STATE OF WISCONSIN

STANDARD SPECIFICATIONS
FOR
HIGHWAY AND STRUCTURE CONSTRUCTION

2019 Edition

Effective with December 2018 letting

The annotations, shown in boxed text, in this 2019 edition of the standard specifications identify substantive changes made since the 2018 edition. A brief explanation of each change is shown both in the table of contents and again adjacent to each revised passage. These annotations are not part of the contract.

Foreword

The department issues standard specifications annually. The "general" special provision of each proposal references the edition that applies to that proposal. ASP 6 "Modifications to the Standard Specifications" contains revisions made between the publication of successive annual editions and is bound into each proposal.

Edition:	Effective From: Letting	through	Letting
2019 Standard Specifications	Dec. 2018	---	Nov. 2019
2018 Standard Specifications	Dec. 2017	---	Nov. 2018
2017 Standard Specifications	Dec. 2016	---	Nov. 2017
2016 Standard Specifications	Dec. 2015	---	Nov. 2016
2015 Standard Specifications	Dec. 2014	---	Nov. 2015
2014 Standard Specifications	Dec. 2013	---	Nov. 2014
2013 Standard Specifications	Dec. 2012	---	Nov. 2013
2012 Standard Specifications	Dec. 2011	---	Nov. 2012
2011 Standard Specifications	Dec. 2010	---	Nov. 2011
2010 Standard Specifications	Dec. 2009	---	Nov. 2010
2009 Standard Specifications	Dec. 2008	---	Nov. 2009
2008 Standard Specifications	Dec. 2007	---	Nov. 2008
2006 Supplemental Specifications	Dec. 2006	---	Nov. 2007
2005 Supplemental Specifications	Dec. 2005	---	Nov. 2006
2004 Supplemental Specifications	Nov. 2004	---	Nov. 2005
2003 Standard Specifications	Nov. 2003	---	Nov. 2007

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https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/rdwy/ss-order.aspx

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Revise 614.5(4) to specify that removing and re-installing posts to verify embedment is incidental to the contract.

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Revise 646.3.1.3 to include tape; epoxy width, thickness, and bead rate; and proving period for cold weather marking.

Revise 646.3.2.4(1) to no longer require the application of black aggregate on black epoxy.

Revise 646.4(5) specify measurement of the cold weather bid items previously in STSP 646-010.

Revise 646.5 to add payment for Cold Weather Marking Epoxy 4-Inch and 8-Inch bid items previously in STSP 646-01.

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Revise 701.1.2.7(1) to eliminate the same-day submittals; time frames are specified in individual QMP provisions.

Revise 701.1.2.7(3) to eliminate the electronic submittal requirement.

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Revise 715.3.1.1(1) to include super air meter (SAM) testing for pavements at least once per lot. This change was implemented in ASP 6 effective with the December 2017 letting.

Revise 715.3.1.3(1) to require a 1 in 5 QV testing frequency with at least one QV test per lot for class I concrete. This change was implemented in ASP 6 effective with the December 2017 letting.

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Add Cold Weather Marking Epoxy 4-Inch and Cold Weather Marking Epoxy 8-Inch standard bid items.

Add a 10" X 10" X 6" junction box bid item.

Add new bid items for contractor-provided poles typically used with monotube and steel luminaire arms.

Add new bid items for contractor provided monotube arms.

Add new bid items for contractor provided steel luminaire arms.

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Part 1 General Requirements and Covenants

Section 101 General Information, Definitions, and Terms

101.1 General

(1) The department defines the contractor and department responsibilities within the contract documents in one of the following ways:

1. Taken in context, the contract language makes the responsible party clear.
2. Direct commands written to the contractor in the active voice-imperative mood.
3. Using "shall" to indicate contractor responsibility and "will" to indicate department responsibility. For example, "Aggregates shall be stored in stockpiles" or "Sampling and testing will be according to the following AASHTO methods."

(2) If the contractor thinks the responsibility for an action under the contract is unclear or given to the wrong party, the contractor shall seek clarification from the department.

(3) These standard specifications for highway and structure construction are written to the bidder before award of the contract and to the contractor after award of the contract. The sentences directing the contractor to perform work are written in the active voice-imperative mood. These contractor directions 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.

(4) Requirements to be performed by others are 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 the active voice, rather than the active voice-imperative mood, if the sentence includes requirements for others in addition to the contractor. For example, a sentence that involves action by both the contractor and the engineer would be expressed, "After the contractor provides initial written notice, the engineer will revise the contract as specified in 104.2."

(5) Sentences that define terms, describe a product or desired result, or describe a condition that may exist are written in neither the active voice nor 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."

(6) The document contains the following components identified by number and organized in a hierarchy as follows:

1. Parts, for example "Earthwork" referred to as: part 2.
2. Sections, for example "Bidding Requirements and Conditions" referred to as: 102.
3. Subsections, potentially containing subordinate subsections, for example "Issuing Bidding Proposals" referred to as: 102.3 or "General" referred to as: 102.3.1.
4. Paragraphs, for example paragraph one of 102.3.2 referred to as: 102.3.2(1).
5. Numbered items, for example item 1 of 102.3.2(1) referred to as: item one of 102.3.2(1).

(7) In addition to identifying numbers; parts, sections, and subsections have descriptive titles. These titles provide reference only, not interpretation. If a subsection contains a subordinate subsection entitled "General," the provisions of that general subsection apply to all subsections in the parent subsection.

(8) Bid item names are capitalized, as are proper names and acronyms. Capitalization of other words not beginning a sentence is avoided.

101.2 References and Acronyms

(1) References made within these specifications use the conventions specified in paragraph 6 of subsection 101.1. For example, 101.1(6) is used to make the reference in the previous sentence. References to parts or sections include the words "part" or "section," references to subsections or paragraphs use only the identifying numbers, and references to numbered items use the words "item number ___ of " and the identifying paragraph number. Occasionally a subsection will contain a reference to itself to avoid possible confusion due to the nesting of subsections. Imprecise references like: "in this subsection," "above," "below," "elsewhere in the contract," etc., are eliminated.

(2) Unless specified by year or date, cited publications refer to the most recent issue, including interim publications, in effect on the bid closing date.

(3) The department identifies acronyms used throughout the contract here in 101.2. The department may also identify acronyms, used in a more limited scope, within individual parts of the contract. Interpret acronyms used throughout the contract as follows:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISI	American Iron and Steel Institute
APL	Department's approved products list
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
ATMS	Advanced Traffic Management Systems
ATSSA	American Traffic Safety Services Association
AWPA	American Wood Protection Association
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
CMM	The department's Construction and Materials Manual
CRSI	Concrete Reinforcing Steel Institute
EBS	Excavation below subgrade
ECIP	Erosion Control Implementation Plan
EIA/TIA	Electronic Industry Association/Telecommunications Industry Association
EPA	United States Environmental Protection Agency
FHWA	Federal Highway Administration
FOA	Fiber Optic Association
FTMS	Freeway Traffic Management System
HTCP	The department's Highway Technician Certification Program
	ACT An HTCP assistant certified technician
IES	Illuminating Engineering Society
IPCEA-NEMA	Insulated Power Cable Engineer's Association - National Electrical Manufacturer's Association
IPS	Iron Pipe Size
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
MASH	Manual for Assessing Safety Hardware
MIL	Military Specification
WMUTCD	The Wisconsin Manual on Uniform Traffic Control Devices for Streets and Highways
NACE	National Association of Corrosion Engineers
NIST	National Institute of Standards and Technology
NCHRP	National Cooperative Highway Research Program
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NRTL	National Recognized Testing Laboratory
NTPEP	AASHTO’s National Transportation Product Evaluation Program
OSHA	Occupational Safety and Health Administration
PAL	Department's erosion control product acceptability list.
QMP	Quality management program
	QC Quality control
	QV Quality verification
	IA Independent assurance
QPL	Department's electrical qualified product list
SAE	Society of Automotive Engineers
SI	International System of Units
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratory
USACE	United States Army Corps of Engineers

WDNR Wisconsin Department of Natural Resources

WEC Wisconsin Electrical Code

WSEC Wisconsin State Electrical Code, consisting of chapter SPS 316 of the Wisconsin administrative code combined with the NEC.

