with the upper and lower spacer bars.

811.09.01 Chair, Spacer, Aligning Bars, and Upper Tie Bars. Furnish steel for these items that conforms to AASHTO M 32.

811.09.02 Dowel Bars. Furnish dowel bars that are plain round bars conforming to ASTM A 615, A 616, or A 617 with respect to mechanical properties only. Provide either Grade 40, 50 or 60 steel. Saw cut the free ends of the dowels and ensure that they are free of burrs or projections. Coat dowel bars according to AASHTO M 254 with the following exceptions for Type B coatings:

1) ensure that the thickness is 12 ± 3 mils,
2) subject the coated dowel bars to a bend test (KM 64-102),
3) use a bond breaker from the Department's List of Approved Materials for load transfer assemblies,
4) the maximum pull-out load shall not exceed 2,500 pounds,

Use any Type B Coatings that are on the Department's List of Approved Materials for epoxy coating materials, and apply them (except for thickness) according to Subsections 811.10.03 and 811.10.04.

The Department will inspect and accept dowel bars with Type B coatings as specified in Subsection 811.10.06. Obtain a Certificate of Compliance as specified in Subsection 811.10.07.

811.09.03 Dowel Bar Sleeves. Furnish a sleeve for each dowel bar used with expansion joints. Place these sleeves on alternate and opposite ends of the dowels. Furnish sleeves manufactured from sheet metal or metal tubing having a minimum thickness of .010 inch, 32 gage. Ensure that they are of such length as to cover no less than 2 inches nor more than 3 inches of the dowel, have a closed end, fit the dowel bar snugly, and are of such design as to provide an unobstructed expansion space of no less than one inch to allow movement of the dowel bar.

811.09.04 Fabrication Tolerance. Ensure that the longitudinal alignment of dowel bars in load transfer assemblies is within 1/4 inch in 18 inches of the specified alignment.

When checked along the total length of the dowels, allow the deviation to be 0 ± 1/4 inch for assemblies on a zero degree skew, and 3 ± 1/4 inch for assemblies on a 9.5 degree skew.

811.10 EPOXY COATED STEEL REINFORCEMENT.

811.10.01 Uncoated Bars. Ensure that the deformed steel bars conform to the applicable requirements of Subsections 811.01 and 811.02. In addition, blast clean all surfaces of the steel bars to a near-white surface finish according to SSPC-SP 10. Blast clean to produce a surface having a profile no greater than 3 mils. Immediately before application of the coating, ensure that the blast cleaned surface corresponds with either pictorial standard A SP 10, B SP 10, or C SP 10 of SSPC-Vis 1, and the surfaces are free of all dust and grit.

811.10.02 Epoxy Coating Material. Select the epoxy coating material for

reinforcing steel from the Department's List of Approved Materials. Ensure that the coating material conforms to the prequalification requirements of ASTM D 3963 Annex. Submit documentation in the form of test results from a private testing laboratory verifying that the coating material conforms to ASTM D 3963 to the Division of Materials to gain approved list status.

Select and furnish the powdered epoxy resin of the same material and quality as the resin which has been previously submitted for prequalification. Ensure that the resin manufacturer annually furnishes a written certification to the Division of Materials that attesting to the sameness of the powdered epoxy resin.

Obtain the approval of the Engineer for epoxy material for touch-up and repair work. Ensure that the epoxy material furnished by the epoxy manufacturer is compatible with the coating material and inert in concrete, and is suitable for use in the field.

811.10.03 Application of Epoxy Coating Material. Notify the Director of the Division of Materials at least 2 weeks before performing blast cleaning and applying of the epoxy coating, so the Department can inspect the work. Apply the powdered epoxy resin to the blast cleaned steel bars within 8 hours after blast cleaning and before any visible rusting of the near-white surfaces appears. Apply the resin as an electrostatically charged dry powder sprayed onto the grounded steel bars by electrostatic sprays. Ensure that the steel bars are at the temperature recommended by the powdered epoxy resin manufacturer at the time of the application of the coating.

After coating the bars, give them the thermal treatment recommended by the manufacturer of the powdered epoxy resin to provide fully cured coating on the bars. Touch up all uncoated areas of electrical contact points as directed.

Ensure that the epoxy coating applied to the bars is uniform and smooth with 90 percent of the film thickness measurements falling between 7 and 12 mils after curing, when checked according to KM 64-102.

The Department will reject the coated bars for either an insufficient or excessive film thickness or a partially cured coating.

811.10.04 Properties of the Coated Bars. Ensure that the coated bars, after curing, display a continuous, flexible, and abrasion resistant coating as determined by the following.

A) Continuity of Coating. After curing, check all bars visually for defects in the coating such as holes, voids, delaminations, contamination, and damaged areas. In addition, check for "holidays" (pinholes not visually discernible) according to KM 64-102. When any bar has more than 2 defects or "holidays" per linear foot or a total defective area exceeding 0.25 percent of the surface area per linear foot, repair the defects or "holidays" with the touch-up material. When any bar has more than 5 defects or "holidays" per linear foot or a total defective area exceeding 0.5 percent of the surface area per linear foot, the Department will reject the bar.

B) Flexibility of Coating. The Department will evaluate the flexibility of the coating by bending tests according to KM 64-102. Ensure that the coated bars are capable of being bent 120 degrees (after rebound) over a mandrel, without any visible evidence of cracking the coating.

C) Recleaning. Do not remove the coating from rejected bars for the purpose of recoating by any process involving temperatures higher than 500 °F.

D) Color of Coating. For all epoxy coatings use a light color that will provide a distinct contrast with the color of cleaned steel, and the color of rusted steel.

811.10.05 Fabrication of Coated Bars. Fabricate the steel bars into the shapes and lengths specified on the bridge plans either before or after coating. When performing fabrication after coating the bars, repair any damage to the coating. Repair the coating on straight portions of the bars when damaged or bare areas exceed 0.25 percent of the coated area per linear foot or when individual damaged areas are in the order of 0.063 square inch, 1/4 inch by 1/4 inch or larger. When repairing coating,

clean and repair all damaged and bare areas on the straight portion of the bar. When the amount of repair in the straight portion of a bar exceeds 2 percent of the surface area per linear foot the Department will reject the bar.

Repair coating within each bent area of the bar when bond loss and damage exceed 0.25 percent of the surface area within each bent area or when individual damaged areas are in the order of 0.063 square inch, 1/4 inch by 1/4 inch or larger. When repairing coating, clean and repair all damage within each bent area. When the amount of repair in a particular bent portion of a bar exceeds 2 percent of the surface area, the Department will reject the bar. It is not necessary to repair hairline cracks that do not have bond loss or other minor damage on fabrication bends.

Do not allow the amount of touch-up area for repair of defects and necessary overlap to exceed 5 percent of the surface area of the bar per meter for straight bars.

Do not allow the amount of touch-up area for repair of defects and necessary overlap to exceed 10 percent of the surface area of the bar per linear foot for bent portions of bars.

The Department will approve of all cleaning and repair methods and materials. Coat the ends of the coated bars cut during fabrication with the epoxy used for repairs. Repair the damaged areas and the coating of the ends of cut bars within 24 hours and before any visible rusting appears.

Obtain the Department's approval for any additional requested splices to accommodate lengths suitable for coating. Make requested additional splices at no additional expense to the Department.

Coat all areas receiving touch-up material, including ends with a minimum thickness of 5 mils. The Department will allow a maximum thickness of 16 mils in repair of overlap areas.

Extend touch-up material, applied to sheared or sawn bar ends to coat the resulting damaged area, up to a maximum of 7 inches from the end of the bar. When the sheared or sawn surface conforms to the specifications after touch-up, the Department will not count the bar end and first 7 inches from the bar end in determining the percent of repair area.

811.10.06 Inspection and Acceptance. Before subjecting them to blast cleaning and coating with the powdered epoxy resin, confirm that uncoated steel bars are from a manufacturer on the Department's List of Approved Materials for Reinforcing Steel Manufacturers. The Department may inspect and test all materials at the coating plant, and after delivery to the project.

Use an epoxy coater to apply the coating that is on the Department's List of Approved Materials. To be approved, epoxy coaters must conform to KM 64-101 and KM 64-102.

If the Department's inspection or testing indicates that material furnished to a Department project materially differs from the specification requirements, the Department will review and reconsider the approval of the epoxy coater's quality control program.

811.10.07 Certificate of Compliance. Ensure that each shipment of epoxy coated steel reinforcement is accompanied by a Certificate of Compliance prepared by the epoxy coater according to KM 64-101.

811.11 ACCEPTANCE PROCEDURES FOR NON-SPECIFICATION REINFORCING STEEL. Ensure that all reinforcing steel conforms to the requirements of this section. However, when non-specification reinforcing steel is inadvertently incorporated into the work before completion of testing, the Department may accept the material with a reduction in pay, provided the failure is marginal and will not cause poor performance. When the failure is excessive, then remove the reinforcing steel, and replace it unless the Engineer determines that the reinforcing steel can remain in place with a 100 percent reduction rate. The Department will apply the largest payment reduction when the material fails to meet more than one specification requirement. The Department will calculate the payment reduction on the invoice cost of the material delivered at the project site. The Department will reject reinforcing steel that fails and

has not been incorporated into the work.

YIELD STRENGTH				
% of Requirement	97% - 100% or more	91% - 96%	86% - 90%	85% or less
Reduction Rate	0%	20%	50%	(1)

TENSILE STRENGTH				
% of Requirement	97% - 100% or more	91% - 96%	86% - 90%	85% or less
Reduction Rate	0%	20%	50%	(1)

ELONGATION				
% of Requirement	97% - 100% or more	91% - 96%	86% - 90%	85% or less
Reduction Rate	0%	20%	50%	(1)

WEIGHT PER FOOT				
% of Requirement	94% - 100% or more	89% - 93%	86% - 88%	85% or less
Reduction Rate	0%	20%	50%	(1)

EPOXY COATING THICKNESS			
Thickness (mils)	7 - 13	14 - 15	0 – 6 Over 16
Reduction Rate	0%	25%	(1)

(1) *Remove and replace the reinforcing steel unless the Engineer determines that the steel can remain in place at a 100% reduction rate.*

SECTION 812 ¾ STRUCTURAL STEELS

812.01 STRUCTURAL STEEL SHAPES, PLATES, BARS, AND FASTENERS. Conform to Charpy V-notch toughness requirements for structural steel for load carrying members in bridges when specified in the Plans.

812.01.01 Structural Steel, All Types. Conform to AASHTO M 270 (ASTM A 709), Grades 36, 50 50W, 70W, HPS70W, 100 and 100W. When the supplementary requirement of this specification are specified, they exceed the requirements of M 183, M 223, M 222, ASTM A 852, and M 244.

A) Structural Steel. Conform to AASHTO M 270 Grade 36, AASHTO M 183, ASTM A 709 Grade 36, or ASTM A 36.

B) High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality. Conform to AASHTO M 270 Grade 50, AASHTO M 223 Grade 50, or ASTM A 709 Grade 50, or ASTM A 572.

C) High-Strength Low-Alloy Structural Steel with 345 MPa Minimum Yield Point to 4 Inches Thick. Conform to AASHTO M 270 Grade 50W, AASHTO M 222, ASTM M 270 Grade 50W, or ASTM A 588.

D) Quenched and Tempered Low-Alloy Structural Steel Plate with 485 MPa Minimum Yield Strength to 4 Inches Thick. Conform to AASHTO M 270 Grade 70W, ASTM A 709 Grade 70W, or ASTM A 852.

E) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding. Conform to AASHTO M 270 Grade 100/100W, AASHTO M 244, ASTM A 709 Grade 100/100W, or ASTM A 514.

F) High-Strength Low-Alloy, Quenched and Tempered Structural Steel Plate. Conform to ASTM A 709 Grade HPS70W.

812.01.02 Hot-Rolled Carbon Steel Sheets and Strip of Structural Quality, Grade 33 (Corrugated Steel Plank for Bridge Floors). Conform to ASTM A 570.

812.01.03 Cold Rolled Carbon Steel Sheet of Structural Quality, Grade "D" (40 ksi) (Corrugated Steel Plank for Bridge Floors). Conform to ASTM A 611.

812.01.04 Steel Sheet Piling. Conform to AASHTO M 202 (ASTM A 328).

812.01.05 Frames and Grates (for Catch Basins, Inlets, Outlets, and Manholes). Use steel in these items that conforms to the following properties:

Yield Strength	36 ksi. minimum
Tensile Strength	58 ksi mimimum
Elongation in 2-inch specimen	21 percent minimum

The Department will accept steel for frames and grates according to the Manual of Field Sampling and Testing Practices.

SECTION 813 ¾ MISCELLANEOUS METALS

813.01 PINS AND ROLLERS. Use steel specified in the AASHTO Standard Specifications for Highway Bridges conforming to AASHTO M 169 (ASTM A 108) or AASHTO M 102 (ASTM A 668).

813.02 STEEL CASTING. Conform to AASHTO M 103, Grade 70-36 (ASTM A 27).

813.03 EXPANDING STEEL MANHOLE RISERS. Use an approved type that expands to fit tightly and rigidly within the existing frame.

813.04 GRAY IRON CASTINGS. Conform to AASHTO M 105, Class 30-B.

813.05 MALLEABLE CASTINGS. Conform to ASTM A 47. Use the grade specified.

813.06 CASTINGS FOR RIGHT-OF-WAY MARKERS. Provide aluminum alloy conforming to ASTM B 26, Alloy 319.1.

813.07 LEAD PLATES. Manufacture plates from lead conforming to ASTM B 29.

813.08 ALUMINUM.

813.08.01 Cast Aluminum Sand Castings. Conform to ASTM B 26, Alloy 356.0-T6.

813.08.02 Aluminum Alloy Permanent Mold Castings. Conform to ASTM B 108.

813.08.03 Aluminum Alloy Sheet and Plate. Conform to ASTM B 209.

813.08.04 Aluminum Alloy Extruded Bars, Rods, Shapes and Tubes. Conform to ASTM B 221, Alloy 6061-T 6511 or Alloy 6063-T 6.

813.08.05 Aluminum Alloy Rolled or Extruded Shapes. Conform to ASTM B 308, Alloy 6061-T4 and T 6.

813.08.06 Aluminum Alloy Seamless Pipe. Conform to ASTM B 241, Alloy 6061-T 6 and 6063-T 6.

813.08.07 Aluminum and Aluminum Alloy Bars, Rods, and Wire Bolts. Conform to ASTM F 468, Alloy 2024-T 4. Give finished bolts a minimum anodic coating of 0.0002 inch.

813.08.08 Aluminum Nuts. Conform to ASTM F 467, Alloy 6061-T6 or 6062-T 9. Give finished nuts a minimum anodic coating of 0.0002 inch.

813.08.09 Welding Rods. Conform to AWS A5.10.

813.09 STEEL BOLTS, NUTS, AND WASHERS.

813.09.01 Carbon Steel Bolts and Nuts. Conform to ASTM A 307. Nuts conform to AASHTO M 291.

813.09.02 High-Strength Steel Bolts, Nuts, and Washers. Mark all bolts, nuts, and washers according to the appropriate ASTM Specifications. If using galvanized bolts, nuts, or washers, measure the thickness of the zinc coating. Take measurements on the wrench flats or top of bolt head.

Submit mill test reports for all steel used in the manufacture of the bolts, nuts, or

washers to the Department for approval. Include with the mill test reports the place where the material was melted and manufactured. The Department will take field samples for testing to verify compliance with this section.

Ship bolts, nuts, and washers (where required) from each rotational-capacity lot in the same container. If there is only one production lot number for each size of nut and washer, the Department will allow shipping of the nuts and washers in separate containers. Permanently mark each container with the rotational-capacity lot number to allow identification at any stage before installation. Supply the appropriate mill test report, manufacturer's certified test report, or distributor's certified test report to the Engineer before beginning installation.

For bolts, nuts, and washers, conform to the following dimensions:

BOLT AND NUT DIMENSIONS [1]

Nominal Bolt Size in D	Bolt Dimensions in			Nut Dimensions in	
	Heavy Hexagon Structural Bolts			Heavy Hexagon Nuts	
	Width Across Flats F	Height H	Thread Length T	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

[1] *ANSI Standards B 18.2.1 and B 18.2.2 shall govern tolerance to these dimensions.*

WASHER DIMENSIONS IN MILLIMETERS[1]							
Circular Washers					Square of Rectangular Beveled Washers for American Standard Beams and Channels		
Bolt Size	Nominal Outside Diameter[2]	Nominal Diameter of Hole	Thickness		Minimum Side Dimension	Mean Thickness	Slope or Taper in Thickness
			Min.	Max.			
1/2	1 1/16	17/32	0.097	0.177	1 3/4	5/16	1:6
5/8	1 5/16	21/32	0.122	0.177	1 3/4	5/16	1:6
3/4	1 15/32	13/16	0.122	0.177	1 3/4	5/16	1:6
7/8	1 3/4	15/16	0.136	0.177	1 3/4	5/16	1:6
1	2	1 1/16	0.136	0.177	1 3/4	5/16	1:6
1 1/8	2 1/4	1 1/4	0.136	0.177	2 1/4	5/16	1:6
1 1/4	2 1/2	1 3/8	0.136	0.177	2 1/4	5/16	1:6
1 3/8	2 3/4	1 1/2	0.136	0.177	2 1/4	5/16	1:6
1 1/2	3	1 5/8	0.136	0.177	2 1/4	5/16	1:6
1 3/4	3 3/8	1 7/8	0.178[3]	0.28[3]	—	—	—
2	3 3/4	2 1/8	0.178	0.28	—	—	—

[1]ANSI Standard B 18.22.1 Type A washer tolerances apply to the nominal dimensions for outside diameter and hole diameter.

[2]May be exceeded by 1/4 inch.

[3]3/16 inch nominal.

A) Bolts. Conform to AASHTO M 164 (ASTM A 325). Do not use bolts conforming to AASHTO M 253 (ASTM A 490). Hardness for bolt diameters 1/2 to 1 inch inclusive are as noted below:

HARDNESS NUMBER				
Bolt Size (in)	Brinell		Rockwell C	
	Min.	Max.	Min.	Max.
1/2 - 1	248	311	24	33

Perform proof load testing according to ASTM F 606 Method 1 at the minimum frequency specified in ASTM A 325.

Perform wedge testing on full size bolts according to ASTM F 606 paragraph 3.5 at the minimum frequency specified in ASTM A 325. If bolts are to be galvanized, perform tests after galvanizing.

Plain bolts must be oily to touch when delivered and installed.

B) Nuts. Conform to AASHTO M 292 (ASTM A 194) as applicable or AASHTO M 291. If nuts are to be galvanized (hot dip or mechanically galvanized), use heat treated Grade 2H, DH, or DH3.

For plain (ungalvanized) nuts, use Grades 2, C, D, or C3 with a minimum Rockwell hardness of 89 HRB (or Brinell Hardness 180 HB), or heat treated Grades 2H, DH, DH3.

For nuts that are to be galvanized, overtap the nuts the minimum amount required for proper assembly allowing the nut to assemble freely on the bolt in the coated condition. Overtap the nuts according to the mechanical requirements of AASHTO M 291 and the rotational-capacity test requirements of this section.

Lubricate galvanized nuts with a lubricant containing a dye that

contrasts with the color of the galvanizing.

Perform proof load testing according to ASTM F 606, paragraph 4.2 at the minimum frequency specified in AASHTO M 291 or AASHTO M 292 (ASTM A 194). If nuts are to be galvanized, perform tests after galvanizing, overtapping, and lubricating.

C) Washers. Conform to AASHTO M 293. If supplying galvanized washers, perform hardness testing after galvanizing. Remove coating before taking hardness measurements.

D) Rotational-Capacity Test. Perform rotational-capacity tests on all black or galvanized (after galvanizing) bolt, nut, and washer assemblies by the manufacturer or distributor before shipping. Perform additional rotational-capacity tests on each lot at job sit. Use washers as part of the test even though they may not be required as part of the installation procedure. Perform the following:

1) Except as modified herein, perform rotational-capacity testing according to AASHTO M 164.
2) Test each combination of bolt production lot, nut lot, and washer lot, shipped as a rotational-capacity lot, as an assembly. Where washers are not required by the installation procedures, the Department will not require lot identification for them.
3) Assign a rotational-capacity lot number to each combination of lots tested.
4) Test at least 2 assemblies per rotational-capacity lot.
5) Assemble the bolt, nut and washer assembly in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device (Note this requirement supersedes the ASTM A 325 requirement that the test be performed in a steel joint). For bolts too short to be assembled in the Skidmore-Wilhelm Calibrator, test them according to 9) below.
6) Provide the minimum rotation, from a snug tight condition (10 percent of the specified proof load), as follows:

   300 degrees (0.83 turn) for bolt lengths ≤ 4 diameters
   360 degrees (1 turn) for bolt lengths > 4 diameters and ≤ 8 diameters
   480 degrees (1.33 turns) for bolt lengths > 8 diameters

7) Ensure that the tension reached at the above rotation is ≥ 1.15 times the required installation tension. The installation tension and the tension for the turn test are as noted below:

TENSION		
Diameter (inches)	Req. Installation Tension (kips)	Turn Test Tension (kips)
1/2	12	14
5/8	19	22
3/4	28	32
7/8	39	45
1	51	59
1 1/8	56	64
1 1/4	71	82
1 3/8	85	98
1 1/2	103	118

8) After exceeding the required installation tension listed above, take and record one reading of tension and torque. Ensure that the torque value

conforms to the following:
Torque ≤ 0.25 PD

Where: Torque = measured torque (foot-pounds)
P = measured bolt tension (pounds)
D = bolt diameter (feet)

9) Test bolts too short for assembly in a Skidmore-Wilhelm Calibrator in a steel joint. Disregard the tension requirement of 7) above. For the maximum torque requirement of 8) above, use a value of P equal to the turn test tension shown in the table in 7) above.

The Department will not require an inspection agency present during testing; however, the manufacturer or distributor performing the tests shall certify that the results recorded are accurate. The Engineer reserves the right to witness testing on request.

Ensure that the lot number appearing on the shipping package for bolts, washers, and nuts corresponds to the lot number identified on the distributor's and manufacturer's certification.

Provide the Engineer with the certified test report from the manufacturer or distributor performing the rotational-capacity test. Include the following information:

a) The lot number of each of the items tested.
b) The rotational-capacity lot number.
c) A statement that the items conform to this section and the Contract.
d) The results of the tests.
e) The location and date of the tests.
f) The location where the bolt assembly components were manufactured.

813.09.03 Corrosion-Resisting Steel Bolts and Set Screws. Fabricate bolts and screws from bars conforming to ASTM A 276. Use Types 302 or 304 for steel machine bolts to attach aluminum posts to concrete and for steel set screws for aluminum railings.

813.09.04 Stainless Steel Hardware, Bolts, Nuts, and Washers. Conform to ASTM A 320.

813.09.05 Cadmium Coatings for Steel Anchor Bolts, Nuts, and Washers. Conform to ASTM B 766, Class 12, Type II.

813.10 WELDING MATERIAL, PROCEDURES, AND INSPECTION. For bridges comply with the ANSI/AASHTO/AWS D1.5 Bridge Welding Code with modifications and additions as specified in the Plans.

For other steel structures comply with the AWS Structural Welding Code D1.1 with modifications and additions as specified in the Plans. For aluminum structures comply with the AWS Structural Welding Code-Aluminum D1.2.

813.11 STUD SHEAR CONNECTORS. Conform to AASHTO M 169 (ASTM A 108, Grade 1015).

813.12 HANDRAIL.

813.12.01 Type B. Fabricate the channel, picket, and posts using hot rolled steel conforming to AISI M 1020; ASTM A 519, Grade 1020; ASTM A 575, Grade M 1020; or ASTM A 659, Grade 1020. For the lambs tongue, use either a gray iron casting or a commercial grade steel. After fabrication and cleaning, paint the handrail with 2 coats of commercial grade primer paint and one coat of commercial grade black enamel. Repaint damaged areas as directed.

813.12.02 Type C. Furnish aluminum posts and rails conforming to ASTM B 221, alloy 6063, temper T52. Provide rails with a polished finish and posts and fittings with a satin finish. Use aluminum alloy fittings for handrails as recommended by the handrail manufacturer.

813.13 MATTRESSES AND GABIONS. Conform to ASTM A 975, Style 1. Use wire with a minimum elongation of 10 percent of the length of the wire when tested according to ASTM A 370 without reducing the diameter or tensile strength of the wire.

Supply lacing wire in sufficient quantity to ensure that all required tying, connecting, and lacing can be performed. For Department direct purchases, supply an amount of lacing wire equal to or greater than 8 percent of the weight of the units.

Fabricate the mattress units to the dimensions required by the Contract. The Department will accept mattresses with dimensions within ± 3 percent of the ordered width.

813.13.01 Mattress Units. As an alternate to lacing wire, the Engineer will allow mattress unit fasteners, from the Department's List of Approved Materials, that conform to mattress unit manufacturer's recommended assembly and connection instructions.

Subdivide the mattress units into compartments a maximum of 3 feet in length extending over the full width of the mattress unit by inserting diaphragms made of the same mesh as the rest of the mattress unit. Secure the diaphragms in position on the bottom with a continuous spiral wire at the factory so no additional tying at this joint is necessary.

813.13.02 Gabion Baskets. As an alternate to lacing wire, the Engineer will allow gabion unit fasteners, from the Department's List of Approved Materials, that conform to mattress unit manufacturer's recommended assembly and connection instructions.

Supply diaphragms of the same material composition as the gabion to form individual cells of equal length and width when the gabion length exceeds its width.

813.13.03 Acceptance. The Department will test each shipment for wire size and zinc coating, and will perform any other Engineer ordered tests. The Department will accept shipments based on laboratory testing and the Engineer's visual inspection.

SECTION 814 ¾ GUARDRAIL SYSTEMS

814.01 DESCRIPTION. This section covers material requirements for corrugated sheet steel beams and accessories for guardrail, terminal sections, guardrail posts, offset blocks, end treatments, and timber guard posts.

814.02 BEAMS AND ACCESSORIES. Conform to AASHTO M 180. Hardware for Type I, II, or III beams may be either hot-dip galvanized, electrogalvanized, or mechanically galvanized. Galvanize according to AASHTO M 232. The Engineer will reject beams with zinc oxide (white rust) in amounts deemed objectionable. Furnish Type II beams of either Class A, 0.105 inch thick or Class B, 0.135 inch thick as specified in the Contract.

814.03 TERMINAL SECTIONS. Conform to AASHTO M 180 and the details shown on the Standard Drawings. Galvanize sections after fabrication. Furnish Type 2 sections of either Class A, 0.105 inch thick or Class B, 0.135 inch thick as specified in the Contract.

814.04 GUARDRAIL POSTS. Provide either steel or timber, and use the same type throughout the Project.

814.04.01 Steel Guardrail Posts. Fabricate from steel conforming to AASHTO M 183 for the wide flange shapes and ASTM A 570 for C shapes except ensure that C shape posts have mechanical properties equal to those required by AASHTO M 183. Punch or drill holes for connector bolts before galvanizing. Galvanize all posts according to AASHTO M 111.

814.04.02 Timber Guardrail Posts. Furnish either square sawn or round timber guardrail posts. Conform to the nominal dimensions shown on the Standard Drawings. The Engineer will allow a minus 2-inch tolerance from the specified nominal length. Saw the butts of all posts square, and finish the tips as specified in the Contract.

Bore bolt holes to a driving fit for the bolts. Frame, bore, and trim, as much as is practical, before giving the posts a preservative treatment. When it is necessary to bore or cut the posts after treatment, or when any treated surface has been badly scarred, treat the cut or scarred surface according to AWPA M4.

Treat the posts with preservative according to AWPA C 14 as applicable for guardrail posts. Use only one type throughout the project unless otherwise approved by the Engineer.

Use any of the species of wood for round guardrail posts covered under AWPA C 5. Use any of the softwood species for square sawed posts covered under AWPA C 2. When furnishing oak posts, treat with creosote or creosote solution according to AWPA C 2 for "Above Ground, Soil or Fresh Water Exposure."

See Subsection 818.01 for inspection, testing and acceptance procedures for Timber Guardrail Posts.

A) Square Sawed Posts. Ensure the posts, in the direction parallel to the axis of the bolt holes, do not exceed the dimensions specified in the Contract by more than 1/4 inch.

Use posts that have straight grain, and that have a slope of the grain not deviating more than one inch in 12 inches from being parallel to any face when measured over the middle one-half of the length. The Engineer will not accept posts having a crook exceeding 1/2 inch in 10 feet. Limit wane to one end of the post only, and do not allow it to extend more than 10 feet from that end. Do not reduce the flat width of any face by more than 25 percent at the point of most wane. Do not use wood with ant tunnels, woodpecker holes, plugged holes, or any large unsightly gaps. The Department will allow wood with grub and worm holes less than 1/2 inch in average diameter, provided

that the sum of the diameters of all holes in any 12 inches of post length does not exceed 1/4 the nominal width of the face. Do not use posts showing signs of powder post beetle infestation. The Engineer will not limit the use of posts that have grub holes appearing entirely on the surface of the post and that do not penetrate to more than 1/2 inch in maximum depth.

Do not use posts with knots greater than 3/8 the nominal width of the face, measured by the smallest diameter. Do not allow the sum of the diameters of all knots in any 6 inches of post length to exceed 3/4 the nominal width of the face. Do not allow the sum of the diameter of all knots appearing within the middle half of the length of any face to be greater than 4 times the size of the largest knot allowed in that face. The Department will allow posts with unsound knots no larger than half the maximum allowable size for sound knots and no more than 1 1/2 inches in depth, provided that the surrounding wood is not affected by the decay. Do not use posts that have clusters of knots where the maximum distortion of the grain around the cluster exceeds the maximum allowable size for one knot.

Entirely confine shakes within the ends of the post, without extending to any face. Measure the shake as the sum of the 2 adjoining sides of the smallest rectangle that will completely enclose the shake. Measure the sides of the rectangle parallel to the faces of the post. Do not allow shakes to occur in more than one annual ring or to extend to more than 3/4 of the circumference of the annual ring in boxed heart. Do not allow total shake measurement to exceed one-half the width of the face.

Do not use posts with splits greater in length than the width of the face. Do not use posts with a check or series of contiguous checks having a width of 8 mm or greater at the surface and more than 3 inches in depth at any point and extending more than 3/4 of the length of the post from one end. The Engineer will determine the depth of checks by the penetration of a probe 1/64 inch thick and 1/4 inch wide. The Engineer will consider the extent of a check or series of contiguous checks to end at the last point where the opening does not exceed 1/8 inch in width and is no more than 3/4 inch in depth.

Do not use any post having a shake that does not exceed the maximum limits for shakes as specified herein, but contains a check which penetrates to the annual ring in which the shake occurs.

B) Round Posts. Peel all posts for their full length, and remove all outer and inner bark. Shave all knots and projections smooth and flush with the surface of the surrounding wood.

Ensure that the posts are a constant diameter not less than 1/4 inch under the nominal diameter.

Do not use posts that have short or reverse bends, one way sweeps exceeding one inch, and winding twists that are unsightly and exaggerated. The Engineer will not allow more than 10 percent of the number of pieces of any shipment to contain the maximum sweep.

Do not use posts with unsound, loose or hollow knots. The Department will allow use posts that have sound knots when the diameter of any one knot or when the combined diameters of 2 or more knots occurring in the same cross section are no greater than 1/3 of the diameter of the post at that cross section.

Ensure that posts are close grained and do not show spiral grain exceeding 1/8 turn in 5 feet.

Do not use posts with seasoning checks that penetrate the interior of the post to a depth greater than 1/3 of the diameter at any point, or which measure more than 1/4 inch in width at any point.

Do not use posts that have ring shakes, sap rot, bird pecks, insect holes, pitch pockets, or pitch streaks, and other defects that will impair the strength of the post, or give it an unsightly appearance.

814.05 OFFSET BLOCKS. Use the size, and when specified, the type the Contract

specifies.

814.05.01 Wood. Conform to 814.04 for material properties.

814.05.02 Composite Plastic. Use blocks that are uniform in composition throughout the product and consist of at least 70 percent plastic by weight. Use sufficient additives to inhibit photo degradation. The Department will consider 2 percent carbon black to be a minimum. Ensure the blocks conform to the National Cooperative Highway Research Program (NCHRP) 350 Test Level 3 requirements.

Submit a written manufacturer's certification to the Engineer stating the material composition conforms to this subsection and is the same that was tested and approved under NCHRP 350.

814.06 MATERIALS FOR END TREATMENTS. Conform to Subsections 814.02 through 814.05 for common components, and, except where otherwise provided, ensure they are of the same class and type as required for the guardrail to which they are attached. Galvanize all non-corrosion-resistant metals used in end treatments according to AASHTO M 111 or AASHTO M 232 as applicable. For other materials, comply with the following requirements:

A) Anchorage Systems. Furnish anchorage systems that have a minimum breaking strength of 40,000 pounds. The anchorage system may employ either a cable assembly or continuous steel rod or other system of equal or greater strength when approved. For cable assemblies, use cable that is 3/4-inch (6 by 19) wire rope conforming to AASHTO M 30, Class C. Provide swage fittings as required by the Standard Drawings and include studs as required. Ensure that eye bolts conform to ASTM A 489 and are of either Type 1 or Type 2. For wire rope clips use a commercial grade capable of being torqued to a minimum of 130 foot-pounds.

Use commercial grade wire rope thimbles.

B) Anchor and Miscellaneous Plates. Fabricate from steel conforming to Subsection 812.01.01.

C) Miscellaneous Hardware.

Bolts	ASTM A 307
Nuts	ASTM A 563, Grade A or better

D) Steel Sheet (for rail plates and mounting brackets). Conform to ASTM A 570, Grade D.

E) Tubular Sections (for posts and blocks). Conform to ASTM A 500, Grade B or ASTM A 501.

F) Steel Drums. For steel drums conform to Federal Specification PPP-D-729C for Type II, straight side, with rolled or expanded hoops, cylindrical drum; double seamed without chime reinforcement. Ensure that average diametrical crushing strength per drum is 6,000 pounds with maximum variation for 10 tests being 400 pounds. Galvanize steel drums on all surfaces according to AASHTO M 111.

G) Concrete. Conform to Section 601, Class A.

H) Welded Wire Fabric. Use welded wire fabric for concrete reinforcement that is W3 by W3, 6 by 6-inch conforming to Subsection 811.04. The Department may allow other approved types of steel reinforcement.

SECTION 815 ¾ CAST ALUMINUM BRIDGE RAILING POSTS

815.01 CHEMICAL COMPOSITION. Conform to ASTM B 108, Alloy A 356.0. Contrary to ASTM B 108, heat treat to a T6 temper instead of T61 to produce the following tensile properties:

TENSILE PROPERTIES [1]		
Properties	Minimum	Typical
Tensile Strength, psi [1]	25,000	30,000
Elongation in 4x Diameter, % [2],[3]	6	8

[1]*For the purposes of design in the tension test, ensure that the specimens conform to the minimum yield strength of 18,000 psi (acceptance testing for this property is not required).*
[2]*Minimum tensile properties based on separately cast test bars are 32,000 psi tensile strength and 10 percent elongation.*
[3]*Gage length 4 times the diameter of the specimen.*

815.02 TEST SPECIMENS. Machine the tension test specimens from integrally cast test coupons extending from one side of the base of the posts sufficiently large enough to obtain an 0.350-inch diameter test specimen as defined in ASTM E 8.

815.03 TESTING. Sample a minimum of one percent of the posts in any lot, but not less than one, for tensile testing. For the purpose of sampling, 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.

Determine tensile properties according to ASTM E 8. When the results of any tensile test do not conform to the requirements prescribed, perform 2 additional tests on the same group of castings. The average of the 3 tests must conform to the requirements.

815.04 HEAT TREATMENT. Heat treat the castings to produce material with the utmost uniformity conforming to the properties specified in this section. Perform heat treatment on the whole casting, never on a portion only.

815.05 WORKMANSHIP AND FINISH. Ensure that castings are uniform in quality and condition, free from cracks, blowholes, porous places, hard spots, shrinkage defects, or other defects that may detrimentally affect the suitability of the castings for their intended use. Ensure that the castings are smooth and well cleaned before inspecting.

Produce castings under radiographic control. Radiographically examine castings to establish proper foundry technique for each mold that will produce castings commercially free from harmful internal defects, and examine production castings to ensure maintenance of satisfactory quality.

Provide a normal mill finish.

815.06 INSPECTION. The Department may inspect the manufacturer's work either where the castings are made or at the point at which they are received.

The Department will either visually inspect the castings or compare the castings by a method adopted as standard to determine compliance with the requirements of Subsection 815.05.

When the Department elects to have inspection made at the manufacturer's works, the manufacturer shall afford the inspector representing the Department all reasonable facilities to verify that the material is being furnished according to this

section. The Department will conduct all tests and inspection in a manner not interfering unnecessarily with the operation of the works.

815.07 INSPECTION REPORTS. When requested by the Department, furnish certified inspection reports certifying compliance with the requirements of this section.

SECTION 816 ¾ WOVEN-WIRE FENCING MATERIALS

816.01 DESCRIPTION. This section covers the materials for use in construction of woven-wire fences.

816.02 GENERAL. Galvanize all ferrous materials used in a complete installation of fence, except aluminum coated fabric, aluminum coated posts and braces, or aluminum coated barbed wire. Galvanize all iron and steel hardware according to AASHTO M 232. Galvanize other components as designated. Where it is not practical to secure a specimen of measurable area or uniform thickness for determining the weight of zinc coating, ensure that all such galvanizing withstands 4 dips of the Preece Test as set out in ASTM D 2521. Ensure that post caps and socket type brace connections are galvanized malleable iron, or other approved type, and designed to exclude moisture from inside posts or rails.

816.03 WOVEN WIRE FABRIC. Ensure that the woven wire fabric is either zinc-coated steel or aluminum-coated steel. Provide the size and style of fabric specified in the Contract.

Use zinc-coated steel fabric that conforms to ASTM A 116 and that has a Class 3 coating.

Use aluminum-coated steel fabric that conforms to ASTM A 584.

816.04 BARBED WIRE. Use either zinc-coated steel, aluminum-coated steel, or aluminum alloy. Use barbs of 4-point pattern spaced at intervals of 5 inches. The wire for barbs may be either round or half-round.

816.04.01 Zinc-Coated Steel. Conform to ASTM A 121. Use size 0.099-inch diameter or heavier with Class 3 coating. The Department will allow high tensile strength barbed wire provided it conforms to ASTM A 121, and the following exceptions: (1) nominal diameter of 0.067 inch for the coated line wires and 0.057 inch for the coated barbs; (2) minimum weight of zinc coating of 0.75 ounces per square foot for line wires and 0.70 ounces per square foot for barbs; and (3) minimum tensile strength of 475 pounds for each individual strand of the line wire.

816.04.02 Aluminum-Coated Steel. Use either Type I or Type II conforming to ASTM A 585. Use size 0.01 inch diameter or heavier.

816.04.03 Aluminum Alloy. Use 2 strands of 0.110 inch nominal diameter or heavier wire strands having minimum tensile strength of 42,000 psi, minimum yield strength of 35,000 psi and minimum elongation of 10 percent.

816.05 BRACE WIRE. Conform to ASTM A 777-91 except provide a minimum weight of coating of 0.6 ounce per square foot. Use size 0.148-inch nominal diameter or larger.

816.06 FABRIC TIES. Use either a minimum 0.109-inch nominal diameter galvanized steel conforming to ASTM F 626, except ensure that the minimum weight of coating is 0.6 ounces per square foot, or 0.148-inch nominal diameter aluminum alloy.

816.07 FENCE POSTS AND BRACES.

816.07.01 Steel Posts and Braces. Conform to ASTM F 1043, ASTM F 1083, and the Standard Drawings.

When the Contract specifies a thermoplastic acrylic coating, apply a chromate conversion coating at the manufacturer's recommended rate. Ensure that the coating is designed for pretreatment of galvanized coatings. After pretreating, electrostatically apply the thermoplastic acrylic coating with a minimum dry film thickness of 0.3 mils.

816.07.02 Wood Posts and Braces. Treat wood fence posts and braces with preservative and ensure that they are made of timber cut from live, sound, standing trees. See Subsection 818.01 for inspection, testing and acceptance of wood products. Ensure that round or half-round posts and braces are preservative treated according to and are of the species covered by AWPA C 5. Ensure that sawed posts and braces are preservative treated according to and are of the species covered by AWPA C 2 for "Soil or Fresh Water Exposure".

Use posts that are round, half-round, or square-sawed.

Ensure that wood for fence posts is sound and free from decay, excessive knots, seasoning checks, and end splits that will affect serviceability. The Department will allow sound knots, provided the width of the knot does not exceed one-third the diameter of a round post at the point where it occurs, or one-third the width of any face of a sawed post, or a maximum of 2 1/2 inches. The Department will reject wood with season checks that penetrate more than one-third of the diameter of the piece or which have a width of more than 1/4 inch.

Use round posts and half-round posts that are free of multiple crooks. The Department will allow crooks in one plane only, provided that a straight line between the centers of the butt and tip does not deviate more than 2 inches from the center of the post at any point. Ensure that crooks in square-sawed posts do not exceed one inch in 5 feet.

Cleanly peel round posts and remove all bark. Strips of inner bark that are less than 1/2 inch wide and 3 inches long may remain on the peeled post. Trim all protruding knots flush with the sides and remove all spurs and splinters. In machine peeling operations, follow the natural taper of round posts. Manufacture half-round posts by sawing in half the round posts complying with the above manufacturing methods.

Square cut the ends of all posts unless the Engineer allows driving. When driving is specified or allowed, point the butt end before receiving preservative treatment. Do not allow the length of the point to exceed 1.5 times the diameter or width of face, as applicable.

A) Line Posts. Use line posts with a length of 7 feet and a minus one-inch tolerance. Use line posts that are either round, half-round, or square-sawed; however, furnish the same type section for all line posts throughout the project.

Ensure that round posts have a minimum diameter of 4 inches. Ensure that half-round posts have a minimum face of 6 inches and a minimum radius of 2 3/4 inches. Cut square-sawed posts to 4-inch by 4-inch, ± 1/8 inch.