101.3 Definitions

(1) The department defines terms used throughout the contract here in 101.3. The department may define, or redefine, terms within individual parts of the contract if using those terms in a more limited scope. Interpret these terms, used throughout the contract, as follows:

Addenda Revisions to the plans or the proposal form developed before opening of proposals.

Adjustment A modification in the contract price or contract time as specified in 108.10 or 109.4.

Adverse weather day For calendar day or completion date contracts, a day the contractor is scheduled to work when weather, or job conditions caused by recent weather, cause the contractor to lose 4 or more hours of work on the controlling item.

Advertisement See also notice to contractors

Affiliated Having a relationship where one business concern or individual directly or indirectly controls or can control the others.

Auxiliary lane The portion of the roadway adjoining the traveled way for parking, change of speed, or for other purposes supplementary to through traffic movement.

Award The department's acceptance of a bid.

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

Bid See proposal

Bidder An individual, partnership, joint venture, corporation, limited liability company, limited liability partnership, or a combination of any or all jointly, submitting a proposal (bid) for the work advertised in the invitation for bids, acting directly or through a duly authorized representative.

Bidding proposal The department-approved form the department requires bids to be prepared and submitted for the work on. The bidding proposal is further described in 102.2.

Bridge A structure having a span of more than 20 feet from face to face of abutments or end bents, measured along the centerline of the roadway, spanning a water course or other opening or obstruction, such as a highway or railroad, including the substructure, superstructure, and trestle work approaches.

Bureau The department's bureau of project development. Language specifically identifies other department bureaus.

Business day Every day the calendar shows, except Saturdays, Sundays, and department-specified holidays.

Calendar day Every day the calendar shows, including Saturdays, Sundays, and department-specified holidays.

Certificate of compliance A document, provided by a manufacturer, producer, or supplier of a product, stating that the product as furnished to the contractor complies with the pertinent specifications and contract requirements.

Certified report of test or analysis A certified test report, provided by a manufacturer, producer, or supplier of a product, indicating that actual results of tests or analyses comply with the elements of the specification requirements.

Completion date The calendar date shown in the proposal on or before which the work contemplated under the contract shall be completed.

Construction limits The limits of grading or other work generally defined by slope stakes offset from the actual slope intercepts or limits of the work.

Consulting firm The individual, partnership, joint ventures, corporation, or agency contracted by the department to act directly or as a duly authorized construction representative providing services for the department.

Contract The written agreement between the department and the contractor setting forth the obligations of the parties to the contract, including, but not limited to, performance of the work, furnishing of labor and materials, and basis of payment.

The contract includes the notice to contractors, proposal, contract form, contract bond, standard specifications, special provisions, addenda, general plans, detailed plans, notice to proceed, and contract change orders and agreements required to complete the construction of the work in an acceptable manner, including authorized extensions, all of which constitute one instrument.

Contract bond The department-approved form of security, executed by the contractor and the contractor's surety or sureties, guaranteeing the performance of the contract work, completion of the contract requirements, and the payment of claims as provided in 779.14 of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/779

Contract change order A written order or authorization the engineer executes covering work not otherwise provided for in the contract, revisions in or amendments to the contract, or conditions specifically prescribed in the specifications as requiring contract change orders. The change order document becomes a part of the contract when executed by the department.

Contract modification Any change to the contract made after it is executed, including but not limited to, the following:

- A contract change order.
- An administrative change adding a non-bid item.
- A general administrative change.

Contract revision See: contract modification

Contract time The number of calendar or working days shown in the proposal representing the time allowed for the completion of the work contemplated in the contract.

Contractor The individual, partnership, joint venture, corporation, limited liability company, limited liability partnership, or agency undertaking the performance of the work under the terms of the contract and acting directly or through a duly authorized representative.

Controlling item of work An activity on the project schedule, that if delayed, delays completion of the project.

Culvert A structure not classified as a bridge that provides an opening under a roadway.

Department The Wisconsin Department of Transportation.

Detour An existing, permanent road designated as a temporary route to carry vehicular traffic around a section of a highway closed to through traffic.

Divided highway A highway with separate roadways for traffic in opposite directions.

Division administrator The administrator of the department of transportation, division of transportation system development.

Engineer The secretary of the department of transportation or the secretary's authorized representative limited by the particular duties assigned to the representative.

Equipment Machinery and articles necessary for the proper construction and acceptable completion of the work. This includes the supplies, tools, and apparatus for upkeep and maintenance of the equipment.

Erosion control implementation plan The erosion control implementation plan, or ECIP, as required under Trans 401 of the Wisconsin administrative code.

Extra work All work performed by the contractor, with approval of the engineer, that does not appear in the proposal or contract as a specific bid item accompanied by a unit price, and that is not included under the price bid for other bid items in the contract. Extra work may also consist of additions to, or changes in, design of contract bid items or portions of contract bid items, if additions are wholly disassociated from or outside the scope of work in the contract, and if the work caused by these additions or changes must be performed under

conditions or in a manner materially different from the conditions and manner existent for contract bid items under the original scope of work.

Force account A method of payment based on the cost of labor, equipment, materials furnished, and consideration for overhead and profit as specified in 109.4.5.

Frontage road or street A local road or street auxiliary to and located along the side of an arterial highway for service to abutting property and adjoining areas and for control of access.

Government entity Any unit of federal, state, county, municipal, or town government, including all entities described in the definition of "municipality" in 16.70(8) of the Wisconsin statutes. Where a project is constructed across state boundaries, it includes those same entities from the adjoining state or states.

http://docs.legis.wi.gov/statutes/statutes/16

Hazardous substance A substance or combination of substances, including waste of a solid, semisolid, liquid, or gaseous form, that may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating, reversible illness, or that may pose a substantial present or potential hazard to human health or the environment.

Highway separation A structure carrying highway traffic over or under another highway or street.

Highway, street, or road A public way for the purpose of vehicular travel, including the entire area within the right-of-way.

Holidays The following days are department-specified holidays for use in determination of working days:

New Year's day	Thanksgiving day
Martin Luther King Jr. day	Christmas Eve day
Memorial day	Christmas day
Independence day	New Year's Eve day
Labor day	

Inspector The authorized representative of the engineer assigned to inspect the work or materials.

Interchange A highway separation with access connections between the highways.