B) End, Corner, Gate, Brace, and Pull Posts. Do not use lengths less than 8 feet. Use either round or square-sawed posts; however, furnish the same type section for all of these types throughout the project. Ensure that round posts have a minimum diameter of 8 inches. Cut square-sawed posts to 8-inch by 8-inch, ± 1/8 inch.

C) Braces. Conform to all requirements for line posts, except use braces that are either round or square-sawed and furnish them in the lengths specified in the Plans.

816.07.03 Untreated Wood Posts. Furnish untreated wood posts of Osage-Orange, Black Locust, Red Cedar, White Oak, or of other approved species, and ensure that posts conform to all applicable requirements of Subsection 816.07.02. Use untreated wood posts only when specified in the Contract.

816.08 GATES. Fabricate gate frames to the size and dimensions specified in the Contract. Ensure that pipe used in frames conforms to Subsection 816.07.01. Weld or otherwise construct all joints to form a rigid and water-tight frame.

Furnish all gates complete with approved hinges, latches, and auxiliary braces as required.

Fit gate frames with a fabric that conforms to the same requirements as the corresponding fence.

The Department may approve the use of gates fabricated of other materials.

SECTION 817 ¾ CHAIN LINK FENCING MATERIALS

817.01 DESCRIPTION. This section covers materials for use in the construction of fences of chain link fabric. The Department will allow 3 optional types of fabric; zinc-coated steel, aluminum-coated steel, or aluminum alloy (Type I, II, or III fabric, respectively). Use vinyl coated fabric (Type IV) only when specified in the Contract.

817.02 REQUIREMENTS. Conform to AASHTO M 181 for all materials except steel posts and barbed wire.

817.02.01 Fabric. Use 0.148-inch nominal diameter wire woven in 2-inch mesh. Coat Type I fabric to conform to Class D. Furnish fabric for fences 4 feet and 6 feet high that has the top selvages knuckled and bottom selvage knuckled or twisted and barbed. Furnish fabric for fences 8 feet high or higher with both top and bottom selvages twisted and barbed.

817.02.02 Barbed Wire. Conform to Subsection 816.04.

817.02.03 Post Caps and Socket Type Brace Connections. Use galvanized malleable iron, or other approved type, designed to exclude moisture from inside posts and rails.

817.02.04 Posts, Rails, Gate Frames and Expansion Sleeves. With zinc-coated steel fabric or with aluminum-coated steel fabric, use either zinc-coated steel or zinc-acrylic coated steel. With aluminum alloy fabric, use aluminum alloy. Furnish steel posts that comply with Subsection 816.07.01.

817.02.05 Fabric Ties. Use either a minimum 0.148-inch nominal diameter aluminum alloy or 0.120-inch nominal diameter galvanized steel.

817.02.06 Hog Rings and Tension Wire. With zinc-coated steel fabric or with aluminum-coated steel fabric use zinc-coated steel wire or aluminum-coated steel wire. Ensure that steel ties and wire conform to ASTM F 626, except that the minimum weight of coating is 0.6 ounces per square foot. With aluminum alloy fabric, use aluminum alloy wire.

817.02.07 Miscellaneous Fittings and Hardware. With zinc-coated steel fabric or with aluminum-coated steel fabric use zinc-coated steel. With aluminum alloy fabric, use aluminum alloy.

SECTION 818 ¾ WOOD PRODUCTS

818.01 INSPECTION, TESTING, AND ACCEPTANCE. The Engineer will visually inspect and approve all treated wood products before use on the project. The Division of Materials will grade inspect, sample, and test all treated wood products before their use on the project if the plant producing the wood materials is located within the Commonwealth or a 100-mile driving distance of its borders. When obtaining treated wood materials from a plant outside this 100-mile distance, have an independent treated-wood testing company approved by the Division of Materials grade inspect, sample, and test the wood treated material at no expense to the Department. Obtain a report prepared by the independent testing firm that grade inspected, sampled and tested the treated wood material, and submit it to the Division of Materials at least 15 days before using the wood materials on the project.

Use only treated wood that has been cut to size before treating. Treat field sawn surfaces according to AWPA M4.

818.02 BOARDS. Boards are defined as being less than 2-inch in nominal thickness and one inch or more in width. Only use boards that are one of the available grades established by either the Southern Pine Inspection Bureau (SPIB) or the West Coast Lumber Inspection Bureau (WCLIB). The Contract will designate the grade and applicable inspection bureau.

818.03 DIMENSION LUMBER. Dimension lumber is limited to surfaced softwood lumber of nominal thickness from 2-inch through 4-inch. Only use dimension lumber for framing members such as joists, planks, rafters, studs, and small timbers.

Use only dimension lumber boards that are one of the available grades established by either the SPIB or the WCLIB. The Contract will designate the grade and applicable inspection bureau.

818.04 TIMBERS, 5-INCH BY 5-INCH AND LARGER. Use only timbers that are of one of the available grades established by either the SPIB or the WCLIB. The Contract shall designate the dimensions, grade, species, and applicable inspection bureau.

818.05 STRUCTURAL LUMBER. Conform to the AASHTO Standard Specifications for Highway Bridges.

818.06 BRIDGE PLANKING AND ROUGH LOCAL HARDWOODS.

818.06.01 Species. Use only bridge planking that is White Oak, Red Oak, or Southern Yellow Pine.

The term "White Oak" includes White Oak, Chestnut Oak, Post Oak, Burr Oak, Swamp Chestnut Oak, Swamp White Oak, Live Oak, Chinquapin Oak, and other less known varieties of oak of this character.

The term "Red Oak" includes Red Oak, Black Oak, Southern Red Oak, Willow Oak, Water Oak, Pin Oak, Cherrybark, or Swamp Red Oak, and other less known varieties of oak of this character.

Southern Yellow Pine may be any species except Field or Loblolly.

818.06.02 Quality of White Oak or Red Oak. The Engineer will not approve wood for use that has splits, rot, or unsound knots. Use only pieces that are sawed full to specified sizes and lengths, with square edges except wane (bark or the lack of wood) as follows. The Engineer will allow wane on one corner on 30 percent of the pieces in any shipment, not to exceed 15 percent of the width of the face on which it appears. The Engineer will allow this grade with sound stains, scattered worm holes or grub holes not materially affecting the strength of the piece and sound bird pecks, or their equivalent; sound knots or their equivalent not exceeding in diameter 25 percent the width of the face in which they appear. Use only boxed heartcenter wood

products. Cut pieces not large enough to box the heartcenter outside the heart except that sizes 2 to 6 inches in thickness, 6 inches wide and wider, may show heart on one face only, in 30 percent of the pieces in any shipment.

818.06.03 Quality of Southern Yellow Pine. Conform to the SPIB grades as follows:

A) Structural Light Framing (2-inch by 2-inch to 4-inch by 4-inch). Provide No. 1 Dense.
B) Structural Joists and Planks (3-inch by 8-inch or 4-inch by 6-inch). Provide No. 1 Dense.
C) Stress Rated Timbers (5-inch by 5-inch and larger). Provide No. 1 SR.

818.06.04 Dimensions and Tolerances. Use rough timber that is cut full size as specified, sawed true with parallel faces. The Engineer will allow no more than 25 percent of a lot or shipment to be scant 1/4 inch in thickness and no more than 10 percent of a lot or shipment may be scant 1/4 inch in width.

Ensure that dressed dimensions for both oak and pine material conform to Southern Pine Inspection Bureau thicknesses and widths for Dimension Lumber.

818.06.05 Rough Local Hardwood. This subsection covers hardwood lumber and timber that is produced locally. Use only White Oak, Red Oak, or Beech hardwood. Where hardwood material is intended to be used inside, the Department will allow other species of hardwood, that are suitable for the intended use, when such species are specified.

1) Use only material that is cut from live standing trees and is free from any form of decay.
2) The Department does not require seasoned material.
3) Cut all pieces to a square edge with no less than 75 percent heart, girth measurement, for full length of the piece.
4) Saw all material to the full nominal dimensions.
5) Ensure that all knots are tight and sound. Do not allow any material with a knot of greater diameter than half of the width of the face on which it occurs. Allow only one maximum knot, or small knots aggregating in diameter of one maximum knot, in each one-foot length of timber.
6) Ensure that all material is reasonably free from crook and warp.
7) Do not allow any piece that has a shake, crack, or split which extends over half through the narrow face of the piece.
8) Do not allow any boxed heart in pieces less than 3 inches in thickness.
9) The Engineer will reject material having any defect or combination of defects that seriously impairs the strength or that renders it unsatisfactory for the intended use.

818.07 PRESERVATIVE TREATMENT. When the Contract specifies preservative treatment of wood products, treat according to AWPA C14. Provide preservative conforming to AWPA C14 as the Contract specifies.

Do not use creosote or creosote solutions with wood required to be paintable.

When the Contract specifies pentachlorophenol preservative, use heavy petroleum solvent when the Contract does not require painting. Use light petroleum solvent when the Contract requires that the wood is to be paintable.

Do not use water-borne preservatives where the wood will be in contact with water unless recommended by AWPA specifications.

Follow the guidelines set in AWPA M4 for the care of preservative treated wood products.

SECTION 819 —TUNNEL LINING MATERIALS

819.01 DESCRIPTION. This section covers materials requirements for steel plates and fittings to be used for lining tunnels. Refer to the Contract for sectional properties.

819.01.01 Steel Plates. Use base metal for steel plates that conforms to the chemical requirements of ASTM A 569. Ensure that the flat plate, before cold forming, conforms to the following minimum mechanical properties:

Tensile Strength	42,000 psi
Yield Strength	28,000 psi
Elongation, 2 inches	30%

Ensure that nominal plate dimensions provide the sectional properties shown in the current edition of the AASHTO Standard Specifications for Highway Bridges. For thickness tolerances, conform to Paragraph 14 of AASHTO M 167. Provide steel liner plates of additional thickness or protect by coatings or other means when specified in the Contract for resistance to abrasion or corrosion.

819.01.02 Bolts and Nuts. Do not use any bolts and nuts with lapped seams that are less than 5/8 inch in diameter. Provide bolts conforming to ASTM A 449 for plate thicknesses equal to or greater than 0.209 inch and A 307 for plate thickness less than 0.209 inch. Provide nuts conforming to ASTM A 307, Grade A.

Only use bolts and nuts with 4-flanged plates of no less than 1/2 inch in diameter for plate thicknesses to and including 0.179 inch and no less than 5/8 inch in diameter for plates of greater thickness.

SECTION 820 ¾ TIMBER POLES

820.01 REQUIREMENTS. Provide poles of Southern Pine conforming to ANSI Specification 05.1. Provide poles of the length and ANSI size classification specified in the Contract. The Department will not allow sweep exceeding one inch in 10 feet or double sweep.

Treat poles with pentachlorophenol conforming to AWPA P8 according to AWPA C4. Treat with a light petroleum solvent to provide an oil-free paintable finished product. The Engineer will allow other processes which produce the specified paintability.

Ensure that net retention is no less than 0.075 pounds per cubic foot on the outer 1/2-inch and no less than 0.045 pounds per cubic foot in the 1/2 to one-inch zone with average retentions of no less than 0.080 and 0.050 pounds per cubic foot, respectively.

Follow the guidelines for the care of preservative treated wood products as set in AWPA M4.

820.02 ACCEPTANCE. The Department will inspect, test and accept poles according to Subsection 818.01.

SECTION 821 — BRIDGE COATINGS

821.01 DESCRIPTION. This section covers requirements for paints used in steel bridge construction and maintenance.

821.02 GENERAL REQUIREMENTS. Use only paint components that are factory mixed and delivered ready for use. Sediment formed during shipment must be easily dispersed with a paddle to produce a smooth, uniform coating having good spreading characteristics. Reject paint that excessively gels, or cakes in the container.

Ensure that the paint will produce a smooth uniform finish without sags or streaks. Use Federal Standard No. 141, Methods 4321 and 4331 to test the paints for finish characteristics. Ensure that batches of paint used on an individual structure do not differ in color from each other.

Store paint at temperatures above 32 °F and below the maximum temperature recommended by the coating manufacturer. The Engineer will reject or retest paint exposed to temperatures outside this range.

821.03 SAMPLING AND TESTING. Apply no paint until the Division of Materials has approved it. The Department will sample the material before, or after, delivery to the project. Allow the Department 10 calendar days to test and approve samples. Retest paint that is not used within its specified approval period. Remove rejected paint from the job site before starting painting operations.

Use paint conforming to this section and on the Department's List of Approved Materials. For a manufacturer to place their paint on the list, submit a verifiable field performance history and a certified test report from an approved independent testing laboratory showing specific test results conforming to all requirements of this section. The Department will accept independent laboratory testing completed within 2 years of the submittal date. Send the certified report and a one-gallon sample kit for testing by the Department. For zinc rich primers, include a separate one-quart sample of zinc dust. Upon approval by the Department, the Department will add the material to the List of Approved Materials. The Department requires new certified test results and samples for analysis when the manufacturing process or the coating formulation is changed or when testing indicates nonconformity with the specified requirements.

The Department will remove the product from the List of Approved Materials if it does not produce uniform results, does not consistently comply with this section, or does not produce an acceptable and durable coating.

821.04 ZINC RICH PRIMER COAT.

821.04.01 Composition.

A) Zinc Dust. Conform to ASTM D520 Type II with average particle size of 4-9 µm.

B) Base Component. Formulate with a solvent system compatible with its intended use. With organic systems, or paints applied to less than a SSPC-SP 10 blast cleaned surface, require compatibility between the base components and all materials, such as paint or mill scale, on the existing steel surface.

821.04.02 Properties of Mixed Coating.

MINIMUM REQUIREMENTS			
Characteristic	Inorganic	Organic	ASTM
Total Solids (% by weight of coating)	78	70	D 2369
Pigment (% by weight of total solids)	85	83	D 2371
Metallic zinc (% by weight of pigment)	87	93	D 521
Metallic zinc (% by weight of total solids)	74	77	D 521

A) Volatile Organic Content. 3.75 pounds per gallon maximum.
B) Water Tolerance. Ensure that water contamination up to one percent by weight will not cause the coating to gel within 5 minutes.
C) Color. Distinct contrast with the cleaned metal surface and with the top coat.
D) Usable Pot Life. A minimum of 4 hours at 70 °F and 50 percent relative humidity.

821.04.03 Field History. Provide certified documentation that the proposed coating has performed successfully on at least 10 projects for a minimum of 2 years. Include the name, address, and telephone number of the proprietary agency (including the name of a responsible contact person), the location of each structure involved, and the beginning and ending dates of each coating application.

821.05 MOISTURE CURE ALUMINUM POLYURETHANE INTERMEDIATE COAT.

821.05.01 Composition.

A) Pigment. Use a pigment containing a non-leafing aluminum. Ensure the dry whole paint contains 26 ± 2 percent aluminum by weight.
B) Vehicle. Use a one-component intermediate coat that cures by reaction with the atmospheric moisture. Formulate with a moisture cure polyisocyanate diphenylmethane diisocyanate based prepolymer with an isocyanate content of 16.0 to 17.0 percent by weight, an NCO equivalent weight of 247 to 263, and a viscosity of 1400 ± 200 cps at 77 °F.

821.05.02 Properties of Mixed Coating.

A) Total Solids by Weight of Coating. 69 ± 2.0 percent by weight according to ASTM D 2369 using a 4 hour dry time plus a one hour oven dry at 230 °F.
B) Viscosity. The manufacturer will supply a sample for qualifying purposes. Ensure the material at the project does not vary more than ± 10 KU from the qualifying sample.
C) Density. 9.5 ± 0.2 pounds per gallon.
D) Isocyanate Content. 9.6 ± 0.9 percent by weight according to KM 64-250.
E) Recoat Window. Provide a coating with a recoat window of at least 5 days for the application of the moisture cure intermediate coat and the acrylic polyurethane finish coat.
F) Volatile Organic Content. 2.8 pounds per gallon maximum as applied.
G) Single Coat. Will not run or sag when spray applied at 5 mils wet film thickness.

821.06 URETHANE FINISH COAT.

821.06.01 Composition. Use a two-component polyester or acrylic aliphatic urethane that conforms to the following physical requirements:

A) Resin. Formulate Component A with a hydroxyl bearing polyacrylic resin with a typical hydroxyl content of 4 percent and an average equivalent weight of 425 (both values at 100 percent resin solids). Ensure the resin makes up at least 95 percent of the polyol vehicle solids. Ensure Component A contains a hindered amine light stabilizer in the amount of one percent by weight of the combined Component A and B resin solids.
B) Curing Agent. Formulate Component B, the curing agent, with a polyisocyanate resin based on Hexamethylene diisocyanate with an NCO content of 21.0 to 22.0 percent and an average NCO equivalent weight of 195.

C) Specular Gloss.

1) Initial. 80 percent minimum at 60° angle of incidence according to ASTM

D 523.

2) Retention. 70 percent minimum after weathering 24 months at 45° according to the South Florida Testing Service. As an alternate method, the Department will accept accelerated weathering data according to ASTM G 26, Type B, Method 2. Use cycles of 3.8 hours of light followed by one hour dark with a water spray during the dark cycle. Use a light source of 0.5 W/M^2 at 340 nanometers.

D) Rapid Chemical Resistance. The Department will test according to KM 64-256.

E) Total Solids. Minimum of 75 percent by weight according to ASTM D 2369 using a 4 hour dry time plus a one hour oven dry at 230 °F.

F) Color. The qualifying sample will conform to Federal Standard No. 595-36314. When aesthetic considerations for the project dictate a variation, submit samples for analysis and color comparison prior to supplying paint to the project.

The Department will use the manufacturer's qualifying sample as the control sample. Ensure the color of the mixed product supplied to the project does not vary more 1.0 ΔE_{cmc} from the control sample. Ensure the color of the field applied product does not vary more 1.5 ΔE_{cmc} from the control sample. The Department will obtain these values with a spectrophotometer using a D65 illuminant at 0° illumination with a 45° viewing angle and 2° observation angle.

G) Volatile Organic Content. 2.8 pounds per gallon maximum as applied.

821.06.02 Variation of Composition. The Department will test all project acceptance samples for conformance to the following physical and chemical tolerances on composition variance from the manufacturer's benchmark sample.

ALLOWABLE VARIATION		
	Variance	Method
Percent non-volatile	± 2.0%	ASTM D 3723
Percent pigment	± 2.0%	ASTM D 3723
Viscosity	± 10.0 KU	ASTM D 562
Weight per gallon	± 0.25 lb/gal	ASTM D 1475
Chemical composition of vehicle remains	essentially identical	IR spectroscopy
Chemical composition of volatile organic compounds remains	essentially identical	gas chromatograph

821.06.03 Packaging. Package in 2 containers and label them Part A and Part B. Package so that when Part A and Part B are mixed the yield is less than 5 gallons of mixed coating. Label each container clearly to show the manufacturer or brand name of the coating, the lot number, and the date of manufacture. Include complete instructions on the label of one container or send separate written instructions with each shipment.

821.07 APPROVAL REQUIREMENTS.

821.07.01 Product Data Sheets. Supply a Manufacturer's Product Data Sheet which provides the following information:

A) Volatile Organic Compound (VOC).

1) VOC supplied in the container for single component materials.
2) VOC for multiple component systems when supplied containers are

properly mixed.

3) The volume of the thinner that can be added to a single component material or mixed component materials and not exceed 3.75 pounds per gallon of VOC for the zinc primer and 2.8 pounds per gallon for the intermediate and finish coats.

B) Properties of Mixed Materials.

1) Total percent solids by weight.
2) Percent pigment by weight.
3) Total solids by volume according to ASTM D 2697.
4) Percent metallic zinc in the dried film.
5) Weight per gallon.
6) Viscosity in Krebs units. (Stormer at 77 °F).
7) Pot life in hours, at a specified temperature and humidity.
8) Lenata (Sag resistance) in mils wet film thickness.
9) Recommended minimum and maximum dry film thickness in mils. Report the dry film thicknesses as the thickness of the coating to the top surface of the profile peaks.
10) Minimum drying time at 77 °F and 50 percent relative humidity. Include touch dry, handling, and recoat. If applicable, include a maximum recoat window.
11) Mix ratios for multi-component paints.
12) Shelf life of each component stored at 77 °F.

C) Independent Laboratory Reports. Supply test reports with the following information:

1) Name of the testing firm(s) preparing the report and the date the report is prepared.
2) Name of the coatings' manufacturer and the trade name of the coating tested.
3) Notarized "Certificate of Compliance". Include a statement by the testing firm stating that they tested the products according to this section, the support specifications, and that all information presented is truthful and without bias. The manufacturer and testing firm will maintain all unsubmitted records and documents pertaining to the certificate for at least 7 years. The manufacturer's representative, the test supervisor, and the principal owner/manager of the testing firm will sign the certificate. These individuals will also include their name and title in typed or printed form.
4) Table of Contents.
5) Summary of all test results.
6) Individual test results of all panels tested.

821.07.02 Resistance Tests. Require for zinc rich primer, moisture cure aluminum polyurethane intermediate coat, and urethane finish.

A) Preparation. White metal blast clean (SSPC-SP 5), with a nominal anchor profile from 1.5 to 2.5 mils, both sides of steel test panels (ASTM A 36 hot rolled steel or equivalent) measuring 4 by 6 by 1/16 inches or greater.

1) Zinc Rich Primer Coat. Coat both sides with zinc rich primer. Protect the edges of the coated panels by applying electrical tape. The tape should not extend more than 0.2 inches onto the coated surface from the edge of the panel. Spray apply and cure the coating by the manufacturer's recommendations.
2) Moisture Cure Aluminum Polyurethane Intermediate Coat. Coat both sides with the zinc rich primer and moisture cure intermediate. Protect

the edges of the coated panels by applying electrical tape. The tape should not extend more than 0.2 inches onto the coated surface from the edge of the panel. Spray apply and cure the coating by the manufacturer's recommendations.

3) Urethane Finish Coat. Coat both sides and all edges with the zinc rich primer, moisture cure intermediate, and urethane finish. Spray apply and cure the coating by the manufacturer's recommendations.

The dry film thickness shall be 2.5 to 3.5 mils of primer, with the manufacturer's recommended thickness of the moisture cure intermediate and urethane finish. Age the panels for 14 days at 75-79 °F and 45-55 percent relative humidity before any exposure testing. Perform tests on at least 3 panels. The average of the 3 test results will be the value reported for acceptance.

B) Fresh Water Resistance. Scribe panels down to base metal with an **X** with at least 2-inch legs and immerse in fresh tap water at 75 ± 5 °F. Examine the panel after 30 days, and verify that there is no rusting, blistering, or softening of the coated panels.

C) Salt Water Resistance. Scribe down to the base metal with an **X** with at least 2-inch legs and immerse in a 5 percent sodium chloride solution at 75 ± 5 °F. Examine the panel after 7, 14, and 30 days, and verify that there is no rusting, blistering, or softening of the coating. Replenish the sodium chloride solution with fresh solution after each examination.

D) Weathering Resistance. Perform an accelerated weathering resistance test according to ASTM G 53 [Standard Practice for Operating Light - and Water - Exposure Apparatus (Fluorescent UV - Condensation Type) for Exposure of Nonmetallic Materials]. Ultraviolet Region: use the UV-A radiation with a lamp having a peak of 340 nanometers and a range of 295 to 365 nanometers. Use the following time cycles: 8 hours UV at 158 ± 4 °F, alternating with 4 hours condensation at 122 ± 4 °F, and repeating.

Place the panels in the test cabinet at the beginning of the wet cycle and expose for a 4,000 hour duration. Evaluate Color Change according to ASTM D 2244. Perform color change procedures according to Section 6.2 CIE 1976 L*a*b.

Require no spontaneous delamination (evaluated subjectively) or blistering after exposure. Evaluate according to ASTM D 714. Ensure that rust creepage at the scribe is no greater than 6 mils and total rusting at the scribed edges is no more than 2 percent of the exposed face area according to ASTM D 1654, Method 2 (scraping). Ensure that the difference in color does not exceed a ΔE of 3.0.

The acceptance goal will be to meet the 4,000-hour limit. However, full evaluations will be performed at 2,000, 3,000, and 4,000 hours to determine the maximum acceptable limit for panels coated with primer/intermediate and primer/intermediate/finish coats for all resistance tests.

E) Relative Humidity Resistance. Perform according to ASTM D 2247 for 4,000 hours. Require no blistering, cracking, or delamination after exposure. Ensure that rust creepage at the scribe is no greater than 3 mils and total rusting at the scribed edges is no greater than 2 percent of the exposed face area, according to ASTM D 1654, Method 2 (scraping).

F) Salt Fog Resistance Test. Perform according to ASTM B 117 and evaluate at 4,000 and 5,000 hours. Require no spontaneous delamination (evaluated subjectively) or blistering after exposure. Evaluate according to ASTM D 714. Ensure that rust creepage at the scribe is no greater than 6 mils and total rusting at the scribed edges is no more than 2 percent of the exposed face area according to ASTM D 1654, Method 2 (scraping).

821.07.03 Slip Coefficient Test. When using zinc rich primer coats on new and rehabilitated structures with painted connections designed for Class B allowable stress, conform to the Class B slip coefficient requirements specified in the AASHTO

Standard Specifications for Highway Bridges. Provide test data from the supplier stating the compliance with this requirement as well as the cure time and the maximum allowable coating thickness according to the test.

821.08 PROJECT ACCEPTANCE. Submit a written manufacturer's certification with each shipment of paint stating that the material furnished conforms to this section. Submit a separate certification for each batch or lot number furnished for each project. Verify that the batch or lot of paint is approved by the Department before applying.

SECTION 822 ¾ ELASTOMERIC BEARING PADS

822.01 ELASTOMERIC BEARING PADS. Furnish elastomeric bearing pads conforming to the design and dimensions as specified in the Plans and to the AASHTO Standard Specifications for Highway Bridges, Division II, Section 18.

Use bearings that are low temperature Grade 3 with durometer hardness of 50 and that conform to the load test requirements corresponding to Design Method A.

SECTION 823 ¾ CONCRETE CURING MATERIALS

823.01 GENERAL. This section lists the various types of curing materials allowed for concrete and the materials requirements applicable to each. The Department will provide specifications governing the particular type or types of curing materials allowed for specific classes of construction in the Contract or other sections of these specifications.

823.02 LIQUID MEMBRANE FORMING COMPOUNDS. Ensure that all curing compounds Conform to AASHTO M 148 and are from a Department approved manufacturer.

1) Type 1-D (Clear with fugitive dye or translucent with fugitive dye), Class A or Class B.
2) Type 2 (White pigmented), Class A or Class B. Supply Type 2 curing compounds in agitating type drums, except the Department will not require agitating type containers when Type 2 curing compound is supplied in 5 gallon pails.

The Department will accept curing compounds on the basis of certification of their conformance to this section and their being from an approved manufacturer. The Department will reject curing compounds from an unapproved manufacturer and require their removal from the project site.

823.01.02 Acceptance Procedures for Non-Specification Curing Compounds. The Department will test project samples. When non-specification curing compounds are inadvertently incorporated into the work the Department will accept the material with a reduction in pay. The Department will apply the largest payment reduction when the material fails to meet more than one specification requirement. The Department will calculate the payment reduction on the invoice cost of the material delivered at the project site.

MOISTURE LOSS PAYMENT REDUCTION				
kg/square meter	0.00-0.55	0.56-0.65	0.66-0.75	0.76 or more
Reduction Rate	0%	20%	30%	50%

REFLECTANCE PAYMENT REDUCTION				
% Reflectance	60.0% or more	50-59.9%	40.0-49.9%	39.9% or less
Reduction Rate	0%	20%	30%	50%

823.03 BURLAP CLOTH. Conform to AASHTO M 182, Class 4.

823.04 WATERPROOF PAPER (Regular or White). Conform to AASHTO M 171.

823.05 WHITE POLYETHYLENE FILM (White Opaque). Use white polyethylene film of either single sheet construction conforming to AASHTO M 171 or laminated construction consisting of 2 sheets of white polyethylene reinforced with synthetic fiber cords, providing the total thickness of polyethylene, exclusive of the cords, averages no less than 4 mils and the sheeting conforms to all other applicable requirements of AASHTO M 171. Incorporate the reinforcing cords diagonally in 2 directions and ensure that the number of cords averages 24 per linear foot in each direction.

823.06 WHITE BURLAP - POLYETHYLENE SHEET. Conform to AASHTO M 171.

823.07 CURING BLANKETS. Use curing blankets that consist of a top layer of white copolymer material and a bottom layer of absorbent, non-woven, synthetic fabric. Ensure that the layers are securely bonded together so there will be no separation of the layers during handling and curing of the concrete. When tested according to AASHTO M 171, ensure that moisture loss does not exceed 0.010grams per square centimeter and that reflectance is at least 70 percent.

SECTION 824 ¾ MASONRY MATERIALS

824.01 CONCRETE MASONRY UNITS (FOR CONSTRUCTION OF CATCH BASINS AND MANHOLES). Conform to ASTM C 139.

824.02 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS. Conform to Subsection 710.02.13.

824.03 CONCRETE BRICK. Conform to ASTM C 55. Use Type II, Grade N or S.

824.04 SEWER AND MANHOLE LEVELING BRICK. Conform to AASHTO M 91. The Department will waive the requirement for saturation coefficient for Grades SM and MS. Ensure that the dimensions are of the specified standard size.

824.04.01 Sewer Brick. Use Grade SS or SM.

824.04.02 Manhole Brick. Use Grade MS or MM.

824.05 HYDRATED LIME. Conform to ASTM C 206.

SECTION 825 ¾ DE-ICERS

825.01 SOLID (TYPE S) CALCIUM CHLORIDE. Conform to ASTM D 98 for the following:

A) Grade 1. Class A or Class B.
B) Grade 2. Class A or Class B.
C) Grade 3. Class A or Class B.

825.02 SODIUM CHLORIDE. Conform to ASTM D 632, Type I, Grade 1.

SECTION 826 ¾ EPOXY RESIN SYSTEMS

826.01 GENERAL. Conform to ASTM C 881, except as specified in Subsections 826.01.01 and 826.01.02. Provide materials, of all types, of the Grade and Class required. Types are as follows:

A) Type III. Use in epoxy-sand slurry, as a binder in epoxy mortars or epoxy concretes.
B) Type IV. Use for installing dowels into hardened portland cement concrete.
C) Type V. Use for bonding plastic portland cement concrete to hardened portland cement concrete.

826.01.01 Epoxy-Sand Slurry for Concrete Bridge Deck Overlays. Conform to ASTM C 881, Type III or AASHTO M 200, Class II.

826.01.02 Reinforcing Bar Grout Adhesives. The Department will allow reinforcing bar grout adhesives, from the Department's List of Approved Materials, as an alternate to Type IV epoxies for doweling reinforcing bars into hardened concrete.

826.02 APPROVAL. The Department will approve ASTM C 881 epoxies based on the manufacturer's submission of independent laboratory data showing the actual test values for all of the ASTM specification requirements. The Department will test reinforcing bar grout adhesives according to KM 64-209.

826.03 PACKAGING. Package the 2 components in separate containers. Identify the containers as "Component A - Contains Epoxy Resin" and "Component B - Contains Hardener." Include on the container the following information:

1) Type, mixing directions, and usable temperature range.
2) Name of the Manufacturer.
3) Lot or batch number.
4) Date of packaging.
5) Type of pigmentation.
6) Quantity contained in pounds and gallons.
7) Potential hazards according to the Federal Hazardous Products Labeling Act.

826.04 ACCEPTANCE. The Department will accept the materials based on the sampling and testing performed according to the Department's Manual of Field Sampling and Testing Practices.

SECTION 827 ¾ EROSION CONTROL MATERIALS

827.01 DESCRIPTION. This section covers the requirements for various materials used for erosion control.

827.02 AGRICULTURAL LIMESTONE. Conform to the requirements and provisions of the Kentucky Department of Agriculture. The Department of Agriculture furnishes a test report and any required weight penalties to each agricultural limestone producer. Furnish the Engineer with a copy of the test report, current within 9 months, as the basis of approval. The Engineer may sample any agricultural limestone that appears to be of questionable quality upon visual inspection.

827.03 FERTILIZER. Provide commercial fertilizer that complies with the Kentucky Fertilizer Law, and contains the plant nutrients of nitrogen, available phosphoric acid, and soluble potash as specified in the Contract. Ensure that bagged fertilizer displays the following information on the bag or on a sticker or tag attached to the bag:

1) Net Weight
2) Brand and Grade
3) Guaranteed Analysis
4) Name and Address of Manufacturer

Ensure that the manufacturer includes a statement with the bulk fertilizer (dry or liquid) that contains the same information required for the bagged fertilizer.

Provide either bagged or bulk (dry or liquid) fertilizer manufactured and sold under the jurisdiction of the Division of Regulatory Services of the University of Kentucky Agricultural Experiment Station. Select a supplier from the Department's List of Approved Materials for fertilizer. The Department must sample, test, and approve any other fertilizer prior to its use.

827.04 SEED. Do not use seed that contains more than 1.0 percent weed seeds by weight. Ensure that the noxious weed seeds contained in any seed does not exceed the maximum number specified in the following listing:

Noxious Weeds	Max. No. Seeds (per ounce)
Johnson Grass (Sorghum halepense)	0
Giant Foxtail (Setaria fabrii)	3
Canada Thistle (Cirsium arvense)	0
Wild Onion (Allium vineale)	3
Nodding Thistle (Carduus nutans)	0
Buckhorn (Plantago canceolata)	9
Corncockle (Agrostemna quithago)	9
Dodder (Cuscuta sp.)	9
Oxeye Daisy (Chrysanthemum leucanthemum)	9
Quack Grass (Agropyron repens)	0
Sorrel (Rumex acetosella)	15

Conform to the applicable minimum purity and actual germination percentages specified in the table, Requirements for Seeds, with no tolerances below the minimum percentages. Do not use seed later than 9 months after testing, exclusive of the month testing was completed.

The Department will sample and test all seed, exclusive of seed used for temporary seeding and protection, either before or after delivery to the project. If requested, the Department will sample and test seed for a seed vendor who supplies seed for use on highway projects and who agrees to comply with all of the following requirements:

1) Select, set aside, and provide easy access to at least a total of 10,000 pounds of one or more kinds of seed each time a request is made for pretesting.
2) Provide the necessary labor to assist the Engineer in handling the seed packages or bags during sampling and tagging.
3) Reserve the quantity of seed pretested in storage until authorized by the Department to dispose of the seed for purposes other than highway uses.
4) Preserve and leave attached, all tags and labels attached by the Engineer, unless the Department authorizes to remove them.
5) Cooperate with and aid the Engineer in a manner that will expedite the pretesting operations.

Do not sow any seed until the Engineer receives verification that the seed complies with all specified requirements. The Engineer may obtain proper verification by one of the following methods:

A) Pretesting Method. If seed arrives to the project with tags or seals or other methods of identification affixed to the bag, the Department has pretested the seed. The Engineer will verify that the seed conforms to the specified requirements and that the approval period has not expired.

B) Project Sampling Method. The Engineer will take samples and submit them to the Division of Materials for testing. Allow the Division of Materials 5 weeks to provide test reports indicating that the samples conform to the specified requirements.

REQUIREMENTS FOR SEEDS				
	Grasses	Purity (Min. %)	Germination (Min. %) Including Hard Seed	Hard Seed (Max.%) Allowed in Germinatio
	Bentgrass (Argrostic palustris)	98	80	-
C	Bermudagrass, common (Cynodon dactylon)	95	80	-
H	Bluegrass, Kentucky (Poa pratensis)	90	80	-
A	Brome, smooth (Bromus inermis)	85	80	-
F	Canarygrass, reed (Phalaris arundinacea)	90	80	-
F	Fescue, Chewings (Festuca rubra var. commutata)	95	80	-
Y	Fescue, meadow (Festuca elatior)	96	85	-
	Fescue, red (Festuca rubra)	95	85	-
S	Fescue, tall (Festuca arundinacca)	95	85	-
E	Orchardgrass (Dactylis glomerata)	85	80	-
E	Redtop (Agrostic alba)	90	80	-
D	Ryegrass, annual, common or Italian (Lotium	97	85	-
S	Ryegrass, perennial (Lolium perenne)	95	85	-
	Lovegrass, Weeping (Eragrostic curvula)	96	75	-
N	Oat (Avena Sativa)	96	80	-
O	Rye (Secale cereale)	96	80	-
N	Timothy (Phleum pratense)	98	80	-
C	Wheat, common (Triticum aestivum)	96	80	-
H	Legumes			
A	Alfalfa (Medicago sativa)	98	85	30
F	Clover, alsike (Trifolium hybridum)	96	80	35
F	Clover, ladino (Trifolium repens)	97	80	35
Y	Clover, white (Trifolium repens)	96	80	35
	Crownvetch (Coronilla varia)	96	80	30
S	Lespedeza, Korean (Lespedeza stipulacea)	97	80	25
E	Lespedeza, Sevicea (Lespedeza cuneata)	97	80	25
E	Sweetclover, white (Melilotus alba)	97	85	30
D	Sweetclover, yellow (Melilotus officinalis)	97	85	30
S	Trefoil, birdsfoot (Lotus corniculatus)	97	80	35

827.05 MULCH MATERIALS. Use material for mulching that is baled wheat, oat, barley, or rye straw, or excelsior wood fibers. Ensure that mulch material is reasonably free from weed seeds, stolons, foreign matter, or chaff, and does not contain any Johnson Grass, Canada Thistle, Quack Grass, or Nodding Thistle. Ensure that the mulch material is reasonably bright in color and not musty, moldy, or otherwise of low quality, and does not contain chemicals toxic to plant growth.

Use excelsior wood fibers that consist of fibers cut from sound green timber. Ensure that the cut is made in a manner to provide maximum strength of fiber, but is at a slight angle to the natural grain of the wood so as to cause splintering of the fiber when weathering occurs. Use fibers with the following approximate physical properties: width 0.02 to 0.04 inch, thickness 0.02 to 0.04 inch, and length 4 to 6 inches.

827.06 ASPHALT MATERIALS FOR MULCH. Use either SS-1, SS-1h, Primer L, AE-60, MC-30, or MC-70, all confoming to Section 806 except that the Department may waive retesting as provided by Subsection 806.04. The Engineer may reject asphalt materials that fail to disperse properly or otherwise fail to provide satisfactory results.

827.07 EROSION CONTROL BLANKET. Use a machine constructed curled wood fiber mat with two-sided netting. Ensure the blanket is smolder resistant without the use of chemical additives.

A) Dimensions. Furnish in strips either 4 or 8 feet wide and at least 50 feet long.
B) Weight. Ensure the blanket weighs between 0.98 and 1.5 pounds per square yard.
C) Fill. Use curled wood fiber of consistent thickness with at least 80 percent of its fibers 6 inches or longer in length. Ensure the fibers are evenly distributed throughout the blanket.
D) Netting. Use photodegradable extruded plastic mesh or netting, with a maximum spacing width of one inch square, on both sides of the blanket. Secure the netting by stitching or other method to ensure the blanket retains its integrity.
E) Staples. Use steel wire U-shaped staples with a minimum diameter of 0.09 inches (11 gauge), a minimum width of one inch, and a minimum length of 6 inches. Use a heavier gauge when working in rocky or clay soils and longer lengths in sandy soils.

827.08 TEMPORARY SILT FENCE.

A) Posts. Use either hardwood or steel greater than 4 feet in height. For hardwood, provide a minimum 1 1/2-inch by 1 1/2-inch cross section that is straight enough to provide a fence without noticeable misalignment. For steel, provide a 1 1/4-inch by one-inch T-section with projections to fasten wire and fabric in position.
B) Woven or Welded Wire Fabric. Conform to Section 816 or 811. Provide fabric with a minimum height of 2 feet 8 inches. Require at least 6 horizontal wires spaced 6 1/4 inches or closer with the top and bottom wires 0.134 inch or larger and all other wires 0.1 inch or larger. Require 0.1 inch or larger vertical wires spaced 12 inches or closer.
C) Geotextile Fabric. Conform to AASHTO M 288 for temporary silt fence. Provide fabric with a height of 3 feet.
D) Fasteners. Use No. 9, one inch long wire staples and/or fabric ties that conform to Subsection 816.06.

827.09 NETTING AND STAPLES. Conform to the Standard Drawings and the Plans. The Engineer may accept netting and staples on the basis of visual inspection.

827.10 TOPSOIL. Topsoil is the portion of the soil profile defined technically as the "A" horizon by the Soil Science Society of America. Use loose, friable, topsoil that is free of stones 1 inch or greater in overall dimensions, admixture of subsoil, refuse, stumps, roots, brush, weeds, and other material that prevent the formation of a suitable seed bed. Before stripping the topsoil, inspect for existing vegetation. Do not use topsoil from sites having Johnson Grass, Canada Thistle, Quack Grass, Nodding Thistle, or excessive amounts of other noxious weeds, or their rhizomes. The Department will sample the soil and determine the textural classification according to the US Department of Agriculture system, the particle size according to KM 64-519, the organic content according to KM 64-243, and the pH according to ASTM D 4972. Acceptable topsoil composition is:

Clay	40% maximum
Silt	70% maximum
Sand	60% maximum
Organic Material	2% minimum, 10% maximum
pH	6.0 minimum, 7.0 maximum

827.11 SOD. Use sod that is either well-rooted Kentucky Bluegrass or Tall Fescue sod. However, obtain the Engineer's approval prior to using Tall Fescue sod in residential areas. Use sod that is completely free from noxious weeds and reasonably free from other objectionable grasses and weeds and stones or other foreign materials

detrimental to the development and future maintenance of the sod. Obtain sod from sources that are covered with grass having a maximum height of 3 inches. Obtain approval of the selected source prior to cutting.

SECTION 828 ¾ MASONRY COATING MATERIALS

828.01 DESCRIPTION. This section covers requirements for materials to be used as surface finishes for designated surfaces of cement concrete structures. The masonry coatings must hide form marks, patches, and other minor irregularities and prevent deterioration, spalling, and other damage to the concrete due to the action of the weather and deicing chemicals.

828.02 APPROVAL. Select masonry coatings from the Department's List of Approved Materials. Use a material that is readily recognizable by its name, trademark, container, or other feature. Conform to the Department's testing criteria to be placed on or remain on the Department's List of Approved Materials.