Laboratory The materials testing laboratory of the department or other testing laboratory the engineer designates.

Local road or street A street or road used primarily for access to residences, businesses, or other abutting property.

Local traffic Passage of vehicles, people, and goods originating within, or having a destination on, the portion of the highway closed to through traffic as specified in the contract.

Major and minor bid items A major bid item is a bid item whose total cost, determined by multiplying the bidding schedule quantity and the contract unit price, is equal to or greater than either 5 percent of the total amount of the original contract or $400,000.

Other bid items are minor bid items. A minor bid item, when its quantity is increased, becomes a major bid item if it meets either of the criteria for a major item.

Materially unbalanced bid A bid that generates a reasonable doubt that award to the bidder submitting a mathematically unbalanced bid will result in the lowest ultimate cost to the department.

Mathematically unbalanced bid A bid containing lump sum or unit price bid items that do not reflect reasonable anticipated actual costs of labor, equipment, materials, plus a reasonable proportionate share of the bidder's anticipated profit, overhead costs, and other indirect costs.

Materials Substances specified for use in the construction of the work.

See also: new material, reclaimed asphalt, recovered material, recycled material, and special waste.

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

New material Material not used for another purpose before incorporation into the work.

Notice to contractors The advertisement for proposals for work or materials on which bids are required. The advertisement will indicate with reasonable accuracy the quantity and location of the work to be done, or the character and quantity of the material to be furnished, and the time and place of submitting and opening the proposals.

Notice to proceed A written notice from the engineer to the contractor of the time period within which the prosecution of the work shall begin.

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

Plans The department-approved plans, profiles, typical cross-sections, working drawings, and supplemental drawings that show the location, character, dimensions, and details of the work to be done.

Plant names and labels The plant names and labels used in the nomenclature references listed in the current edition of the American Standard for Nursery Stock.

Project The designated physical area together with improvements to be constructed under the contract.

Project engineer The authorized representative of the engineer having direct supervision of the administration of the contract.

Proposal The written offer of the bidder, submitted on the prescribed proposal form, to perform the work at the prices quoted by the bidder; also commonly known as the "bid."

Proposal guaranty The security furnished with a bid to guarantee that the bidder will enter into the contract if the bid is accepted.

Quality management program The department's specifications defining both department and contractor responsibilities for assuring quality construction. The specifications provide for the following:

- **Quality control** Required contractor sampling and testing the department uses to determine specification conformance.
- **Quality verification** Department sampling and testing the department uses to validate the quality of the final product.
- **Independent assurance** Activities the department uses to evaluate the QC and QV sampling and testing procedures.
- **Dispute resolution** Procedures the department uses to resolve disputes over conflicting test results for nonconforming work.

Reclaimed asphalt A recovered material from existing asphaltic pavement or surface.

Recovered material A product recovered from solid waste in a form identical to the original form, for a use that is the same or similar to the original use.

Recycled material A product manufactured from previously-used products.

Region The department's transportation region office.

Review panel The department's claims review panel.

Responsible bidder A bidder determined by the department to possess the ability to perform the contract work and complete the contract requirements.

Right-of-way Land, property, or interest in land or property acquired for or devoted to transportation purposes.

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

Roadside The area adjoining the outer edge of the roadway. Areas between the roadways of a divided highway may also be considered roadside.

Roadway The portion of a highway within the limits of construction. A divided highway has 2 or more roadways.

Roadway foundation The area underlying the proposed roadway within the limits of assumed one-to-one slopes extending outward and downward from the subgrade shoulder points.

Schedule of items The prepared schedule, included as a part of the proposal form, containing the estimated quantities of the pay items for which unit bid prices are invited.

Secretary The secretary of the Wisconsin Department of Transportation.

Semi-final estimate An estimate indicating the engineer has measured and reported all contract quantities and materials requirements.

SI metric The International System of Units for metric measure.

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

Shop drawings Stress sheets, working drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or other supplementary plans, computations, or similar data that the contractor is required to submit to the engineer.

Sidewalk The portion of the roadway constructed primarily for the use of pedestrians.

Special provisions Written directions and requirements applicable to a specific project and not otherwise thoroughly or satisfactorily detailed or prescribed in the standard specifications or supplemental specifications.

Special waste Solid waste characterized for beneficial use in public works projects by the WDNR under section 895.58 of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/895

Specifications Written directions, provisions, and requirements contained in the standard specifications or special provisions, together with written agreements and documents referenced in the contract, pertaining to the method or manner of performing the work, the quantities of work, and the quality of materials to be furnished under the contract; as made part of the contract and contained in or referenced in the proposal.

See also: special provisions and standard specifications.

Stabilization Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement.

Standard specifications Written directions and requirements approved for general application and repetitive use as contained herein for highway and structures construction and for administration of the contract.

State The state of Wisconsin.

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

Subcontractor The individual, partnership, corporation, limited liability company, or joint venture to which the contractor, with the department's written consent, sublets part of the contract.

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

Substructure All of the bridge below the bridge seats or below the tops of the caps of piling or framed trestles, including the wing walls, backwalls, and parapets of abutments.

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

Superstructure All of the bridge above the bridge seats or above the tops of caps of piling or framed trestles, including flooring, but excluding wing walls, backwalls, and parapets of abutments.

Surety The company executing a contract bond with the contractor.

Surface course One or more layers of a pavement structure, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate.

Traffic lane The portion of a traveled way for the movement of a single line of vehicles.

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

Unacceptable work Work that does not conform to the contract and results in a product that is insufficient to fulfill the needs of the project.

Unbalanced bid See: materially unbalanced bid and mathematically unbalanced bid

US standard The US standard measure system of units for english measure.

Work The furnishing of all labor, materials, equipment, and incidentals and the performing of all tasks needed to complete the project or a specific part of the project as specified in the contract, together with fulfillment of all associated obligations and duties required under the contract.

Working day A calendar day, except Saturdays, Sundays, department-specified holidays, and the period from November 16 to March 31, both dates inclusive, on which weather or other conditions not under the control of the contractor will allow construction operations to proceed for at least 8 hours of the day with the normal working force engaged in performing the controlling item of work which would be in progress at this time.

Section 102 Bidding Requirements and Conditions

102.1 Prequalifying Bidders

(1) The department will provide, upon request, information regarding departmental policy and procedures for prequalification of a bidder.

(2) Furnish a dated prequalification statement on the department's form at least 10 business days before the time set for opening proposals.

(3) The prequalification statement establishes proof of the prospective bidder's competency and responsibility to perform work. The department will evaluate each prospective bidder based on verified information in the prequalification statement and on other relevant information the department may have. The department will assign ratings, honoring all limitations requested by the bidder, as provided in the departmental policy. The department will maintain the bidder's ratings for a period of time provided in the departmental policy.

(4) The department will indicate, in the notice to contractors, if a contract does not require prequalification.

102.2 Bidding Proposal Content

(1) The bidding proposal is the department-required form the prospective bidder must use to prepare and submit bids for the work. The department will provide the bidding proposal that includes:

1. The name and bidder identification number of the prospective bidder.
2. Location and description of the project.
3. Estimate of quantities and type of work to be performed or materials to be furnished.
4. Time to complete the work.
5. Amount of the proposal guaranty.
6. Department's deadline for receiving completed proposals.
7. Schedule of items.
8. Contract requirements not contained in the standard specifications.
9. Special provisions.