For initial approval submit representative samples, color chip(s), and duplicate copies of certified test reports to the Division of Materials for review and approval. An independent testing laboratory acceptable to the Department shall perform the tests described herein on representative samples of the material. Tests listed herein are the minimum testing requirements to be met. When requested in writing, the Engineer may accept materials based on conformance to the same type of test but differing on minor procedural points. Attach copies of test procedures which differ from those stated herein. In addition to the material, provide brochures or booklets containing detailed instructions and explanatory remarks about surface preparation, application procedures, and other pertinent operations.

828.02.01 Freeze-Thaw Test. Cast and cure 3 concrete specimens no less than 4 by 4 by 6 inches. Moist cure specimens for 14 days and then dry in room air at 60 to 80 °F for 24 hours before applying masonry coating. Ensure that there is no excessive oil on specimen forms. Coat sides of specimens (brush permitted) according to the manufacturer's directions at a rate of 50 ± 10 square feet per gallon and cure at room temperature for 48 hours; after which:

1) Immerse in water at room temperature 60 to 80 °F for 3 hours and remove.
2) Place in cold storage at -15 °F for one hour and remove.
3) Thaw at room temperature 60 to 80 °F for one hour.
4) Repeat steps 1), 2), and 3) to complete a total of 50 cycles. At the end of 50 cycles of the Freeze-Thaw Test, ensure that the coated specimens shows no visible defects.

828.02.02 Accelerated Weathering. Test according to ASTM D 822. Apply at an application rate of 50 ± 10 square feet per gallon. Test for 335 hours in an Atlas Type XW Sunshine Arc Weatherometer or for 500 hours in an Atlas Type DMC Enclosed Violet Carbon Arc Weatherometer or equivalent. Perform the test in 120-minute cycles consisting of 102 minutes of light and 18 minutes of light and demineralized water. At the end of the exposure test, ensure that there is no checking, cracking, or loss in film integrity, and no other film defects. Ensure that the coating shows no more than very slight color change.

828.02.03 Salt Spray Resistance. Apply the masonry coating to concrete at a rate of 50 ± 10 square feet per gallon, and test the coating according to ASTM B 117. Expose the coating to a 5 percent sodium (salt) solution for 300 hours, and maintain it at 90 ± 2 °F during the period of exposure. Ensure that it shows no loss of adhesion or deterioration at the end of the 300 hours.

828.02.04 Fungus Growth Resistance. Ensure that the masonry coating passes a fungus resistance test as described by Federal Specification TT-P-29. After a minimum incubation period of 21 days, ensure that no growth is exhibited on the coating.

SECTION 829 —HARDWARE FOR TIMBER STRUCTURES

829.01 GENERAL. Use only black nails, spikes, bolts, dowels, washers, and lag screws.

829.02 BOLTS. Use machine bolts having square heads and nuts, and ensure that screw threads make a close fit in the nuts. Furnish machine bolts, drift-bolts, and dowels of either wrought iron or medium steel. Designate the weight of bolts as "American Standard Regular."

829.03 WASHERS. Furnish washers that either are cast O-gee or malleable castings or are cut from medium steel or wrought-iron plate, as specified in the Contract.

829.04 NAILS. For nails, use cut or round wire of standard form. Furnish cut or wire spikes, or boat spikes, as specified in the Contract.

SECTION 830 ¾ RETROREFLECTIVE MATERIALS

830.01 DESCRIPTION. This section covers the requirements for retroreflective materials for use in delineators, barricades, traffic drum channelizing tapes, cone collars, signs, and for other applications as required.

830.02 GENERAL REQUIREMENTS. Use retroreflective materials that exhibit a daylight appearance unaffected by viewing angle. Use materials that exhibit the same color and appearance at night under directional lighting as in daylight. Ensure that all materials and prepared sign faces are free from cracks, tears, ridges, humps, discoloration, or other objectionable blemishes. Use material that is resistant to the formation of appreciable fungus growth. When furnishing materials for the Department or its agent to fabricate signs, ensure compatibility with the manufacturer's recommended fabrication procedures and the requirements of this section. The Department will reject material that prevents successful fabrication.

830.02.01 Delineators. Provide the size and shape specified in the Contract. Use delineator units that are readily attachable to mounting posts.

Provide delineators that exhibit no significant change in shape or appearance when subjected to the heat resistance test.

Provide delineators that exhibit the following minimum specific reflectivity:

MINIMUM COEFFCIENT OF RETROFLECTION R[1] (Candelas per lux per meter squared)			
Observation Angle	Entrance Angle	White	Yellow
+ 0.1	0	119	71
+ 0.1	+ 20	47	28
+ 0.33	0	20	12
+ 0.33	+ 20	8	5

A) Type A. Furnish a plastic prismatic retroreflective optical system forming a single reflectorized surface. Provide units that are completely sealed against dust, water, and water vapor in a non-corrosive metal-backed housing and exhibit no water intake when subjected to the seal test. Provide screw-on or bolt-on demountable units.

B) Type B. Furnish Type III, Class 1 retroreflective sheeting attached to a non-corrosive metal backing.

C) Type C. Furnish Type III, Class 1 retroreflective sheeting attached to flexible delineator posts.

830.02.02 Barricade Sheeting. Conform to ASTM D 4956, Type III, Class 1.

830.02.03 Traffic Drum Channelizing Tape. Conform to ASTM D 4956, Type III, Class 1 or 3.

830.02.04 Cone Collars. Conform to ASTM D 4956, Type III or Type VI, Class 1 or 3.

830.02.05 Retroreflective Sheeting. Furnish either Type III or Wide Angle Prismatic (WAP) as specified in the Contract. Use sheeting materials that present a finished surface suitable for receiving stenciled messages or paint overlays.

Provide only retroreflective sign sheeting materials that conform to Federal Specification L-S-300C for solvent resistance, heat resistance, cold resistance, and humidity resistance.

A) Type III. Conform to ASTM D 4956.

B) WAP. Use 3M Diamond Grade sheeting, Series 3924 for fluorescent orange and 3970 for all other colors, or Department approved equal. Conform to the following retroreflectivity requirements:

MINIMUM COEFFICIENT OF RETROFLECTION R[1] (Candelas per lux per meter squared) (0.2° Observation and -4° Entrance Angle at 0° and 90° Orientation)							
Observation Angle	Entrance Angle	White	Yellow	Green	Red	Blue	Fluor-Orange
0.2	-4	800	660	80	215	43	200
0.2	+30	400	340	35	100	20	120
0.2	+45	145	85	12	25	7.6	-
0.2	+60	35	23	2.0	6.6	1.0	50
0.5	-4	200	160	20	45	9.8	80
0.5	+30	100	85	10	26	5.0	50
0.5	+45	75	60	6.0	18	2.8	-
0.5	+60	30	20	2.0	6.4	2.0	20

**Measure the 60° entrance angle at 90° orientation only.*

830.03 FIELD PERFORMANCE. The using agency is responsible for requiring the dating of all signs at the time of application. The Department will begin the field performance obligation period based on that date.

The Department will consider the retroreflective sheeting defective if it has deteriorated due to natural causes to the extent that the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions or when the sign does not conform to the following tables:

MINIMUM COEFFICIENT OF RETROREFLECTIVE R[1] **TEN YEAR PERFORMANCE** (Candelas per lux per meter squared) (0.2° Observation and -4° Entrance Angle)	
Color	Type III
White	200
Yellow	136
Red	36
Green	36
Blue	16
Brown	8

MINIMUM COEFFICIENT OF RETROREFLECTIVE R[1] SEVEN YEAR PERFORMANCE (Candelas per lux per meter squared) (0.2° Observation and -4° Entrance Angle)		
Color	Type III	WAP
White	212	400
Yellow	144	330
Red	38	107
Green	38	40
Blue	17	22
Brown	10	—

MINIMUM COEFFICIENT OF RETROREFLECTIVE R[1] THREE YEAR PERFORMANCE (Candelas per lux per meter squared) (0.2° Observation and -4° Entrance Angle)		
Color	Type III	WAP
Fluorescent Orange	—	100
Orange	96	—

For screen printed transparent colored areas on white sheeting, ensure that the coefficients of retroreflection are not less than 50 percent for Type III and 70 percent for WAP of the values for the corresponding color in the above tables.

Make all measurements after cleaning the sign according to the manufacturer's recommendations.

830.04 WARRANTY. When the Engineer determines that the retroreflective traffic control devices supplied and used according to the manufacturer's recommendations have not met field performance requirements, the manufacturer shall cover restoration costs as follows for Type III and WAP sheeting:

1) White, Yellow, Red, Green, Blue, and Brown. Within the first 7 years after application, replace the sheeting and cover the cost of materials and labor required to restore the sign surface to its original effectiveness. Within the 8th through 10th year after application, replace the sheeting required to restore the sign surface to its original effectiveness.
2) Orange and Fluorescent Orange. Within 3 years after application, replace the sheeting required to restore the sign to its original effectiveness.

830.05 PACKAGING. Ensure that all materials are suitably and substantially packaged and have the name and address of the manufacturer or vendor, contract or purchase order number, kind of material, trade name, date of manufacture, lot and run number, color, and net contents plainly marked on each package or container. Ensure that if stored under normal conditions, the retroreflective material as furnished is suitable for use for a minimum period of one year.

830.06 SAMPLING. For the purpose of sampling, a shipment consists of the amount of material received in one delivery even though it may represent only partial delivery of the Contract quantities. The Department will sample according to the Manual for Field Sampling and Testing.

830.07 TESTING AND ACCEPTANCE. Furnish copies of actual passing test reports for retroreflective sheeting. Provide certifications from the sign supplier that the material furnished is the same represented by the test reports.

Use only retroreflective sign sheeting, barricade sheeting, traffic drum channelizing tape, and cone collars that have approved list status.

SECTION 831 — CONSTRUCTION ZONE TEMPORARY MARKING TAPES

831.01 DESCRIPTION. This section covers pavement marking material designed to provide reflective delineation in construction zones. This section covers the following types of marking material:

A) Type A. Non-removable Pavement Marking Tape.
B) Type B. Removable Pavement Marking Tape.

831.02 REQUIREMENTS.

831.02.01 Manufacture. Use a material consisting of a weather and traffic-resistant reflective film on a backing precoated with a pressure-sensitive adhesive.

831.02.02 Adhesive. Use a precoated pressure-sensitive adhesive that does not require a liner or activation.

831.02.03 Application Properties. Ensure that the material adheres to asphalt and concrete surfaces, when applied according to the manufacturer's recommendations, at or above surface temperatures of 40 °F. Ensure that the material does not require any protective devices such as traffic cones or barricades after application.

831.02.04 Conformability and Thickness. Use material that is thin, flexible, formable, and remains conformed to the texture of the pavement surface following application. Ensure that the thickness of the material furnished is within 2 mils of the thickness of the material submitted for initial testing for placement on the Department's List of Approved Materials. Use tape with a minimum width of 4 inches.

831.02.05 Miscellaneous Requirements. Ensure that the supplied material is of good appearance, free from cracks, with edges true, straight, and unbroken. Make the material available in rolls with no more than 3 splices per 50 yards of length. Package the material according to accepted commercial standards. Ensure that the supplied material is capable of being stored at temperatures up to 100 °F for a period of one year after purchase without adversely affecting the physical properties stated in this section.

831.02.06 Performance. The AASHTO Regional Test Facility and the National Transportation Product Evaluation Program will perform field performance testing. They will perform testing at approximately one year intervals, and will require a 6 month minimum testing period. Procedures will be according to the AASHTO Regional Test Facility and the National Transportation Product Evaluation Program. They will evaluate all tapes on both asphalt and PCC pavement. The performance criteria is included in the Department's List of Approved Materials.

831.03 APPROVAL. Use materials that are on the Department's List of Approved Materials. To be placed on the approved list, tapes must conform to all requirements of this section. Ensure that each shipment of tape to a project is accompanied by a statement from the manufacturer indicating the brand or trade name of the tape. The Department reserves the right to sample and test materials actually furnished at any time.

The Department will remove materials from the list if the material fails to be acceptable in subsequent field performance testing or the material's composition has changed since the original approval.

SECTION 832 ¾ SIGN POSTS

832.01 GENERAL. Furnish Type I and II posts. Type I posts are square tubular posts. Type II posts are channels. Provide all posts in lengths as specified in one foot increments with a tolerance of ± 1 inch. The Department may require anchor plates for either type.

Ensure that posts are straight, smooth, and free from any defects affecting their strength, durability, or appearance. Ensure that all holes and ends are free from burrs and sharp edges and that ends are cut square.

832.02 TYPE I POSTS. Use hot rolled carbon sheet steel of structural quality that conforms to ASTM A 570, Grade 50. Yield strength after cold-forming is 60,000 psi minimum.

832.02.01 Fabrication. Fabricate the post from square tube formed of steel, rolled to size and welded directly in the corner by high frequency resistance welding and externally scarfed to agree with corner radii. Provide the following sizes:

Outside Dimensions (in.)	**Corner Radii** (in.)	**Thickness** (in.)	**Weight** (lb/ft)
1 3/4 by 1 3/4	5/32	0.08	1.7
2 by 2	5/32	0.08	2.0

Provide 7/16-inch diameter holes on the centerline of all 4 sides, space on one-inch centers along the entire post length beginning 1 inch from the top. Ensure holes are in true alignment and opposite each other directly and diagonally.

Ensure consecutive sizes of square tubes will freely telescope for 10 feet or more of their length without the necessity of matching any particular face to any other face.

832.02.02 Finish. Conform to ASTM A 653, G90, Structural Quality, Grade 340, Class 1. Galvanize both the interior and the exterior of the post. Coat the corner weld with zinc after the scarfing operation. Coat the steel with a chromate conversion coating and a clear organic polymer topcoat.

832.02.03 Tolerances. The Department may reject material falling outside any of the following tolerances:

A) Outside Dimensions. ± 0.008 inch. Measure at least 2 inches from the end of the tube.
B) Wall Thickness. ± 0.008 inch.
C) Holes. ± 0.016 inches in diameter.
D) Convexity and Concavity. Ensure that no sides exceed ± 0.1 inch. Measure in the center of the flat side relative to the corner.
E) Square (1 3/4-inch posts). Ensure sides are 90 degrees to each other within ± 0.01inch.
F) Square (2-inch posts). Ensure sides are 90 degrees to each other within ± 0.012 inch.
G) Twist. Ensure twist does not exceed 0.02 inch in any one-foot length.
H) Straight. Ensure deviation does not exceed 0.02 inch in any one-foot length.
I) Corner Radii. 5/32 ± 0.016 inch.

832.03 TYPE II. Use hot wrought steel conforming to the physical properties of ASTM A 499-89, Grade 60, and conforming to the chemical requirements of ASTM A 1 for rails of nominal weight between 28.4 and 38 pounds per foot.

The Contractor may request to furnish posts made of material not complying with the specified properties. If desired, submit the written request for approval and

include a description of the physical and chemical properties of the proposed material. Include with the request a certified test report of a dynamic test by an independent laboratory substantiating that the posts, when double mounted in an 8-foot span, conform to the break-away requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

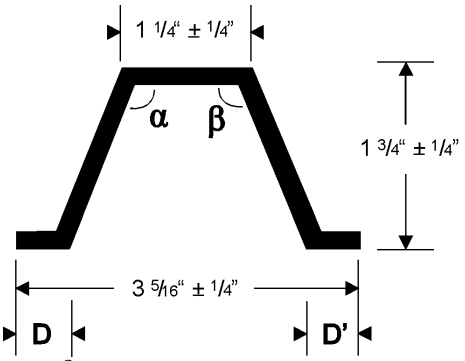
Provide a manufacturer's certification that the material was manufactured and tested according to the applicable specifications or approved alternate along with a report of the physical and chemical test results for each shipment.

832.03.01 Fabrication. Fabricate posts from uniform, modified, flanged channel sections.

Provide 3/8-inch diameter holes on the centerline, space on one-inch centers along the entire post length beginning one inch from the top. Align holes horizontally and vertically to accommodate back to back post installations.

Ensure that the area of contact between the posts and sign is symmetrical about the vertical axes of both sign and post and that the back side furnishes a solid bearing surface the entire length of the post for back to back installation.

Conform to the following typical section:



$\alpha = \beta \pm 4°$ D = D' ± 1/8 inch

832.03.02 Deflection. Test for deflection as simple beams, with the flanges in compression, on non-restricting supports 2 feet apart. Apply a load of 3,500 pounds at the center of the span at a deflection rate not to exceed 0.3 inch per minute. Transmit the load to the beam through a one-inch minimum diameter pin laid across the flanges. With the designated load applied, ensure that the deflection at the center does not exceed 0.18 inch. One minute after removal of the load, ensure that the deflection does not exceed 0.018 inch.

832.03.03 Finish. Galvanize according to AASHTO M 111 after fabrication.

832.04 PACKAGING. Securely fasten posts of the same type and length in bundles of 2,000 pounds or less in a manner that is easily handled by a fork lift and that prevents slipping during handling and shipping. The Engineer will reject posts whose finish is excessively damaged due to slipping, rubbing, or other reasons.

SECTION 833 ¾ SIGN SUBSTRATES

833.01 ALUMINUM.

833.01.01 Panel Signs. Conform to ASTM B 221, Alloy 6063-T6. Fabricate signs from 12-inch wide extrusions and, if specified, compatible 6-inch wide extrusions. When a 6-inch extrusion is specified, use it as the bottom panel of the sign. Typical cross sections and minimum weights per foot are specified in the Plans. Use compatible side extrusions on all sign edges. Prepare surfaces of extrusions composing the sign face to receive retroreflective background material according to the extrusion and retroreflective material manufacturers' recommendations. Provide all remaining surfaces of extrusions and side extrusions with a soft matte finish.

833.01.02 Sheeting Signs. Conform to ASTM B 209, Alloy 6061-T6 or 5052-H38. Fabricate signs of the size and shape specified. Provide a thickness of 125 mils inch if any single edge dimension of the sign exceeds 3 feet. If no single edge dimension exceeds 3 feet, provide a thickness of 80 mils. Prepare the side of the sheet to be used as the sign face to receive retroreflective background material according to the sheeting and retroreflective material manufacturer's recommendations.

SECTION 834 ¾ ROADWAY LIGHTING MATERIALS

834.01 WIRING. For all multiple circuit roadway lighting wires use single-conductor AWG copper of sizes specified in the Plans. Use No. 12 AWG copper wire as leads from pole bases or junction boxes to ballast terminals. Use stranded wire, except for ground wires. Ensure that all insulation for No. 8 or larger wire is Type USE (UL rated). Insulation for No. 10 or smaller wire shall be Type THW or THWN. Plainly mark all wire and cable according to the NEC. Use copper grounding conductors sized as specified by the NEC. Install copper service entrance conductors on the service poles sized and insulated as specified by the NEC.

834.02 DUCTED CABLE.

A) Cable. Use stranded annealed copper cable conforming to ASTM B 8 and ASTM B 33 for operation at 600 volts maximum. Use material that conforms to either the applicable requirements of ICEA Standard S-19-81, with thermoplastic insulation of GRS-rubber base conforming to Appendix K(A) of ICEA and listed by UL as Type USE for direct burial; or the application requirements of ICEA Standard S-66-524, with thermo-setting insulation of cross link polyethylene conforming to the requirement of Column "A" of ICEA and listed by UL as Type USE. Use cable that is preinstalled in the duct.

B) Duct. Use polyethylene duct with a minimum tensile strength of 3,100 psi for secondary cable underground. Provide for 40 percent maximum fill. Conform to ASTM D 3485.

834.03 CONDUIT. Except in load bearing areas, use UL rated, schedule 40, PVC conduit. In load bearing areas, use rigid steel conduit that is galvanized inside and out. For underground installation, use conduit of 1 1/4-inch or larger nominal diameter, except use 3/4-inch PVC conduit in the pole bases.

834.04 FUSED CABLE CONNECTOR KIT. Connect lighting fixtures to the feed circuits with fused cable connector kits. Place each kit in a transformer base, junction box, handhole, or other place as specified in the Contract. Ensure that the fused connector kit can be repeatedly disconnected without damage to the watertight seals and terminals or without reducing the conductivity below specifications. Provide a fused connector kit designed to break away without damage.

Use a fused connector kit that completely encloses and protects the fuse against damage from water and weather. Use a spring loaded contact between the fuse and fuseholder. Ensure that the springs are not a part of the current carrying circuit. Ensure that line and load side terminals of the fused connector kit positively connect to the conductors. Insulate and waterproof the terminals according to the manufacturer's recommendation. Construct the load side housing to retain the fuse when disconnected, and permanently mark it "LOAD" or "LOAD SIDE".

Use high interrupting capacity type fuses with a rating of 6 amperes. Use 13/32 by 1 1/2-inch fuses that are rated for 600 volts. Use fuses that protect circuits having a fault current capacity of up to 100,000 amperes AC. Use fuses tested to carry 110 percent of their rated capacity and that open at 135 percent in one hour or less.

834.05 LIGHTING STANDARDS. For the design of and materials for all lighting standards, conform to the AASHTO Standard Specifications for Highway Signs, Luminaires, and Traffic Signals, except as follows. For breakaway signs, and luminaire supports, conform to the breakaway requirements in the AASHTO Standard Specifications for Highway Signs, Luminaires, and Traffic Signals, 1985 edition as amended by the "1988 Interim Revisions", with the modification that the maximum allowable change in velocity is 16 feet per second. Provide lighting standards that consist of a tapered pole having a base affixed to the lower end, a bracket arm (if required), and a transformer base. Furnish an opening near the top of the pole to provide for a cable entrance from the pole to the bracket arm to provide a smooth cable

guide for wiring. Equip the top of the pole with a removable cap. Secure a one-piece anchor base to the lower end of the pole. Provide this base with 4 slotted holes to receive the anchor bolts and 4 tapped holes for securing the bolt covers. Provide 4 removable bolt covers with each base.

Use single member bracket arms for 4 and 6-foot mast arm assemblies. Use single or double member bracket arms for 8-foot mast arm assemblies. Use double pipe assemblies for 10, 12, and 15-foot mast arm assemblies. Double pipe assemblies consist of upper and lower members securely joined by means of vertical struts. Provide the pole end of the bracket arm with a cast or plate footing or clamp for positioning the assembly on the pole.

Galvanize the steel structures after fabrication.

Ensure that the pole manufacturer provides permanent marking on the pole base or other suitable location, giving the pole design number and other identification data so the poles may be compared with material brochures or drawings.

Provide each pole with a suitable handhole to allow access to the pole for maintenance of wiring inside the pole.

834.06 ANCHOR BOLTS. Fabricate anchor bolts from steel having a minimum yield strength of 50,000 psi. Provide L-shaped anchor bolts with a minimum length of one meter, a minimum diameter of one inch, and the horizontal leg at least 4 inches long. The manufacturer shall specify the correct dimensions; but in no case shall they be less than the dimensions specified above. Provide at least 6 inches of threads and 8 inches of galvanizing at the top of the vertical leg. Provide each anchor bolt with 2 galvanized hex nuts. Submit mill test reports on anchor bolts. Protect anchor bolt threads from damage during shipping.

834.07 TRANSFORMER BASES. Conform to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Ensure that each base has the following minimum outside dimensions: 17 inches high, 15 by 15-inch square bottom and 12 by 12-inch square top. Ensure that bases have a trapezoidal door with the following minimum dimensions: 11 inches high, 9 inches across the bottom, and 7.5 inches across the top. Construct the door of a high density polyethylene material in a color that matches the base. Provide each base with 4 loose bearing plates (anchor washers) and nuts to fasten the base to the anchor bolts. Fasten each transformer base to the base flange of the pole with 4 loose galvanized bearing plates and 4 galvanized steel connecting bolts and nuts. Use connecting bolts of the same diameter and strength as the anchor bolts. Submit mill test reports on the connecting bolts. The manufacturer shall specify the bolt circle and physical dimensions of the base bottom to ensure a proper foundation fit. Provide each transformer base with a 1/2-inch 13 UNC tapped hole or other suitable provisions for grounding purposes.

834.08 MARKERS FOR BURIED CONDUIT. Use 36 by 4 by 4-inch concrete posts reinforced with 4 No. 3 deformed steel bars. The Department will allow the use of standard rural right-of-way markers in lieu of conduit markers.

834.09 CONCRETE. Conform to Subsection 601.02 and 601.03. Use Class A concrete.

834.10 PAINTS. Use commercially available rust inhibiting primer for the prime coat. Use aluminum paint conforming to AASHTO M 69, or equal, for the intermediate and finish coats.

834.11 BALLASTS. Provide only high-pressure sodium luminaire ballasts that operate in a single circuit of the specified voltage ± 10 percent.

834.12 LUMINAIRES. Provide IES distribution as specified in the Contract; 2-inch slip-fitter mounting; and constant wattage type transformers.

Type A - 100 watt high-pressure sodium horizontal roadway luminaires

Type B - 150 watt high-pressure sodium horizontal roadway luminaires
Type C - 250 watt high-pressure sodium horizontal roadway luminaires
Type D - 400 watt high-pressure sodium horizontal roadway luminaires

Use luminaires that provide light levels conforming to AASHTO's An Informational Guide for Roadway Lighting. When submitting brochures for suggested luminaires, include iso lux curves, IES type distribution, lamp lumens, and typical ballast factor used for each type of luminaire. Submit the photometric data in IES format on an IBM compatible 3 1/2-inch floppy disk to the Central Office, Division of Traffic. Include with the submittal a point of contact and phone number to answer technical questions about the luminaire.

834.13 LAMPS. Provide only high-pressure sodium lamps with the following minimum initial light output:

Type A - 9 500 lm
Type B - 16 000 lm
Type C - 25 000 lm
Type D - 50 000 lm

834.14 MAGNETIC CONTACTORS AND CONTROL TRANSFORMERS. Provide only magnetic contactors that are 2 pole, sized as specified in the Contract, and have a 120 volt coil. Protect each contactor coil by a 15 amp fuse. Equip contactors with control switches for both automatic and manual actuation. Provide photoelectric switches for automatic actuation. Use photoelectric controls that are solid state cadmium sulfide type designed for use in 120 volts 60 Hz circuits and rated for 1,000 watts resistive load. Use photoelectric controls with built-in surge protection and designed to provide an output circuit closure when photoelectric control components fail. Provide photoelectric controls and mounting bases that are twist-lock type. Provide 2 pole, double throw switches that manually actuate. Ensure that each switch has minimum rating of 125 volts, 15 amperes.

Use control transformers that are 1 KVA, single phase, 240/480 volt primary, 120/240 volt secondary, dry type, 60 Hz, with primary winding isolated from secondary winding. Use transformers that are capable of indoor or outdoor installation and have a maximum temperature rise of 99 °F at 104 °F ambient temperature.

834.15 DISTRIBUTION TRANSFORMERS. Equip all distribution transformers with 2, 2.5 percent taps above and below rated primary voltage. Provide transformers that are protected by a primary lightning arrester with an indicating fuse cutout of the voltage and amperage as specified in the Plans.

834.16 SECONDARY LIGHTNING ARRESTERS. Provide only secondary lightning arresters designed for use with the specified voltage and rated at 0-650 volts RMS.

834.17 WEATHERPROOF ENCLOSURES. Fabricate enclosures from 125-mil or thicker natural finished aluminum. Provide enclosures with a No. 2 Corbin lock and keys. Install a 120 VAC GFI duplex receptacle in the enclosure with a separate 20 amp breaker.

834.18 GROUND RODS. Provide only composite shaft ground rods consisting of a pure copper exterior that has been inseparably molten welded to a steel core. Use rods with a minimum diameter of 1/2 inch and a minimum length of 8 feet. Equip the rods with copper or bronze clamps.

834.19 WOOD POLES. Use Class 4 poles, of the length specified in the Contract, conforming to Subsection 820.

SECTION 835 ¾ TRAFFIC CONTROL DEVICES

835.01 DESCRIPTION. This section defines minimum acceptable design and operational standards for traffic control devices used in the Commonwealth.

835.02 TIME CLOCKS. Use time clocks that are solid state, microprocessor based units with one to 4 relay outputs rated at 10 amps, 115 VAC resistive load. Connect all relay contacts and clock power through a 16 pin circular plastic connector (Amp #520258-3 or approved equal). Pin designations are as follows:

Pin No.	Function	Pin No.	Function
1	Line	9	#4 Com
2	Neutral	10	#1 N.O.
3	Ground	11	#3 Com
4	#1 Com	12	#3 N.C
5	#1 N.C	13	#3 N.O.
6	#2 Com	14	#4 N.C.
7	#2 N.O.	15	#4 N.O.
8	No Con.	16	#2 N.C.

Operate clocks with a supply voltage from 95 to 135 VAC, 60 Hz at temperatures from -29 to + 165 °F.

Supply backup power for the clock with a battery or capacitor. Ensure that backup power maintains time keeping and program steps for at least 48 hours.

Enter all programming through the keyboard. Ensure that programming features include at least 32 program steps. Ensure that each step shall program a single relay output by hour and minute and allow a single day of week, Monday through Friday or Saturday and Sunday to be set. Provide clocks that have automatic daylight savings time adjustment as default with a daylight savings time override option controlled from the keyboard. Provide clocks that have manual override capability for each relay. Provide clocks that have a self test function which exercises relay outputs. Ensure that units are enclosed in a durable case that can mount on a vertical surface. Supply each unit with a female mating harness with 3-foot wires. Wire the harnesses for the number of relays used in the clock. Label each wire one foot from the plug with permanent non-fading wire labels indicating the wire function.

835.03 PEDESTRIAN PUSHBUTTON DETECTORS. Provide a pedestrian detector that consists of a single plunger push button control switch with a 2 1/4-inch (minimum) chrome plated mushroom shaped plunger. Provide a 5-A (minimum), 110 VAC switch with 2 circuit (NO/NO) slow make contacts. Ensure that pushing of the button closes both NO circuits. Use a switch body that is die cast and painted with a black wrinkle finish paint. Include a neoprene gasket for sealing the switch body to the enclosure.

835.04 EQUIPMENT TESTING. The Department requires that each purchased individual cabinet, controller, conflict monitor, modem, and loop amplifier is environmentally tested. At a minimum, test each unit purchased according to "Traffic Signal Control Equipment Specifications" by the California Department of Transportation. The manufacturer is free to suggest additional tests or variations in the above procedures that may be part of an existing quality control program.

A representative of the Department may travel to the testing site to verify that the environmental testing is being carried out properly and to observe manufacturing practices used at the factory. The manufacturer shall submit a proposed testing procedure and schedule 30 calendar days in advance for evaluation by the Department. Ensure that the test procedures, environmental chambers, automatic test equipment, display boards, power supplies, and controls are described in detail.

Resolve any problems in the testing procedure before the representative arrives.

Test cabinets at ambient room temperature. Use an automatic or semi-automatic method for checking cabinet wiring between equipment harnesses.

835.05 SIGNALS AND BEACONS.

835.05.01 Fittings and Mounting. Supply all traffic control signals, beacons, and lane control signals, unless otherwise specified, with necessary fitting including wire entrance fittings and swivel type balance adjuster for span wire mounting. Design wire entrance fitting to prevent entrance of water when using normal drip loops. Galvanize or cadmium plate span wire clamps and bolts.

Ensure that the total loose play rotational tolerance between span wire clamp and wire entrance fitting, with swivel adjuster assembled, is not more than 3 degrees.

Use mounting arms and brackets made of 1 1/2-inch standard metal IPS pipe. The Department will allow cast or fabricated bottom brackets.

Ensure that signals are adjustable, and arrange them so that each face may be rotated to and positively locked within not more than 5 degrees of any position in the horizontal plane. Use a separate locking ring mating with serrations cast or molded into the signal housing. Do not use serrations cast into the wire outlet body. Use a locking ring designed with a minimum of 2 pins or tabs to mate with corresponding holes or notches in the wire outlet body. Use locking rings that are machined to provide sharp, well formed serrations that exactly match the serrations in the signal housing.

835.05.02 Housings. Provide metal housings cast from a non-ferrous, non-corrosive aluminum alloy. Use parts that are fitted with rubber or neoprene type gaskets to provide weather tight seals. Use housing sections of the same type and make of manufacturer that are interchangeable. Reinforce tops and bottoms to which supporting attachments are fastened to prevent breakage from vibration and shock.

Use polycarbonate signals that are the same in appearance as cast aluminum signals, except mold the housings, doors, and visors from polycarbonate resin to withstand a 70 foot-pound impact without fractures or permanent deformation. Ensure that the color is homogeneous throughout.

Use doors of the same material as the housing. Ensure that doors are suitably hinged and held securely to the housing by simple locking devices, which do not require tools of any kind for opening. Use stainless steel hinge pins, lens clips, etc.

835.05.03 Optical Units. Each optical unit is a complete assembly of lamp receptacle, reflector, cover glass or lens, and door with all necessary supporting parts and with a single signal indication. Conform in all respects, except as further restricted by this section, to the standards of the Institute of Traffic Engineers (ITE).

Provide incandescent illuminated optical units that contain a heat resistant lamp receptacle positioned to provide a light center at the focal point of the reflector. Use reflectors that are "ALZAK" process coated aluminum or other approved equal. Use a 650-watt standard traffic signal lamp in an 8-inch traffic signal, 9-inch pedestrian signal, or 12-inch one-section pedestrian signal. Use a 1 950-lumen standard traffic signal lamp in a 12-inch traffic signal, lane control signal, or 12-inch pedestrian signal.

Construct and mount optical units to provide easy access for all maintenance and repairs including wiring within the signal housing. Design optical units so that the use of tools of any kind are not required for replacing signal lamps.

Wire and connect each lamp receptacle to a suitable terminal block within the signal housing with minimum No. 18 AWG, 194 °F, 600 volt, color-coded, stranded fixture wire. Do not use braided wire. Locate the terminal block in the second section from the top in multi-section faces.

Use glass lenses. Ensure that lenses of the same nominal diameter are interchangeable regardless of manufacturer.

Each signal face contains one or more complete optical units in suitable housings for control in one direction only and is designated as one-section, 2-section, 3-section, etc.

835.05.04 Signal Heads. Each signal head contains one or more signal faces and is designated as one-way, 2-way, 3-way, etc.

One-section signals are standard flashing beacons. For one-way and two-way flashing beacons, supply signal heads with amber or red lenses as specified in the Contract. Mount signals with 2 or more sections vertically with indications positioned according to the MUTCD.

Fit each optical unit with a visor or hood. Provide combination or tunnel type visors that enclose at least 80 percent of the lens circumference for amber lenses. Supply standard visors that enclose at least 50 percent of the lens circumference for all red or green lenses. Supply visor lengths that are approximately the same as the lens diameter and designed to minimize sun phantom. Attach hoods with screws. Do not use snap in hoods.

Ensure that 8-inch signals display circular indications of not less than 7 3/4 inches in diameter. Ensure that 12-inch signals display circular indications of not less than 11 1/2 inches in diameter.

Ensure that signal sections of both 12-inch and 8-inch signals of the same make or manufacture are interchangeable to provide for optional combinations of lens sizes. Use tops and bottoms of signals that have circular openings for 1 1/2-inch IPS rigid pipe, and use replaceable tops and bottoms that are interchangeable. Close all unused openings with removable plugs and caps.

Use signal heads that are assembled and wired. Supply visors, brackets, backplates, hangers, etc. that are packaged and shipped within the same carton as the signal head for which they are being supplied, with or without them attached to the signal.

835.05.05 Pedestrian Signals. Use pedestrian signals that consist of a one-piece die cast aluminum housing. Use a housing that has 1 1/2-inch holes in top and bottom for post top or bracket mounting. These indications consist of the illuminated symbols of a walking person (symbolizing WALK) and an upraised hand (symbolizing DON'T WALK).

Use signal heads that are assembled and wired. Supply brackets, arms, wire entrance fittings, and all other necessary hardware that are packaged and shipped within the same carton as the signal head for which they are being supplied with and without them attached to the signal.

835.05.06 Painting. Paint all signals and beacons (except black polycarbonate), arms and braces, brackets, trunions, wire entrance fittings, sign housings, etc. black with 2 coats of high grade exterior gloss enamel. Paint the inside of all hoods and visors dull black to minimize glare reflections.

Prepare, degrease, and prime all painted surfaces before painting to prevent chipping and peeling.

Ensure that all miscellaneous hardware is corrosion resistant, or galvanize or plate it after any drilling, threading, or welding.

835.06 TRAFFIC LOOP ENCAPSULANT. Provide compressive yield strength adequate to withstand heavy vehicular traffic as well as flexibility to withstand normal movement in asphalt and concrete pavements. Upon testing, if any physical property, although not specifically described herein, renders the product unsuitable, the Engineer may reject the product.

Use an encapsulant that is a one-part polyurethane material of a composition that, within its stated shelf life, cures only in the presence of moisture. Use a sealant suitable for use in both asphalt and concrete. Use a non-shrinking and non-stringing encapsulant that provides a void-free encapsulation for detector loop wires.

Ensure that the cured encapsulant has the following properties:

Hardness (Indentation)	25 - 40	(Shore A)
Minimum Tensile Strength	150 psi	ASTM D 412
Minimum Elongation	125%	ASTM D 412 2-inch/minute pull

Ensure that the cured sealant has the following chemical reactions:
(7-day cure at room temperature, 24-hour immersion)

Deicing Chemical	No Effect
Gasoline	Slight Swell
Hydraulic Brake Fluid	No Effect
Motor Oil	No Effect
Calcium Chloride (5%)	No Effect

Ensure that the wet sealant has the following properties:

Weight	10 ± 1.0 pounds per gallon
Viscosity	20,000-50,000 CPS
Drying Time	Touch - 24 hours
	Complete - 30 hours

Use one-quart tubes of loop sealant that are suitable for use with a standard caulking gun. Provide each tube with a plastic nozzle to facilitate placing of the material in the pavement slot.

835.07 WARRANTIES. Warranty equipment for a period of 6 months, or provide the manufacturer's standard warranty, whichever is greater.

835.08 DOCUMENTATION. With each unit purchased under this section include one documentation package consisting of:

1) A complete instruction manual.
2) A complete step by step explanation of circuit theory and operation.
3) A complete schematic.
4) A complete parts layout. Parts identification may be silk-screened directly on circuit board.
5) All point to point voltages and wave forms pertinent to proper servicing. This information may be included on the schematic diagram.
6) Complete installation procedures for the unit.
7) A complete parts list with full information as to availability of any custom or nonstandard parts.
8) All applicable warranties and guarantees.

SECTION 836 ¾ DURABLE PREFORMED PAVEMENT MARKINGS TYPE I TAPE

836.01 TYPE I TAPE. Use preformed pavement marking material consisting of white or yellow films with glass beads incorporated to provide immediate and continuing retroreflection.

Use preformed pavement marking material capable of adhering to new dense and open graded asphalt surfaces, during the paving operation, or portland cement concrete by a pre-coated pressure sensitive adhesive. The Engineer may require a primer to precondition the pavement surface. Ensure that the markings conform to pavement contours by the action of traffic. Ensure that, after application, the markings are immediately ready for traffic.

Ensure that these markings provide long term reflectivity, as determined in the following performance requirements, when applied according to the manufacturer's instructions.

Ensure that the preformed markings are suitable for use one year after the date of receipt when stored according to the manufacturer's recommendations.

A) Composition. Use retroreflective preformed pavement markings consisting of a mixture of high quality polymeric materials, pigments, and glass beads distributed throughout its base cross sectional area.

B) Reflectance. Ensure that the white and yellow markings have the following initial minimum reflectance values as measured according to the testing procedures of ASTM D 4061. Measure the specific luminance (SL), and express it as millicandelas per lux per square meter. Use a test distance of 30 meters and a sample size of a 24 by 30-inch rectangle.

INITIAL REFLECTANCE			
Color	Entrance Angle	Observation Angle	Specific Luminance
White	86.5º	1.0º	700 minimum
White	86.0º	0.2º	1,100 minimum
Yellow	86.5º	1.0º	500 minimum
Yellow	86.0º	0.2º	800 minimum

C) Skid Resistance. Ensure that the surface of the retroreflective material provides an initial minimum skid resistance value of 45 BPN when tested according to ASTM E 303.

D) Patchability. Ensure that the pavement marking material is capable of use for patching worn areas of the same type according to the manufacturer's recommendations.

E) Material Warranty. For a period of 48 months from the date of installation, regardless of ADT and under normal traffic conditions, the manufacturer will provide replacement material for any material used as longitudinal markings that (1) fails to retain the minimum reflectivity values (minimum replacement zone is 300 feet of roadway length), or (2) fails due to loss of adhesion or complete wear through.

The Department will take measurements according to KM 201. The minimum reflectivity requirements, as measured with a LTL2000 retroreflectometer or mobile 30M geometry device, are as follows:

White: 200 mcd/lux/square meter
Yellow: 150 mcd/lux/square meter

F) Testing and Acceptance. Furnish the manufacturer's typical test analysis for the

durable preformed pavement markings and the manufacturer's certification stating that the material conforms to this section.

The Engineer will submit the above documentation, accompanied by a Sample Identification Form to the District Materials Engineer. The Department will base acceptance on a review of the test data, a certification statement, and initial field evaluation.

SECTION 837 ¾ EXTRUDED THERMOPLASTIC PAVEMENT MARKING MATERIALS

837.01 PRE-MIX BEADS. Use uncoated Type 1 beads conforming to AASHTO M 247.

837.02 DROP ON BEADS. Conform to Section 839. If any shipment consists of 10,000 pounds or less, randomly select 2 one quart samples to represent the shipment. Ensure that a signed statement of certification accompanies each sample and includes the following information:

1) A statement that the beads conform to Section 839.
2) The quantity of beads represented in the lot or batch.
3) The destination of the shipment.

837.03 THERMOPLASTIC MATERIAL. Use a maleic-modified glycerol ester resin (alkyd binder) to formulate the thermoplastic material. Use material that, when heated, does not exude fumes that are toxic or injurious to persons or property.

837.03.01 Composition. Ensure that the pigment, beads, and filler are uniformly dispersed in the resin. Use material that is free from all skins, dirt, and foreign objects, and conforms to following table.

COMPOSITION (Percentage by Weight)		
Component	White	Yellow
Binder, [(1)]	18.0 min.	18.0 min.
Glass Beads (Premixed)	30 - 40	30 - 40
Titanium Dioxide	10.0 min.	—
Calcium Carbonate & Inert Fillers [(2)]	42.0 max.	50.0 max.
Lead Chromate	0.0 max.	4.0 min.