(2) Documents bound with or attached to the bidding proposal are a part of the proposal. Do not detach or alter bound documents when submitting the proposal. The plans, standard specifications, and other documents designated in the bidding proposal are a part of the proposal, whether attached or not, and need not be returned when the proposal is submitted.

102.3 Issuing Bidding Proposals

102.3.1 General

(1) The department will provide, upon request, information regarding departmental policy and procedures for obtaining bidding information, submitting a bid, obtaining sample proposal forms, and purchasing plans.

(2) To obtain the bidding proposal, the prospective bidder shall prequalify as specified in 102.1 unless the department indicates in the notice to contractors that prequalification will not be required. Submit a written request for a bidding proposal on the department's request for proposal form.

102.3.2 Department May Not Issue

(1) The department may refuse to issue bidding proposals to a prospective bidder for one or more of the following reasons:

1. The department's estimate of the cost of the proposal, together with the value of the prospective bidder's uncompleted contract work, exceeds the prospective bidder's established ratings, as determined in 102.1, at the time set for receiving proposals.
2. The prospective bidder has work under way or has performed work not up to the proper standard of progress or quality. The prospective bidder may request, in writing, that the department review its refusal to issue a bidding proposal as provided in the department's prequalification policy.
3. The award of additional work, in the department's opinion, would preclude the satisfactory performance of the additional work or work already under way. The prospective bidder may request, in writing, that the department review its refusal to issue a bidding proposal as provided in the department's prequalification policy.
4. Any of the causes for disqualification of a bidder specified in 102.13.2.

102.3.3 Department Will Not Issue

(1) The department will refuse to issue bidding proposals to 2 or more prospective bidders on the same contract who are affiliated with each other, or for one or more of the following reasons:

1. The prospective bidder has been suspended or debarred from bidding on department contracts under Trans 504 of the Wisconsin administrative code.
2. The prospective bidder does not supply, on the department's request for proposal form, the required information on all incomplete work.

102.4 Interpreting Bid Proposal Quantities

(1) Submit unit bid prices for the estimated quantities as given in the schedule of items. These quantities are approximate and the department only uses them for the comparison of bids. Do not plead misunderstanding or deception because of these quantities as to the character, location, or other conditions pertaining to the work.

(2) The department will only pay the contractor for the actual quantities of the work performed or materials furnished under the contract. The department may increase or decrease the contractor's scheduled quantities of work as provided in 109.3 without invalidating the bid prices.

102.5 Examining Contract Documents and Work Site

(1) Carefully examine the contract documents and perform a reasonable site investigation before submitting a proposal. Submitting a proposal is an affirmative statement that the bidder has examined the contract documents, investigated the site, and is satisfied as to the character, quality, quantities, and the conditions the bidder will encounter in performing the work that the bidder could determine by walking the project site. A reasonable site investigation also includes investigating borrow sites, hauling routes, and all other locations related to the performance of the work.

(2) Before the department's execution of the contract, obtain a permit from the department before performing excavations, borings, or other activities within the highway right-of-way. Obtain the necessary permit request forms from the region operations engineer.

(3) The department may include in the contract documents, or make available for the bidder's review at the department's region or other offices, one or more of the following:

1. As built drawings.
2. Available information relative to subsurface exploration, borings, soundings, water levels, elevations, or profiles.
3. The results of other preliminary investigations.

(4) The department provides information under 102.5(3) for the bidder's general knowledge only. This information is not a substitute for the bidder's own investigation, interpretation, or judgment. The information provided applies only to the locations and at the times indicated.

102.6 Preparing the Proposal

(1) Submit completed proposals on the department's bidding proposal described in 102.2. Submit legible information only. Write everything in ink, by typewriter, or by computer-controlled printer. Provide all dollar amounts in dollars and cents, in numerals. Attach all addenda to the submitted proposal.

(2) Properly execute the proposal. Place the required signatures, in ink, in the space provided on the bidding proposal as indicated below:

ENTITY SUBMITTING PROPOSAL	REQUIRED SIGNATURE
Individual	The individual or a duly authorized agent.
Partnership	A partner or a duly authorized agent.
Joint venture	A member or a duly authorized agent of at least one of the joint venture firms.
Corporation	An authorized officer or duly authorized agent of the corporation. Also show the name of the state chartering that corporation and affix the corporate seal.
Limited liability company	A manager, a member, or a duly authorized agent.

(3) Instead of using the schedule of items provided on the department's bidding proposal, the bidder may submit a substitute schedule with the proposal. Use a format for the substitute schedule conforming to the department's guidelines for approval of a bidder-generated schedule of items. Obtain the department's written approval before using a substitute schedule.

(4) Provide a unit price for each bid item listed in the schedule of items. Calculate and show, in the bid amount column, the products of the respective unit prices and quantities. For a lump sum bid item, show the same price in the unit price column and in the bid amount column pertaining to that bid item. Show the total bid obtained by adding the values entered in the bid amount column for the listed bid items.

(5) If a unit price or lump sum bid already entered in the proposal needs to be altered, cross out the entered unit price or lump sum bid with ink or typewriter and enter the new price above or below and initial it in ink.

(6) A change that the bidder makes in the proposal is not an alteration if the bidder makes that change as directed in a specific instruction contained in an addendum.

102.7 Irregular Proposals

102.7.1 Department Will Correct

102.7.1.1 All Schedules of Items

(1) The department will correct arithmetic errors or omissions found in the completed schedule of items as follows:

1. Discrepancy between a unit price and the corresponding bid amount, or in the absence of a bid amount: the department will use the unit price to determine the correct bid amount.
2. Bidder leaves the unit price column or the bid amount column blank for a lump sum bid item: the department will use the single value shown to obtain the correct unit price and the correct bid amount for that bid item.
3. Discrepancy between the total bid and the sum of the correct bid amounts, or in the absence of a total bid: the department will use the correct bid amounts to determine the correct total bid.

102.7.1.2 Bidder-Generated Schedules of Items

(1) The department will also correct errors in bidder-generated schedules of items as follows:

1. Quantity is incorrect, and both the bid item number and description are correct: the department will correct the quantity and recalculate the bid amount.
2. Item number is correct and the description is incorrect: the department will correct the description.
3. Item number is incorrect and the description is correct: the department will correct the bid item number.
4. Item number is correct but out of sequence and the description is correct: the department will ignore the error.

102.7.2 Department May Reject

(1) Proposals are irregular and the department may reject them for one or more of the following reasons:

1. The proposal contains unauthorized alterations of format, words, or figures.
2. The schedule of items contains errors, alterations, or omissions in, bid item numbers, quantities, descriptions, or units of measure, that cannot be corrected as specified in 102.7.1.
3. The proposal is not prepared as specified in 102.6.
4. There are unauthorized alterations, additions, conditional or alternate bids, amendments, attachments, or irregularities that may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.
5. There are unauthorized erasures or alterations appearing on the designation of the party to whom the department issued the bidding proposal.
6. The award of the bid, together with the value of the bidder's uncompleted contract work, exceeds the bidder's established ratings, as determined in 102.1, at the time set for awarding the work.
7. A single entity, under the same or different names, or affiliated entities submit more than one proposal for the same work. The submitting entity may be an individual, partnership, joint venture, corporation, or limited liability company.

102.7.3 Department Will Reject

(1) Proposals are irregular and the department will reject them if the bidder:

1. Does not furnish the required proposal guaranty in the proper form and amount as specified in 102.8.
2. Does not submit a unit price for each bid item listed, except for lump sum bid items where the bidder may show the price in the bid amount column for that bid item.
3. Includes conditions or qualifications not provided for in the department-supplied bidding proposal.
4. Submits a bid on a bidding proposal issued to a different bidder without obtaining departmental authorization to do so.
5. Submits a bid that contains unauthorized revisions in the name of the party to whom the bidding proposal was issued.
6. Submits a schedule of items with illegibly printed bid item numbers, descriptions, or unit prices.
7. Submits a schedule of items for the wrong contract.
8. Submits a bidder-generated schedule of items with an incorrect bid item number and incorrect description for a single bid item.
9. Omits a bid item or bid items on a bidder-generated schedule of items.
10. Submits a materially unbalanced bid.

11. Does not sign the proposal.

102.8 Proposal Guaranty

(1) The department will reject and will not post a proposal submitted without a proposal guaranty in the amount designated and payable to the party designated in the notice to contractors. Submit the required proposal guaranty in one of the following forms:

1. Properly executed proposal bid bond submitted on the department's form.
2. Properly executed annual bid bond submitted on the department's form.
3. Certified check drawn on the account of the bidder submitting the proposal.
4. Bank's check.
5. Cashier's check.
6. Postal money order.

(2) When submitting a bid bond, ensure that the surety is licensed to do business in Wisconsin and has an equivalent A.M. Best rating of A- or better.

(3) If the department invites alternate bids and the bidder elects to bid more than one alternate, the bidder may submit one proposal guaranty in the amount required for a single alternate. The proposal guaranty covers each individual proposal bid.

(4) If the department invites combined bids and the bidder elects to bid one or more individual proposal in addition to the combined proposal, the bidder must submit a proposal guaranty in the amount required for the combined proposal. The combined proposal guaranty covers each individual proposal bid.

102.9 Proposal Delivery

(1) Submit bids via the internet using Bid Express unless the department indicates in the notice to contractors that bid submittal on paper is allowed.

(2) If submitting a bid on paper, place each proposal, together with the proposal guaranty, in a sealed envelope, furnished by the department. On each envelope, indicate the proposal number and the name of the bidder. For mailed submittals, mark the sealed proposal as indicated above and enclose in an additional envelope. The department will accept proposals at the place, until the hour, on the date designated in the notice to contractors. The department will return proposals received after the designated time to the bidder unopened.

102.10 Withdrawing or Returning Proposals

(1) Provide a written request to withdraw a proposal already filed with the department. Submit the withdrawal request before the deadline set for receiving proposals. The bidder named on a withdrawn proposal cannot subsequently bid on that contract unless the department issues a new invitation for bids.

(2) The department may withdraw a bidding proposal already issued or return unopened a proposal already filed with the department if, after issuing the bidding proposal, the bidder is found to be ineligible to bid on that contract.

102.11 (Vacant)

102.12 Public Opening of Proposals

(1) The department will publicly open proposals at the time and place indicated in the notice to contractors. The department will post the total bid for each proposal on the Bid Express web site beginning at 9:30 AM except as specified in 102.8. If a proposal has no total bid shown, the department will not post the bid. After verification for accuracy under 103.1, the department will post bid totals on the department's HCCI web site.

https://wisconsindot.gov/Pages/doing-bus/contractors/hcci/bid-let.aspx

(2) Bidders or their authorized agent and other interested persons are invited to be present.

(3) The department may postpone the receipt of bids time or the opening of bids time due to emergencies or unforeseen conditions. If the department changes the hour or the date of the receipt of bids time or the opening of bids time, the department will issue an addendum or public notice to notify prospective bidders.

102.13 Disqualification of Bidders

102.13.1 General

(1) If the department disqualifies a bidder, the department will notify that bidder in writing. The department will give the reason for disqualification, the term of disqualification, and instructions for reestablishing eligibility to bid on departmental contracts.

102.13.2 Department May Disqualify

(1) The department may disqualify the bidder from further bidding for a period of time determined by the department for one or more of the following reasons:

1. The department has notified the bidder that it has initiated a debarment or suspension action against the bidder under Trans 504 of the Wisconsin administrative code.
2. Developments, subsequent to establishment of a bidder's competency and qualifications, which in the department's judgment affect the responsibility of the bidder.
3. Not complying, within a reasonable time, with the department's request to update a prequalification statement.

102.13.3 Department Will Disqualify

(1) The department will disqualify the bidder from further bidding, for a period of time the department determines, if the bidder has been suspended or debarred from bidding on department contracts under Trans 504 of the Wisconsin administrative code.

Section 103 Contract Award and Execution

103.1 Consideration of Proposals

(1) Following the public opening of the proposals received, the department will compare them based on the summation of the products of the quantities of work listed and the contract unit prices offered. In case of discrepancies, errors, or omissions, the department will make corrections as specified in 102.7.1. In awarding contracts, the department, in addition to considering the amounts stated in the proposals, may consider one or more of the following:

1. The responsibility of the various bidders as determined from a study of the data required under 102.1.
2. The information required on the bidding proposal.
3. Information from other investigations that the department may make.

(2) The department will also review the proposals for the irregularities described in 102.7 and review the eligibility of the bidder as specified in 102.13. The department will determine whether irregularities are matters of form rather than substance and can be waived without prejudice to other bidders or the public interest.

(3) The bidder may submit individual proposals for more than one contract being let. Although each individual proposal may not exceed the bidder's rating, a combination of more than one proposal and incomplete work currently under contract may exceed the bidder's rating. If the bidder exceeds its rating, the department may award a proposal or combination of proposals within the bidder's rating and most advantageous to the department.

(4) The department may reject any or all proposals, or waive technicalities. The department, in its own interest, may re-advertise for bids or proceed with the work in another manner.

103.2 Awarding the Contract

(1) Unless rejecting all proposals, the department will award the contract to the lowest responsible bidder whose proposal complies with 103.1. If two or more bidders submit identical low bids, the department will determine the successful bidder by flipping a coin.

(2) The bidder, by written notice before the time set for opening of bids, may limit the bidder's total dollar volume of work or number of contracts to be awarded in a letting, and the department will determine which contract or contracts to award.

(3) If the department does not make an award within 30 calendar days after opening the proposals, the lowest responsible bidder, after those 30 days, may request, in writing, that the department make the award. Stipulate a deadline of 10 business days or more, after the date of the request, for the department to make the award. If the department does not make the award within the stipulated time, the bidder is relieved of its obligation to execute a contract and contract bond.

103.3 Canceling the Award

(1) The department may cancel a contract award before execution without liability.

103.4 Returning Proposal Guaranty

(1) The department will return the proposal guaranties of all except the lowest responsible bidder within 5 business days after determining the lowest qualified bidder. The department will return the lowest responsible bidder's proposal guaranty as soon as the bidder executes and submits in the proper form the contract, contract bond, and other required documents.

(2) If the department does not make the award within the time stipulated by the lowest responsible bidder as specified in 103.2(3), the department will return their proposal guaranty within 5 business days after that deadline.