[(1)]*Use a binder that consists of a mixture of synthetic resins, at least one being solid at room temperature, and high boiling point plasticizers. Ensure that at least one-third of the binder composition is solid maleic-modified glycerol ester resin and is not less than 8 percent by weight of the entire material formulation. Do not use alkyd binder that contains petroleum based hydrocarbon resins.*

[(2)]*The manufacturer may choose the amount of calcium carbonate and inert fillers, providing all other requirements of this section are met.*

837.03.02 Physical Characteristics.

A) Specific Gravity. Do not exceed 2.3.

B) Color. For thermoplastic material heated for 4 hours at 425 °F under agitation, conform to the following luminosity and color requirements:

1) Luminosity. - Daylight reflectance at 45 degrees entrance angle, 0 degrees observation angle.

White - 75 percent minimum.
Yellow - 45 percent minimum.

2) Color - Conform to the FHWA color standard 595B-38907 for yellow and 595B-37925 for white.

C) Set Time. Use material that, when applied at a temperature range of 415 ± 15 ºF and thickness of 40 to 120 mils, sets to bear traffic in not more than 2

minutes when the air and road surface temperature is approximately ≥ 50 ± 3 ºF, and not more than 10 minutes when the air and road surface temperature is approximately < 50 ± 3 ºF.

D) Bond Strength. After heating the thermoplastic material for 4 hours at 425 ºF, ensure that the bond strength to concrete exceeds 180 psi, according to ASTM D 4796.

E) Cracking Resistance at Low Temperature. After heating the thermoplastic material for 4 hours at 425 ºF, applying it to concrete blocks, and cooling it 46 ºF, ensure that the material shows no cracks when observed from a distance exceeding one foot.

F) Impact Resistance. After heating the thermoplastic material for 4 hours at 425 ºF and forming test specimens, ensure that the impact resistance is a minimum of 1.13 joules.

G) Softening Point. After heating the thermoplastic material for 4 hours at 425 ºF and testing according to ASTM D 36, ensure that the materials have a softening point of 215 ± 15 ºF.

H) Flowability. After heating the thermoplastic material for 4 hours at 425 ºF and testing for flowability, ensure that the white thermoplastic has a maximum residue of 18 percent and the yellow thermoplastic has a maximum residue of 21 percent.

I) Yellowness Index. Use white thermoplastic material that does not exceed a yellowness index of 0.15.

J) Flowability (Extended Heating). After heating and stirring the thermoplastic material for 8.5 hours at 425 °F and testing for flowability, ensure that the thermoplastic has a maximum residue of 28 percent.

K) Flash Point. Use thermoplastic material that has a flash point not less than 475 °F when tested according to ASTM D 92.

L) Storage Life. Ensure that the material conforms to this section for a period of one year. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for this one year period. The manufacturer shall replace any material not conforming to the above requirements.

837.03.03 Certification, Testing and Approval.

A) Sampling. The manufacturer shall perform tests on a minimum of one composite sample per lot of thermoplastic produced. Provide a composite sample composed of equal portions of randomly selected samples taken from each 10,000 pounds during the lot's production. Use a lot size of approximately 44,000 pounds unless the total order is less than this amount. Ensure that the one quart composite sample is collected by an independent laboratory approved by the Division of Materials.

B) Testing. The manufacturer shall perform the following tests on the thermoplastic pavement marking material: Color, Reflectance and Yellowness Index, Bond Strength (Yellow and White), Low Temperature Stress Resistance, Impact Resistance, Softening Point, Flowability, Flowability (Extended Heating), Drying Time and Specific Gravity.

C) Submission. Before shipment of the thermoplastic material, the manufacturer shall submit to the Division of Materials a 1/2-gallon composite sample of the thermoplastic material, a copy of the manufacturer's test results, a listing of the theoretical composition of the thermoplastic material (see Composition table in Subsection 837.03.01) and a signed statement of certification that includes the following information:

1) A statement that the thermoplastic material complies with all requirements of this section.
2) The quantity of material represented in the lot or batch.
3) The destination of the shipment.

D) Verification. The Department reserves the right to verify the manufacturer's

test results by conducting any or all of the tests listed above. The Division of Materials or an approved independent laboratory will perform this testing at the Department's expense and according to AASHTO T 250 and Kentucky Standard Test Methods. Upon completion of testing, the Division of Materials will notify the supplier of approval and forward copies of the material's certification and approval to the Division of Traffic.

837.03.04 Packaging. Package thermoplastic pavement marking material in suitable 50-pound containers to which it shall not adhere during shipment or storage. Include a label stating that the material is to be maintained within a temperature range of 400-440 ºF during application. Provide the thermoplastic material in either block or granular form.

SECTION 838 ¾ FLEXIBLE DELINEATOR POSTS

838.01 GENERAL. Furnish surface and ground mounted flexible delineator posts from the Department's List of Approved Materials. The Department will approve flexible delineators based upon their NTPEP performance evaluation. The Department considers the flexible delineator posts to include the post, reflective element, and mounting hardware.

838.02 PACKAGING. Securely fasten posts of the same type and length in bundles of 2,000 pounds or less in a manner that is easily handled by a fork lift and that prevents slipping during handling and shipping. The Engineer will reject posts with excessively damaged finishes.

SECTION 839 ¾ KY TYPE I GLASS BEADS

839.01 GLASS BEADS. Use for application to reflective pavement markings. Conform to AASHTO M 247, moisture resistant specifications with the following additional requirements for gradation and percentage of rounds:

Gradation:	Sieve Size	Percent Passing
	No. 20	98-100
	No. 30	70-90
	No. 40	—
	No. 50	0-20
	No. 80	0-5

Rounds: 70% minimum for + 50 beads

839.01.01 Sampling. The Department will obtain random samples of all shipments that are intended for use by State Traffic Forces at the point of delivery. The Department will evaluate the beads for acceptance prior to use. The Department will accept beads for Contractor use based upon manufacturer certification.

839.01.02 Testing. The Department will test according to AASHTO M 247 and the following.

A) Chemical Resistance Test. Place three, 0.1 to 0.2-ounce, samples of the beads in separate Pyrex-glass beakers or porcelain dishes. Cover one sample with distilled water; one with a 3N solution of sulfuric acid; and one with a 50 percent solution of sodium sulfide. Examine the samples microscopically after one hour of immersion. Reject the beads if they darken or "frost".

B) Moisture Resistance Test. Place approximately 2 pounds of glass beads in a clean cotton bag not treated with sizing material. Immerse the bag in water, completely covering the beads, for approximately 30 seconds. Remove the bag and wring free of excess water. Hang the bag in room air for 2 hours to dry. Transfer the beads slowly to a clean, dry, standard (4-inch stem, and a 1/4-inch diameter exit) glass funnel. Accept beads that flow freely through the funnel.

839.01.03 Approval. The Department will notify the vendor of acceptance when all testing is complete. The Department will evaluate beads used by the Contractor as part of the painted line by use of hand-held or mobile retroreflectance readings.

SECTION 840 ¾ RAISED MARKERS

840.01 TYPE IV MARKERS. Provide markers from the Department's List of approved Materials. Ensure that the markers conform to the following:

A) Prismatic Reflectors. Use reflectors that are viewable from a single or opposite direction.
B) Shell. Fabricate the acrylic plastic shell with methyl methacrylate conforming to Federal Specification L-P-380C, Type I, Class 3. Fill the shell with a tightly adherent potting compound.
C) Lens. Fabricate the lens with a layer of tough untempered glass.

840.01.01 Dimensions. Provide markers that are each 4 ± 1/2 inches by 2 ± 1/4 inches at the base. Ensure that the height of the marker is at least 0.40-inches and no higher than 1/2 inch after preparation of the base of the marker for bonding.

840.01.02 Outer Surface. Provide a smooth outer surface of the shell except for purposes of identification.

840.01.03 Base Surface. Ensure that the base of the marker is substantially free from gloss or substances that may reduce its bond to adhesive. Laminate an elastomeric pad to the base of each marker prior to attaching to Type V casting with adhesive.

840.01.04 Strength Test. Markers shall support a load of 4,000 pounds at room temperature when applied in the following manner:

Position a marker base down in the center of a fixture consisting of a 1/2-inch thick flat steel plate. Apply a load to the top center of the marker by means of a one-inch diameter by one-inch high solid steel plug at a rate of 0.03 inches per minute. Failure is when either breakage or significant deformation of the marker occurs at any load less than 4,000 pounds.

840.01.05 Impact Test and Temperature Cycling. Perform each impact test on a sample sufficient to provide 20 lenses from the same lot for testing. Condition the markers in a convection oven at 130 °F for one hour.

While at the elevated temperature, impact the reflective face with a 1/2-pound dart fitted with a 1/4-inch radius spherical head dropped 18 inches perpendicularly onto the center of the reflective surface. Cracks in the impact area shall be generally concentric in appearance. There shall be no more than 2 radial cracks longer than 1/4 inches. There shall be no radial cracks extending to the edge of the glass.

Subject samples to 3 cycles of 140 °F for 4 hours followed by -4 °F for 4 hours. There shall be no cracking or delamination following temperature cycling.

In either the impact or temperature cycling test, if 90 percent of the test samples conform to the above requirements, the Engineer will accept the lot. If 20 percent of the sample fails, the Engineer will reject the lot. If 15 percent of the sample fails, the Engineer will request a resample. If more than 10 percent of the resample fails, the Engineer will reject the lot.

840.01.06 Reflectivity. Provide the following specific reflectivity of the reflective surface at 0.2 degrees divergence angle, as tested according to KM 64-203, when the incident light is parallel to the base of the marker:

MINIMUM SPECIFIC REFLECTIVITY candelas/lux/unit marker		
Color	Incidence Angle	
	0°	20°
Silver-White	2.7	0.9
Amber	1.8	0.6
Red	0.5	0.22

840.02 TYPE V MARKERS. Type V markers consist of an iron casting with a Type IV marker (mono or bi-directional) attached. Shape both ends to deflect a snowplow blade. Design the casting to allow the Type IV marker to be removed and replaced. The Department will approve the design of Type V markers before use. The Department will approve markers that incorporate the typical features specified in this section and the Standard Drawing and have shown acceptable performance in actual service on a roadway pavement. The Department will reject, at any time, markers that deviate from previously approved designs.

840.02.01 Dimensions. Conform to the Standard Drawing. Ensure that the installed height is approximately 0.4 inches above the road surface.

840.02.02 Casting Material. Use nodular iron conforming to ASTM A 536, Grade 72-45-05, hardened to 52-54 RC.

840.02.03 Surface. Ensure the surface of the keel and web is free of scale, dirt, rust, oil, grease, or any other contaminant that may reduce its bond to the epoxy adhesive.

840.02.04 Weight. Approximately 4.6 pounds.

840.02.05 Identification. Mark each casting with the manufacturer's name and model number of marker.

840.03 TYPE IVA MARKERS. Conform to the requirements for Type IV markers excepting dimensions. Provide markers that are each 4.7 ± 0.25 by 2.3 ± 0.25 inches at the base. Ensure that the height of the marker is at least 0.40 inches and no higher than 0.50 inches.

840.04 SAMPLING. For the purpose of sampling, a shipment consists of the amount of material received in one delivery even though it may represent only partial delivery of the Contract quantities. Obtain samples from at least 5 widely separated and randomly chosen packages of like materials included in the shipment.

Check the markers for dimensional requirements detailed in this section. Obtain a manufacturer's certification for each shipment.

Include with each shipment of adhesive a written statement from the manufacturer certifying that the material furnished conforms to the recommendations of the marker manufacturer, and stating the minimum temperature the adhesive can be satisfactorily mixed and applied.

840.05 PACKAGING. Suitably and substantially package all materials with the name and address of the manufacturer or vendor, Contract or Purchase Order number, kind of material, trade name, and net contents plainly marked on each package.

SECTION 841 —LATEX ADMIXTURE

841.01 DESCRIPTION. This section covers latex admixtures for concrete bridge deck overlays.

841.02 REQUIREMENTS. Select a latex admixture from the Department's List of Approved Materials. Use a latex admixture that is produced in the United States.

Manufacturers desiring prequalification of new products shall have their product tested and evaluated by a qualified independent laboratory, or the Department's Division of Materials, according to the Prequalification Test Program in the U.S. Department of Transportation Research Report No. FHWA-RD-78-35. When analysis is performed by an independent laboratory, the manufacturer shall submit the certified test results along with a 5-gallon sample of the latex admixture to the Department's Division of Materials. The Department will approve the latex admixture based upon the submitted information and evaluation of the sample.

Use only latex admixtures that are free of chlorides.

Include with each shipment of latex admixture a report of tests performed according to the Certification Program in Report No. FHWA-RD-78-35. In addition to actual test results, include in the report the date of manufacture, batch or lot number(s), quantity represented, manufacturer's name, place of manufacture, a statement that all test results are satisfactory, the date the one-year certification period will expire, and signature of manufacturer's representative.

The Department will check sample and test each lot of latex and will remove it from the list of approved materials at any time there is an indication of nonconformity or questionable quality.

Package and store the latex admixture in containers and storage facilities that protect the material from freezing and from temperatures above 85 °F. When storing outside of buildings during moderate temperatures, keep the material shaded and away from direct sunlight. Do not use any latex admixture exposed to freezing temperatures without approval from the Division of Materials.

SECTION 842 ¾ PAVEMENT STRIPING PAINT

842.01 DESCRIPTION. This section covers quick-drying pavement striping paint for permanent applications.

842.02 APPROVAL. Select materials that conform to the composition requirements below. Submit initial samples for approval before beginning striping operations. The initial sample may be sent from the manufacturer of the paint. The Department will randomly sample and evaluate the paint each week that the striping operations are in progress.

PAINT COMPOSITION		
Property and Test Method	Yellow	White
Color Spectrophotometer using a D65 illuminant at 45° illumination and 0° viewing with a 2° observer	Fed Std. 595B-38907 With a maximum variation of 2.0 ΔE_{cmc}	Fed. Std. 595B-37925 With a maximum variation of 2.0 ΔE_{cmc}
Lead ASTM D 3335	< 5ppm	<5ppm
TiO_2 ASTM D 4764	NA	10% by wt. of pigment min.
VOC ASTM D 2369 and D 4017	1.25-lb/gal max.	1.25-lb/gal max.
Contrast Ratio (at 10 mils wft.)	0.96	0.96

842.03 ACCEPTANCE PROCEDURES FOR NON-SPECIFICATION PAVEMENT STRIPING PAINT. When non-specification paint is inadvertently incorporated into the work the Department will accept the material with a reduction in pay. The percentage deduction is cumulative based on its compositional properties, but will not exceed 60 percent. The Department will calculate the payment reduction on the unit bid price for the routes where the non-specification paint was used.

PAVEMENT STRIPING PAINT REDUCTION SCHEDULE				
Non-conforming Property	Color	Lead	TiO_2	VOC
Reduction Rate	20%	60%	20%	60%

SECTION 843 ¾ GEOTEXTILE FABRICS

843.01 DESCRIPTION. This section covers requirements for geotextile fabrics for slope protection and channel lining, underdrains, subgrade or embankment foundation stabilization, and drainage blankets.

843.01.01 Geotextile Fabric. Use either woven or non-woven fabric consisting only of long chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride formed into a stable network such that the filaments or yarns retain their relative position to each other. Use fabric that is inert to commonly encountered chemicals and free of defects or flaws significantly affecting its physical or filtering properties.

Ensure that the fabric, except wrapping placed directly against perforated pipe, is formed in widths of at least 6 feet. When necessary, sew sheets of fabric together to form required fabric widths. Sew the sheets of fabric together at the point of manufacture or other approved locations.

The geotextile manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with this section.

A) Packaging. During all periods of shipment and storage, wrap the fabric in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140 °F, mud, dirt, dust, and debris.

B) Physical Requirements. Conform to the following applicable table as specified for each use.

C) Acceptance. Obtain the Department's approval for all material before incorporating it into the project.

TYPE I FABRIC GEOTEXTILES FOR SLOPE PROTECTION AND CHANNEL LINING		
Property	Minimum Value[1]	Test Method
Grab Strength (lbs)	200	ASTM D 4632
Elongation (%)	15	ASTM D 4632
Sewn Seam Strength[2] (lbs)	180	ASTM D 4632
Puncture Strength (lbs)	80	ASTM D 4833
Burst Strength (psi)	320	ASTM D 3786
Trapezoid Tear (lbs)	50	ASTM D 4533
Apparent Opening Size U.S. Std. Sieve	Sieve U.S. #40	ASTM D 4751
Permeability (cm/s)	0.004	ASTM D 4491
Ultraviolet Degradation at 500 hours	70% strength retained for all classes	ASTM D 4355
Flow Rate (gal./min./ft^2)	20	ASTM D 4491

TYPE II FABRIC GEOTEXTILES FOR UNDERDRAINS (except pavement edge drains)		
Property	Minimum Value[1]	Test Method
Grab Strength (lbs)	80	ASTM D 4632
Elongation (%)	N/A	ASTM D 4632
Sewn Seam Strength[2] (lbs)	70	ASTM D 4632
Puncture Strength (lbs)	25	ASTM D 4833
Burst Strength (psi)	130	ASTM D 3786
Trapezoid Tear (lbs)	25	ASTM D 4533
Apparent Opening Size U.S. Std. Sieve	Sieve U.S. #50	ASTM D 4751
Permeability (cm/s)	0.010	ASTM D 4491
Ultraviolet Degradation at 150 hours	70% strength retained for all classes	ASTM D 4355
Flow Rate (gal./min./ft^2)	50	ASTM D 4491

TYPE III FABRIC GEOTEXTILES FOR SUBGRADE OR EMBANKMENT STABILIZATION		
Property	Minimum Value[1]	Test Method
Grab Strength (lbs)	180	ASTM D 4632
Elongation (%)	N/A	ASTM D 4632
Sewn Seam Strength[2] (lbs)	160	ASTM D 4632
Puncture Strength (lbs)	67	ASTM D 4632
Burst Strength (psi)	290	ASTM D 3786
Trapezoid Tear (lbs)	67	ASTM D 4533
Apparent Opening Size U.S. Std. Sieve	U.S. #40	ASTM D 4751
Permeability (cm/s)	0.002	ASTM D 4491
Ultraviolet Degradation at 150 hours	70% strength retained for all classes	ASTM D 4355
Flow Rate (gal./min./ft^2)	7	ASTM D 4491

TYPE IV FABRIC GEOTEXTILES FOR EMBANKMENT DRAINAGE BLANKETS AND PAVEMENT EDGE DRAINS		
Property	Minimum Value[1]	Test Method
Grab Strength (lbs)	180	ASTM D 4632
Elongation (%)	N/A	ASTM D 4632
Sewn Seam Strength[2] (lbs)	160	ASTM D 4632
Puncture Strength (lbs)	80	ASTM D 4833
Burst Strength (psi)	290	ASTM D 3786
Trapezoid Tear (lbs)	50	ASTM D 4533
Apparent Opening Size U.S. Std. Sieve	U.S. #50	ASTM D 4751
Permeability (cm/s)	0.008	ASTM D 4491
Ultraviolet Degradation at 150 hours	70% strength retained for all classes	ASTM D 4355
Flow Rate (gal./min./ft^2)	40	ASTM D 4491

[1] *Minimum. Use value in weaker principal direction. All numerical values represent minimum average roll value (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table).*

[2] *Values apply to both field and manufactured seams.*

843.01.02 Acceptance Procedures for Non-Specification Fabric. Ensure that all geotextile fabric conforms to the requirements of this section. However, when non-specification geotextile fabric is inadvertently incorporated into the work before completion of testing, the Department may accept the material with a reduction in pay, provided the failure is marginal and will not cause poor performance. When the failure is excessive, then remove the geotextile fabric, and replace it unless the Engineer determines that the geotextile fabric can remain in place. The Department will apply the largest payment reduction when the material fails to meet more than one specification requirement. The Department will calculate the payment reduction on the invoice cost of the material delivered at the project site. The Department will reject geotextile fabric that fails and has not been incorporated into the work.

AOS PAYMENT REDUCTION					
#35 - #40 or #45 - #50 Glass Beads Passing Fabric as Applicable	0-5	6-10	11-15	16-20	21 or more
Reduction Rate	0%	20%	30%	40%	*

GRAB STRENGTH PAYMENT REDUCTION				
% of Requirement	100% or more	90-99%	75-89%	74% or Less
Reduction Rate	0%	25%	40%	*

ELONGATION PAYMENT REDUCTION (TYPE I FABRIC ONLY)				
% of Requirement	100% or more	90-99%	75-89%	74% or Less
Reduction Rate	0%	25%	40%	*

SEWN SEAM STRENGTH PAYMENT REDUCTION				
% of Requirement	100% or more	90-99%	75-89%	74% or Less
Reduction Rate	0%	25%	40%	*

FLOW RATE PAYMENT REDUCTION				
% of Requirement	100% or more	90-99%	75-89%	74% or Less
Reduction Rate	0%	25%	40%	*

**Remove and replace the fabric unless the Engineer determines the fabric can remain in place at a 100% reduction rate.*

843.01.03 Fastener Pins. The Engineer will accept fastener pins based on visual inspection on the project. Conform to the following:

A) Underdrain Systems. Use pins that are formed of No. 9 diameter or heavier steel wire and are at least one foot long with a 4-inch right angle bend on one end.