103.5 Contract Bond

(1) At the time of submitting the contract for execution by the department, deposit a valid surety bond with the department in the amount designated on the bond form covering both performance and payment. Submit the contract bond on a department-furnished form.

(2) Ensure that the surety is licensed to do business in Wisconsin and has an equivalent A.M. Best rating of A- or better. The surety is subject to the department's approval, and to the governor's approval, if required by law.

103.6 Executing and Approving the Contract

(1) The bidder shall execute the contract. The principal and the sureties shall execute the contract bond. Present the contract, the contract bond, 30 percent rule documentation using department form WS1081, and all other department-required forms within 10 business days after the date of notice of the award of the contract. Department form WS1081 is available at:

(2) The contract is not binding on the department until the final execution of the contract. The contract final execution date is the date the final signer signs the contract.

103.7 Failure to Execute Contract

(1) The department may cancel the award if, within 10 business days after the date of notice of the award of the contract, the successful bidder does not do the following:

1. Return required forms or supply other department-requested information.
2. Execute a contract and contract bond, as provided in 103.6.

(2) If the department cancels the award, the department may retain the proposal guaranty, not as a penalty, but in payment of liquidated damages the department sustains due to the bidder's failure to execute. If the retained proposal guaranty is a bid bond, pay the department the proposal guaranty amount within 10 business days of demand.

103.8 Nullifying the Award

(1) The department will accept the bidder's request to nullify and will nullify the bidder's acceptance of the contract if the following conditions are met:

1. The bidder files the required contract documents in proper form and order.
2. The department does not execute the contract within 30 calendar days after the bidder files the required contract documents.
3. The bidder files a written request to nullify with the department. Wait the 30 days specified in item 2 of 103.8(1) before filing that request. Stipulate in the request a deadline for the department to execute the contract. This deadline must be 10 business days or more after the filing date of the request.
4. The department does not execute the contract within the stipulated deadline.

(2) The department will notify the bidder, in writing, if the department agrees to nullify the award. The department's failure to act within the stipulated deadline also constitutes nullification.

(3) The request to nullify is a voluntary act of the bidder. The department's nullification relieves the bidder, the bidder's surety, and the department of all obligations under the award.

(4) Unless and until the bidder files a request to nullify, and until the department nullifies, the department may execute the contract without prejudice to any contract terms and conditions.

Section 104 Scope of Work

104.1 Intent of the Contract

(1) The intent of the contract is to state the roles and obligations of the department and contractor regarding the construction, execution, and completion of the work. Perform the work as the contract specifies.

104.2 Revisions to the Contract

104.2.1 General

(1) The department reserves the right to revise the contract at any time. These revisions do not invalidate the contract or release the surety. The contractor agrees to complete the contract as revised. Do not proceed with revised work without the project engineer's prior written approval. Upon receiving written approval, proceed immediately with the revised work.

(2) The contractor shall notify the project engineer if the contractor believes a revision to the contract is necessary. Whenever the words notice, notification, or notify are used in 104.2 with reference to the contractor, the contractor shall provide notice as specified in 104.3. The project engineer will determine if a potential contract revision is necessary and will notify the contractor of its determination in writing. The contractor must proceed with the project engineer's direction.

(3) If the project engineer determines a revision is necessary, the project engineer will revise the contract time as specified in 108.10 and will revise the contract price as specified in 109.4. The contractor is entitled to no reimbursement for loss of anticipated profit.

(4) If the project engineer decides that a potential contract revision identified by the contractor is not necessary, and the contractor does not agree with the project engineer's decision, the contractor may pursue a claim under 105.13.

104.2.2 Issuing Contract Change Orders

104.2.2.1 Change Orders for Extra Work

(1) The department will issue a contract change order to accomplish extra work as defined in 101.3.

104.2.2.2 Change Orders for Differing Site Conditions

(1) During the progress of the work, if one or more of the following differing conditions are encountered at the site, the party discovering the condition shall promptly notify the other party of the specific condition before further disturbing the site and before further performing the affected work.

1. A subsurface or latent physical condition, differing materially from those indicated in the contract.
2. An unknown physical condition of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work specified in the contract.

(2) If the contractor discovers the differing condition, the contractor shall provide oral notification as specified in 104.3.2, of the specific differing condition before further disturbing the site and before further performing the affected work.

(3) The project engineer will investigate the conditions. If the project engineer determines the conditions materially differ and cause an increase or decrease in the cost, time, or both, required to perform the work under the contract, the project engineer will adjust the contract price, time, or both, and modify the contract in writing accordingly. The project engineer will respond to the contractor as to whether or not an adjustment is warranted. The project engineer will follow the contractor notification procedures specified in 104.3.

(4) The department will not allow a contract adjustment unless the contractor has provided the required notice as specified in 104.3.

104.2.2.3 Change Orders for Engineer-Ordered Suspensions

(1) If the project engineer suspends or delays the performance of all or any portion of the 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 payment, contract time, or both, is due because of the suspension or delay, the contractor shall notify the engineer as specified in 104.3.

(2) The project engineer will evaluate the contractor's request. If the project engineer agrees that the cost, time, or both, required for the performance of the contract has increased due to the suspension or delay and the suspension or delay was caused by conditions beyond the control of and not the fault of the contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the project engineer will make an adjustment and modify the contract in writing accordingly. The project engineer will respond to the contractor as to whether or not an adjustment is warranted as specified in 104.3.6.

(3) The project engineer will not consider a contract adjustment unless the contractor submits the request for adjustment within the time specified above.

(4) The project engineer will not consider a contract adjustment under this clause to the extent that the performance would have been suspended by any other cause, or for which an adjustment is provided or excluded under any other term or condition of this contract.

104.2.2.4 Change Orders for Significant Changes in the Character of the Work

104.2.2.4.1 General

(1) Under the contract a significant change is defined if either one of two separate and distinct circumstances occur as follows:

1. Altered work.
2. Changed quantities.

(2) Before performing significantly changed work, reach agreement with the department concerning the basis for the adjustment as specified in 109.4.4. If the department does not acknowledge that the work has significantly changed, follow the notification procedures as specified in 104.3.

(3) If the alterations or changes in quantities do not significantly change the character of the work under the contract, the department will pay for the altered work at the contract price.

104.2.2.4.2 Altered Work

(1) The department will adjust the contract if the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction.

104.2.2.4.3 Changed Quantities

(1) The department will adjust the contract if the department or contractor demonstrates that quantity changes affect the contractor's unit cost to perform the work and meet one of the following:

1. The quantity of a major bid item, as defined in 101.3, is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity applies only to that portion in excess of 125 percent of the original contract bid item quantity, or in case of a decrease below 75 percent, to the work actually performed.
2. The quantity of a minor bid item is increased to become a major bid item. An adjustment in the contract unit price for that bid item applies only to the quantity of that bid item having a contract value as follows:

   Original Contract < $8M: In excess of 6.25 percent of the original contract.

   Original Contract >= $8M: In excess of $500,000.
3. The quantity of a minor bid item that is part of an approved subcontract and that exceeds 10 percent of the original value of that subcontract is decreased more than 50 percent from the original contract quantity for that bid item. Either party to the contract may submit a request for a revision to the contract unit price for that bid item. The department’s total payment for the final reduced quantity will not exceed 75 percent of the original contract quantity at the contract price.
4. The quantity of a minor bid item that is part of an approved subcontract and that exceeds 10 percent of the original value of that subcontract is increased more than 50 percent from the original contract quantity for that bid item and which as increased does not qualify for adjustment as a major bid item. Either party to the contract may submit a request to the other for a revision of the contract unit price for that quantity of the bid item that is in excess of 125 percent of the original contract quantity.

104.2.2.5 Change Orders for Eliminated Work

(1) The department has the right to partially eliminate or completely eliminate work the project engineer finds to be unnecessary for the project. If the project engineer partially eliminates or completely eliminates work, the project engineer will issue a contract change order for a fair and equitable amount as specified in 109.5.

104.2.2.6 Change Orders for Revisions to Contract Time

(1) The department will issue a contract change order to revise the contract time as specified in 108.10.

104.3 Contractor Notification

104.3.1 General

(1) Subsection 104.3 specifies the step-by-step communication process to be followed to expedite the resolution of potential contract revisions identified by the contractor. Both contractor actions and department responses are outlined. The contractor's non-compliance with the requirements of 104.3 may constitute a waiver of entitlement to a pay adjustment under 109.4 or a time extension under 108.10.

104.3.2 Contractor Initial Oral Notification

(1) If required by 104.2, or if the contractor believes that the department's action, the department's lack of action, or some other situation results in or necessitates a contract revision, the contractor must promptly provide oral notification to the project engineer. Upon notification, the project engineer will attempt to resolve the identified issue.

104.3.3 Contractor 2-Day Written Notice

(1) If the project engineer has not responded or resolved the identified issue within 2 business days after receipt of oral notification, provide a contractor 2-day written notice to the project engineer. At a minimum, provide the following:

1. A written description of the nature of the issue.
2. The time and date of discovering the problem or issue.
3. If appropriate, the location of the issue.

(2) The contractor is encouraged to provide the additional information specified in 104.3.5 as early as possible to assist the project engineer in the timely resolution of an identified issue. The project engineer will not require, in subsequent submissions, duplication of information already provided.

104.3.4 Engineer One-Day Written Acknowledgment

(1) Within one business day after the contractor provides initial written notice, the project engineer will provide a project engineer one-day written acknowledgment to the contractor. The project engineer will continue to resolve the issue.

104.3.5 Contractor 5-Day Written Statement

(1) If the project engineer has not resolved the issue within 5 business days from the date of the initial written notice, augment the original written notice with an additional contractor 5-day written statement to resolve the issue. In the written statement:

1. State why the issue is a change to the original contract.
2. Refer to the contract to show what has changed from the original contract.
3. Provide all perceived adjustments to contract prices, delivery schedules, phasing, and contract time.
4. Provide an estimate of the time within which the department must respond to the notice to minimize cost, delay, or disruption.

(2) The department understands that the contractor's estimates of the time required and additional costs may be based on incomplete information. The department will attempt to comprehend and resolve the potential change as quickly as possible. The contractor can help the department in this process by providing the requested information as quickly as possible.

104.3.6 Engineer 5-Day Written Response

(1) Within 5 business days after receiving the contractor 5-day written statement, the project engineer will consider the statement and provide a project engineer 5-day response in writing to the contractor with one or more of the following responses:

1. The project engineer will confirm that a contract change order is necessary as specified in 104.2. The project engineer will give direction concerning the potential change.
2. The project engineer will deny that the contract has to be revised. The project engineer will provide a statement as to why the issue is not a change to the contract. At a minimum, the project engineer will respond to the contractor's issues and refer to the contract to show why the issues are not a change from the original contract.
3. The project engineer will request additional information to allow the project engineer to decide whether item 1 or 2 of 104.3.6(1) applies. The project engineer will state the information needed and date it is to be received for further review.

(2) If the contractor does not agree with the project engineer's decision the contractor may pursue the issue as a claim as specified in 105.13. Alternatively, if the contractor and department mutually agree, the department will get a third-party advisory opinion according to the department's dispute resolution procedures.

(3) If a third party reviews the issue, their recommendation is not binding on either party. The project engineer has 14 calendar days after receipt of the third party's written recommendation to render a decision. If the department fails to respond in writing within those 14 calendar days or the contractor disagrees with the project engineer's decision, the contractor may pursue the issue as a claim as specified in 105.13.

104.4 Requests for Information

(1) Either the department or the contractor may request information that the other party must provide in order for the requesting party to fulfill its contract obligations. The requesting party shall submit requests for information (RFI) on department form DT2502 either in hard copy or via email. RFI must conform to the following:

- Be of reasonable scope.
- Explain why a response is necessary to fulfill contract obligations.
- Provide a requested response time, which must be reasonable in relation to its scope.

(2) The responding party shall respond on department form DT2502 either in hard copy or via email within the requested response time. If more time will be required to adequately address the issue, the responding party shall provide a written status report within the requested response time. The parties will discuss the status of outstanding RFI at each progress meeting until the issue is resolved.

104.5 (Vacant)

104.6 Roadway Maintenance and Traffic Control

104.6.1 General

(1) The contractor is not liable for damages to or failure of existing facilities unless the damage or failure results from the contractor's own operations, negligence, or noncompliance with the contract.

(2) The contractor shall maintain only those facilities or portions of facilities, including the roadbed surfaces, on which construction has begun or been completed, or has been damaged by the contractor's operations or has been damaged due to the contractor's negligence or noncompliance with the requirements of the contract.

(3) The contractor is not responsible for snow removal or ice control operations to maintain traffic on highways open to traffic or closed to through traffic.

(4) Maintain the safety of the traveling public and control traffic using barricades, signs, flaggers, and temporary barrier as specified in part VI, of the WMUTCD and ensure that the contractor's use of the right-of-way conforms to 107.9. Furnish, erect, and maintain traffic control devices and facilities conforming to 643, or as the engineer directs, throughout the life of the contract. Use drums, barricades, and temporary barrier to delineate and shield abrupt drop-offs and other hazards. Conduct flagging operations according to the plan details and the WMUTCD. Adequately train flaggers in the methods described in the WMUTCD and associated video before allowing them to control traffic. Costs for flagging and guidance services and signs associated with flagging and guidance, are incidental to the contract. The department will pay separately for temporary portable rumble strips required in the flagging plan details under contract special provision bid item Temporary Portable Rumble Strips.

(5) The contractor is responsible for all damages to the work due to failure of barricades, signs, lights, flaggers, watchers, and temporary barrier to protect it. The engineer may order the contractor to immediately remove and replace or otherwise repair the damaged work at no additional expense to the department.

(6) These provisions do not relieve the contractor of responsibility for injury or damage caused by the contractor's negligence in properly safeguarding public travel.

104.6.2 Temporary Roads

(1) Construct and maintain temporary roads necessary to maintain traffic as the contract specifies or as the engineer directs. Excavate and remove those portions of temporary roads not incorporated into the final roadway section, and restore disturbed areas outside the construction limits to their original condition.

(2) The department will pay for the construction and removal of temporary roads, included in the contract or as the engineer orders, and the associated restoration of disturbed areas. The department will pay for this construction, removal, and restoration work at the contract unit prices of the bid items used, or as extra work, if the necessary bid items are not included in the contract.