B) Slope Protection, Channel Lining, Subgrade and Embankment Foundation Stabilization, and Wrapped Aggregate Drainage Blankets. Provide fastener pins that are formed of 3/16 inch diameter or heavier steel, pointed at one end, with a head on the opposite end to retain a washer with a minimum diameter of 1 1/2 inches.

SECTION 844 ¾ MINERAL ADMIXTURES FOR CONCRETE

844.01 FLY ASH REQUIREMENTS. For fly ash added to concrete mixtures as a separate ingredient, conform to ASTM C 618, Class F or Class C, except ensure that the loss on ignition does not exceed 3.0 percent.

Concrete containing Class C fly ash may reduce sulfate resistance. Susceptibility to sulfate attack relates to the resistance factor, R. The value of R is defined as the ratio, $(CaO -5.0)/(Fe_2O_3)$, as determined from the fly ash oxide analysis. A resistance factor (R) greater than 3.0 indicates a reduction in sulfate resistance. Do not use Class C fly ash having an R ratio greater than 3.0 in concrete where sulfate attack is possible. Identify the locations on the project where concrete containing Class C fly ash is to be used, and obtain the Engineer's approval of its use before beginning concrete work.

844.02 APPROVAL.

844.02.01 Fly Ash. Select from the Department's List of Approved Materials for fly ash sources. To be placed on the list, furnish samples and ASTM C 618 test data developed over the previous 3 months, and conform to the following requirements:

1) Ensure that the fly ash supplier has a quality control program satisfactory to the Engineer, to ensure the fly ash delivered to the project has uniform properties conforming to this section. To be acceptable, laboratories performing tests on fly ash for conformance to ASTM C 618 shall participate in the laboratory evaluation and sample proficiency program conducted by the Cement and Concrete Reference Laboratory of ASTM. This requirement does not apply to routine process control testing at the plant site for fineness, loss on ignition, and uniformity. A Department certified technician shall perform testing at the plant.
2) Provide with each shipment of fly ash a certification from the supplier that the fly ash complies with this section and ASTM C 618.
3) Provide with each shipment actual results of tests for fineness and loss on ignition, and uniformity when applicable. The concrete producer shall keep these test results on file and available for review by the Engineer for a period of at least 3 years after receipt of the fly ash.
4) The Department reserves the right to perform any sampling and testing on Type IP cement or fly ash when deemed necessary or desirable.

844.02.02 Ground Granulated Blast Furnace (GGBF) Slag. The Department's Division of Materials maintains a list of approved GGBF Slag sources by producer. Furnish samples and ASTM C 989 test data for the previous six months and meet the following requirements to obtain approval.

1) Submit the GGBF slag supplier's quality control program to the Engineer for approval. The GGBF slag delivered to the project shall have uniform properties complying with this specification. Laboratories performing tests on GGBF slag for conformance to ASTM C 989 shall participate in the laboratory evaluation program conducted by the Cement and Concrete Reference Laboratory of ASTM.
2) Submit certification with each shipment of GGBF slag to document its compliance with this specification and ASTM C 989.
3) Submit actual ASTM C 989 test results for fineness, air content, slag activity index, sulfide sulfur content, and sulfate ion content with each shipment.

The Department reserves the right to perform all sampling and testing on GGBF slag that it deems necessary or desirable.

844.02.03 Microsilica. The Department's Division of Materials maintains a list of

approved microsilica admixtures by brand name and manufacturer. Furnish samples and AASHTO M 307 test data for the previous six months and meet the following requirements to obtain approval:

1) Submit the microsilica supplier's quality control program to the Engineer for approval. The microsilica delivered to the project shall have uniform properties complying with this specification. Laboratories performing tests on microsilica for conformance to AASHTO M 307 shall participate in the laboratory evaluation program conducted by the Cement and Concrete Reference Laboratory of ASTM.
2) Submit certification with each shipment of microsilica to document its compliance with this specification and AASHTO 307.
3) Submit actual AASHTO M 307 tests results for the chemical and physical requirements with each shipment.

844.03 NON-SPECIFICATION FLY ASH. When either Class C or Class F sampled fly ash fails to meet specification requirements for loss on ignition (LOI), but the Engineer determines that concrete produced using the fly ash meets requirements for entrained air and compressive strength, the Engineer will reduce the price by 5.0 percent of the Contractor's invoice cost of the fly ash for each 0.1 percent that the fly ash LOI is above 3.0 percent. This procedure is intended to provide for acceptance at a reduced Contract price when material is discovered to not meet specification requirements after work is performed, and is not intended as a means to utilize non-specification material.

The Engineer will accept fly ash on the basis of certification and being from an approved source and project samples passing the applicable requirements of ASTM C 618 and/or ASTM C 593. Some variability or small departures from the requirements do not adversely affect properties of the finished product enough for removal and replacement. Therefore, the Department will use the following pay tables when deviations occur. When a sample fails more than one test, the Department will impose the largest reduction rate. The Department will calculate the payment reduction on the invoice cost of the fly ash delivered to the concrete plant or to the project site.

FINENESS PAYMENT REDUCTION				
% Retained on No. 325 Sieve	0-34	35-40	41-45	46 or more
Reduction Rate	0%	25%	50%	*

STRENGTH ACTIVITY INDEX PAYMENT REDUCTION				
Control with Cement (%)	75 or more	70-74	65-69	64 or less
PSI with Lime (Class F)	800 or more	775-799	750-774	749 or less
Reduction Rate	0%	25%	50%	*

AUTOCLAVE EXPANSION PAYMENT REDUCTION				
Expansion ± (%)	0.8	0.9	1.0	1.1 or more
Reduction Rate	0%	25%	50%	*

WATER REQUIREMENT PAYMENT REDUCTION				
Control (%)	105 or less	106-110	111-115	116 or more
Reduction Rate	0%	25%	50%	*

CHEMICAL REQUIREMENTS PAYMENT REDUCTION				
$SiO_2+Al_2O_3+Fe_2O_3$ (%) (Class F)	70 or more	65-79	60-64	59 or less
$SiO_2+Al_2O_3+Fe_2O_3$ (%) (Class C)	50 or more	45-49	40-44	39 or less
SO_3 (%)	0-5	6	7	8 or more
Moisture Content (%)	0-3	4	5	6 or more
Available Alkalies as (Na_2O) (%)	0-1.5	1.6	1.7	1.8 or more
Reduction Rate	0%	25%	50%	*

**Remove and replace finished product unless the Engineer determines that it can remain in place at a 100% reduction rate.*

SECTION 845 ¾ FABRIC WRAPPED BACKFILL DRAIN MATERIALS

845.01 DESCRIPTION. Place fabric wrapped backfill drains at locations where depth to weep hole flowline is 30 feet or less.

845.02 FABRIC WRAPPED BACKFILL DRAIN. Select from the Departments List of Approved Materials. Provide Class I fabric wrapped backfill drains when the depth to weep hole flowline is 12 feet or less. Provide Class II fabric wrapped backfill drains when the depth to weep hole flow line is between 12 feet and 30 feet.

845.02.01 Compressive Strength. Ensure the drain is capable of withstanding the following compressive load on the wide side, with a maximum deflection of 50 percent:

Class I - 2,000 pounds per square foot.
Class II - 5,000 pounds per square foot.

845.02.02 Core. Use a rectangular core at least 17 inches wide, with nominal thickness of at least 0.7 inch, consisting of molded plastic; or of a 3-dimensional structure of mono-filaments bonded at their intersections; or of 3/8-inch average diameter expanded polystyrene beads bound together with an adhesive compound, sufficiently open to allow free movement of water entering through the geotextile fabric, and manufactured specifically for drainage applications.

845.02.03 Wrapping. Wrap the core on all 4 sides with Type II geotextile fabric conforming to the requirements of Section 845.

845.03 PACKAGING AND CARE. Wrap the drain in a protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140 °F, mud, dirt, dust, and debris during all periods of shipment and storage.

Completely cover with backfill material within 14 calendar days after placement. If completely backfilling the drain is not feasible, cover exposed portions with approved material to protect the fabric from direct sunlight. Remove and replace any drain not backfilled or suitably covered within 14 days after placing at no expense to the Department.

845.04 ACCEPTANCE. Furnish the manufacturer's certification to the Engineer stating the fabric wrapped backfill drains meets all requirements herein. The Engineer will accept the fabric wrapped backfill drains by certification and visual inspection.

APPENDIX A

TABULATION OF CONSTRUCTION TOLERANCES

TABULATION OF CONSTRUCTION TOLERANCES

Perform all work and furnish all materials in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown on the plans or indicated in the specifications. The maximum limits of tolerances listed below do not necessarily represent total construction acceptability, but are limits at which the Department may consider construction tolerances acceptable. It is intended that, in general, all work and materials be well within the tolerances given. The Department will not allow continued employment of equipment and methods which allow undue proportion of all work and materials approaching the tolerances limits.

SECTION	SUBJECT	TOLERANCE
109.01.03 D)	Automatic printing scales printed weight compared to scale display.	The printed weight is within 60 pounds of scale display.
204.03.07 A)	Surface for channel lining, class IV.	± 6 inches from a true plane.
204.03.10 1)	Distance from centerline to ditch line in cuts and to shoulder line in fills.	± one foot from dimension shown on plans.
204.03.10 1)	Total width of roadbed.	± one foot at any location.
204.03.10 2)	Specified slope limits for slope surfaces between ditch lines or shoulder lines and original ground.	Not to be inside specified slope limits more than 6 inches nor outside specified slope more than one foot, both measured horizontally.
204.03.10 3)	Cut bench elevation.	± one foot of bench elevation established on plans or by the Engineer.
204.03.10 5)	Subgrade tolerance for roadway and drainage excavation.	Complete to within ± 0.1 foot of designated grade at time of final acceptance, except when rock subgrade is specified, the tolerance is ± 0.2 foot.
206.03.03	Moisture content of embankment or subgrade material.	± 2% of the optimum moisture content as determined by KM 64-511.
207.03.02	Subgrade prepared for base or surface courses.	± 1/2 inch from specified crown section.
302.03.06	Surface of finished gravel and DGA base.	± 1/2 inch from specified cross section; ± 3/8 inch in 10 feet at any location from the specified longitudinal

		grade.
401.02.01 H)	Asphalt Binder control unit metering devices.	± 1% when tested for accuracy.
401.02.02 B)	Scales for weigh box or hopper or for weighting asphalt material.	Tolerance on over registration and under registration of not exceeding 0.5% of indicated weight when tested for accuracy. The change in load required to noticeably alter the position of rest of the indicating element(s) of a non-automatic indicating scale shall not be greater than 0.1% of the nominal scale capacity.
401.02.03	Batch tolerances for automatic batching or proportioning hot-mix asphalt plants. Material:	
	Batch aggregate component	± 1.5% of total batch weights.
	Mineral filler	± 0.5% of total batch weights.
	Asphalt Binder	± 0.1% of total batch weights.
	Zero return (aggregate)	± 0.5% of total batch weights.
	Zero return (asphalt materials)	± 0.1% of total batch weights.
	Accumulated weight of batches.	± 2.0% of that total batch weight.
401.03.01	Bituminous plant mixed pavements - JMF tolerances.	See specifications for individual mixtures.
403.03.06 A)	Asphalt base, initial treatment and resurfacing projects.	The rate of application shall not exceed designated rate by more than + 5%.
403.03.06 B)	Asphalt base, new construct-ion payment on basis of:	
	weight, or	Total combined thickness of all layers within ± 1/2 inch of compacted plan thickness.
	area.	Deficient in thickness by more than 1/2 inch of compacted plan thickness.
403.03.07	Transverse joints in all asphalt courses.	Deviations do not exceed tolerances described in Subsection 403.03.11 from a 10-foot straight edge after joint is complete and rolled.
403.03.11	Surfaces of finished courses;	Finished surfaces of base

	asphalt plant-mixed pavements.	course and binder course shall not deviate more than ± 1/4 inch from 10-foot straight edge.
		Finished surface of final surface course shall not deviate more than + 1/8 inch from 10-foot straight edge.
	Cross slope of all courses.	Do not deviate more 1/4 inch in 5 feet from required cross slope.
405.03.04	Rate for applying cover material for asphalt seal coat.	Not to exceed designated rate by more than 5%.
407.02.02	Asphalt mixture for pavement wedge.	Asphalt binder content shall be maintained within ± 0.5%.
408.03.01	Asphalt pavement milling and texturing surface tolerance.	Finished surfaced after final cut does not deviate more than ± 1/8 inch from a 10-foot straight edge and that the cross slope does not deviate more than 3/8 inch in 10 feet. Correct all irregularities exceeding these limits.
501.03.04	Fly ash incorporated in concrete mixes for PCC pavement.	± 2.0% of specified weight.
501.03.17 D)	PCC pavement; Transverse contraction joints.	Not to deviate from true alignment more than 1/4 inch in one lane width.
501.03.18 C)	PCC pavement - installation of preformed neoprene joint seals.	Not to be stretched more than 5%.
501.03.19	PCC Pavement and Base Surface Tolerances. Pavement abutted by subsequent or PCC shoulder; edge slump with edge forms or tailing forms or fixed forms;	Not to exceed 1/8 inch.
	Pavement not abutted by pavement or shoulders edge slump;	Does not exceed 1/4 inch.
	High spot 6 inches or more from pavement edge.	Do not to exceed 1/8 inch (1/4 inch for base) from a 10-foot straight edge.
508.03.01	Permanent Concrete Median Barriers.	

	Top surface cast-in-place barriers (fixed form).	± 1/4 inch when tested longitudinally by a 10-foot straight edge.
508.03.02	Top surface cast-in-place barriers (slip form).	No deviation more than 1/2 inch from the line established by the reference wire between any 2 reference wire supports.
511.03.01	Masonry drill bits for drilling holes of installation of steel dowels into existing concrete by use of grout.	Diameter no less than 1/8 inch greater nor more than 1/2 inch greater than diameter of dowels.
601.02.14	Scales for weighing water, aggregates, cement, and fly ash for concrete for structures.	Within + 0.5% of net load on scales.
601.03.03	Concrete for structures air-entraining admixture net air content (by volume).	Volume of 6% ± 2% by volume.
601.03.03	Concrete for structures; accur-acy of individual ingredient materials for each batch.	± 2.0% for aggregates. ± 1.0% for water & cement.
601.03.03 B)	Air content of mortar or grout.	Volume of 8% ± 2.0%.
601.03.03 C) 2)	Fly ash in concrete mixes for structures.	± 1.0 % of specified weight.
601.03.03 E) 1)	Measuring cement.	When the weight of entire shipment of cement in bags varies more than 2% from 94 pounds per bag. Weigh the cement in bulk on scales.
601.03.03 E) 3)	Water metering systems for mixing concrete for structures.	+ 1.0% of required amount of water per batch.
601.03.08 C) 1)	Truck mixing of concrete for structures, quantity of mixing water.	Measure and Control to ± 1.0%.
601.03.09 A)	Variation of finished surface of bridge seats.	Not to vary more than 1/32 inch above or below true level plane.
601.03.18	All exposed finished concrete surfaces unless specified else-where in the contract.	Not to vary more than 1/4 inch in 10-feet as measured from a straightedge.
602.03.04	All steel reinforcement	± 1/2 inch of position, and

	except that placed in bridge decks.	specified spacing. ± 1/4 inch of specified clearance from face of concrete.
602.03.05	Epoxy Coated Tie Wires, Chairs, etc.	
	Film thickness of epoxy coating.	± 7 mils.
	Film thickness of vinyl type coating.	± 10 mils.
	Thickness of flexible plastic or vinyl coating for tie wires.	± 7 mils.
604.03.08 A)	Bearing piles that will be exposed.	
	Variance from vertical during driving.	± 1/4 inch per foot from vertical or batter position specified in the Plans.
	Variance from plan position after driving.	± 4 inches from plan position at the pile cut-off elevation.
	Stringline stretched between exterior piles in the exposed portion of the pile bent or group.	± 2 inches.
604.03.08 B)	Bearing piles that will be unexposed in the finished structure.	
	Variance from vertical during driving.	± 1/4 inch per foot from vertical or batter position specified in the Plans.
	Variance from plan position after driving.	± 6 inches from plan position at the pile cut-off elevation.
605.03.05 D) 2)	Calibration of hydraulic jacks for prestressing.	± 2.0%.
605.03.08	Prestressed or precast concrete members dimensional tolerances of I-beams, box beams with cast-in-place slab, precast barrier unit, deck units, and piling.	Refer to tables in Subsection 605.03.08.
606.02.10 C)	Concrete bridge deck overlays; accuracy of latex and water meters used in measurement for mixing.	± 1%.
606.03.18 A) 2)	Concrete bridge deck overlays; air content of concrete.	± 1.5%.

606.03.18 A) 2)	Concrete bridge deck overlays; slump of concrete.	± 1/4 inch.
607.03.23 C)	Shop painting of steel bridge. Dry film thickness of prime coat; Except, Dry film thickness of surfaces to be field bolted in contract or surfaces which will be in contact with concrete.	- 0.5 mils and + 2.0 mils. ± 0.5 mils.
608.03.16	Concrete bridges. Lines of finished concrete, except bridge slabs, and precast piles.	± 1/4 inch per 10 feet or vary from plan lines more than 0.1% of the distance between extremities of the unit considered.
609.03.03	Reinforced concrete bridge slabs; placement of steel reinforcement.	± 1/4 inch vertically and horizontally of the position shown.
609.03.08	Reinforced concrete bridge slabs; slab surface variations.	± 1/8 inch in 10 feet.
609.05	Reinforced concrete ridge slabs; thickness of concrete cover over top mat of steel reinforcement.	See schedule for Adjusted Quality for Depth of Cover Deficiency Subsection 609.05.
612.03.06	Field assembled structural plate pipes; vertical elongation.	± 25% of specified elongation.
612.03.07 A)	Asphalt paving for pipe and pipe arches; aggregate and asphalt binder temperature.	± 60 °F.
612.03.07 B)	Concrete paving for pipe and pipe arches; uniform pavement thickness.	± 1/2 inch.
703.03.01 B)	Slope protection; reinforced concrete slope wall.	No surface variation from a true plane of more than 1/2 inch per 4 feet.
703.03.01 C)	Slope protection; cyclopean stone riprap; finished slope.	No surface variation of more than 6 inches from a true plane.
703.03.01 D)	Slope protection; crushed aggregate slop protection.	No surface variation of more than 1 1/2 inches per 4 feet from a true plane.

703.03.02 A)	Slope protection; channel lining classes II and III.	No surface variation of more than 3 inches from a true plane.
703.03.02 B)	Slope protection; channel lining class IV.	No surface variation of more than 6 inches from a true plane.
705.03	Cored hole drainage connector; diameter of hole shall be equal to the outside diameter of pipe.	+ 1/2 inch.

APPENDIX B

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APPENDIX C

ENGLISH – METRIC CONVERSION TABLE

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

WHEN YOU KNOW	MULTIPLY BY	TO FIND
	Length	
inches (in)	25.4	millimeters (mm)
feet (ft)	0.305	meters (m)
yards (yd)	0.914	meters (m)
miles (mi)	1.61	kilometers (km)
	Area	
square inches (in^2)	645.2	square millimeters (mm^2)
square feet (ft^2)	0.093	square meters (m^2)
square yards (yd^2)	0.836	square meters (m^2)
acres (ac)	0.405	hectares (ha)
square miles (mi^2)	2.59	square kilometers (km^2)
	Volume	
fluid ounces (fl oz)	29.57	milliliters (mL)
gallons (gal)	3.785	liters (L)
cubic feet (ft^3)	0.028	cubic meters (m^3)
cubic yards (yd^3)	0.765	cubic meters (m^3)

Note: Volumes greater than 1000 L shall be shown in m^3

	Mass	
ounces (oz)	28.35	grams (g)
pounds (lb)	0.454	kilograms (kg)
short tons (2000 lb) (T)	0.907	metric tons (t)
	Pressure	
pounds per square inch (psi)	0.0069	megapascal (MPa)
	Temperature	
Fahrenheit temperature (°F)	5(F-32)/9	Celcius temperature (°C)

*SI is the symbol for the International System of Measurement.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS FROM SI UNITS

WHEN YOU KNOW	MULTIPLY BY	TO FIND
	Length	
millimeters (mm)	0.039	inches (in)
meters (m)	3.28	feet (ft)
meters (m)	1.09	yards (yd)
kilometers (km)	0.621	miles (mi)
	Area	
square millimeters (mm^2)	0.0016	square inches (in^2)
square meters (m^2)	10.764	square feet (ft^2)
hectacres (ha)	2.47	acres (ac)
square kilometers (km^2)	0.386	square miles (mi^2)
	Volume	
milliliters (mL)	0.034	fluid ounces (fl oz)
liters (L)	0.264	gallons (gal)
cubic meters (m^3)	35.315	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
	Mass	
grams (g)	0.035	ounces (oz)
kilograms (kg)	2.205	pounds (lb)
metric tons (t)	1.102	short tons (2000) (T)
	Pressure	
megapascals (MPa)	145.04	pounds per square inch (psi)
	Temperature	
Celcius temperature (°C)	1.8C + 32	Fahrenheit temperature (°F)