(3) Maintain temporary roads, included in the contract or as the engineer orders, in a safe and adequate condition. The cost of maintaining these temporary roads is incidental to the contract, except during suspensions under 104.6.7.

(4) The cost of constructing, maintaining, and removing temporary roads the contract does not show or the engineer did not order, is incidental to the contract.

104.6.3 Road Closed to Traffic

(1) If the contract provides, or if the engineer orders, that the road or portions of the road be closed to all traffic, furnish, erect, and maintain the traffic control devices at the project termini and at intersecting roads along the project the contract specifies or as the engineer directs. Unless specifically required in the contract, the contractor is not responsible to maintain the pavement structure or traffic signs of the detour that may be provided for the accommodation of traffic around the portion of the road closed to traffic.

(2) Never close a public road or portion of a public road without the engineer's specific written permission. If the contract specifies, or if the engineer orders, that a road or a portion of road is to be closed, notify the engineer at the earliest possible date of when the closure is needed so the department can make arrangements to close the road and provide detours.

104.6.4 Road Closed to Through Traffic

(1) If the contract provides that the road or portions of the road be closed to through traffic, furnish, erect, and maintain the traffic control devices at the project termini and at intersecting roads along the project the contract specifies or the engineer directs. Also, furnish, erect, and maintain those traffic control devices within the project limits as may be required for the safe accommodation of local traffic as defined in 101.3. At all times conduct the work in a manner to provide safe, reasonably-direct, all-weather, 24-hour pedestrian and vehicular access to abutting properties along the highway being improved.

(2) Unless specifically required in the contract, the contractor is not responsible to maintain the pavement structure or traffic signs of the detour that may be provided for the accommodation of traffic around the portion of the road closed to through traffic. The department will pay for surfacing and base materials that the engineer deems necessary to maintain the roadway at contract unit prices, or as extra work.

104.6.5 Opening Section of Closed Road to Traffic before Work is Completed

(1) For contracts with the road or portions of the road closed to traffic during construction, the engineer may direct or authorize the contractor to open sections of the road to public traffic before the work is completed. The engineer may direct the contractor to open sections of the road for the convenience of the traveling public. The engineer may authorize the contractor to open sections of the road to public traffic due to the contractor's request. Do not open the road to public traffic without the engineer's written direction or written authorization. By opening sections to public traffic, the contractor is not relieved of performing the maintenance. However, the department will assume all costs for repair and maintenance solely attributable to public traffic use, and beyond the control and without fault of the contractor. These maintenance expenses include costs associated with those traffic control devices or facilities specified in this section. The engineer's direction or authorization to open sections of the road to public traffic does not constitute partial acceptance under 105.11.1 and waives no other contract provisions.

(2) Furnish, erect, and maintain those traffic control devices as may be required for the safe accommodation of the traffic.

(3) The contractor is not liable for injuries or damages sustained by a person using the opened highway except for injuries or damages resulting from the contractor's own operations, negligence, or noncompliance with the requirements for traffic control under 104.6.1.

(4) Whenever opening the road or a portion of the road to traffic, conduct the remainder of the construction operations in a way that causes the least obstruction to traffic.

104.6.6 Road Open to All Traffic

(1) If the contract provides for the maintenance of all traffic over or along the road while undergoing improvement or reconstruction, keep the road open to all traffic. Furnish, erect, and maintain the traffic control devices as required to keep the portions of the road being used by public traffic in a condition to safely and adequately accommodate pedestrian and vehicular traffic. The department will pay for necessary work and materials to maintain the roadway at the contract unit prices of the bid items used or as extra work if the necessary bid items are not included in the contract.

104.6.7 Traffic Control and Maintenance During Suspensions of the Work

(1) During a suspension of work as specified in 105.1, the contractor shall make passable and open to traffic portions of the highway under improvement and temporary roads or portions thereof as the contractor and the engineer may agree upon for temporary accommodation of necessary traffic during the period of suspension. During the period of suspension, maintain the surface of the traveled way of the temporary route or line of travel agreed upon.

(2) When resuming work, replace or renew all work or material lost or damaged because of temporary use of the highway under improvement. Remove temporary roads and restore disturbed areas outside the construction limits to their original condition, as the engineer directs. Complete the improvements in every respect as though prosecution had been continuous and without interference, except as the contractor and the engineer may otherwise have agreed upon at the time the arrangement was made for the temporary accommodation of necessary traffic during the anticipated period of suspension.

(3) If the reason for the suspension is beyond the control and without the fault of the contractor, the department will pay for the following at the contract unit prices of the bid items used, or as extra work if the necessary bid items are not included in the contract.

1. The replacement of materials and additional work made necessary because of the temporary use of the highway.
2. The construction and removal of temporary roads needed for public travel during the suspension, and the corresponding restoration of disturbed areas outside the construction limits.
3. Maintaining the surface of the traveled way of temporary roads used by the public during the period of suspension.
4. The furnishing, erecting, and maintenance of those traffic control devices and facilities needed to safely accommodate public travel during the suspension.

104.7 Removing Structures and Obstructions

(1) Remove from within the roadway all or parts of existing culverts, bridges, and miscellaneous structures designated for replacement or that interfere with new construction. The department will:

1. Pay for removing existing culverts and bridges as specified in 203.5.
2. Pay for removing existing miscellaneous structures as specified in 204.5, if the contract contains separate removal bid items under 204.
3. Pay for removing existing miscellaneous structures as follows, if the contract does not contain separate removal bid items under 204:
   - 3.1. Pay as specified in 206.5.1, if the removal is located within the limits of an Excavation for Structures bid item under 206.
   - 3.2. Otherwise, pay as incidental to the Excavation bid items under 205.

(2) Remove all or parts of existing culverts, bridges, and miscellaneous structures from beyond the roadway, but within the highway, if the contract specifies. Within 104.7, highway means the entire highway right-of-way, including abutting portions of existing highways. The department will:

1. Pay for removing existing culverts and bridges, as specified in 203.5.
2. Pay for removing existing miscellaneous structures as specified in 204.5, if the contract contains separate removal bid items under 204.
3. Pay for removing existing miscellaneous structures as follows, if the contract does not contain separate removal bid items under 204:
   - 3.1. Pay as incidental to the Obliterating Old Road bid item, if the removal is located within the limits of the Obliterating Old Road bid item under 214.
   - 3.2. Otherwise, pay as incidental to the other contract bid items.
4. Pay for removals as extra work, if they are not specified in the contract but subsequently required.

(3) Leave structures beyond the limits of the highway in place.

104.8 Rights in the Use of Materials Found on the Project

(1) The contractor may use on the project stone, gravel, sand, or other material found within the vertical and horizontal excavation limits the plans show. Ensure that the engineer determines the material's suitability before using it. The department will pay for both the excavation of these materials at the corresponding contract bid price and the bid item for which the excavated material is used. The department will not charge the contractor for the materials found within the above described excavation limits and so used. Replace, at no expense to the department, with other acceptable material all of the excavation material so removed and used for embankments, backfills, approaches, or otherwise.

(2) Do not excavate or remove material from within the right-of-way that is not within the vertical and horizontal excavation limits the plans show without the engineer's written authorization. Do not base bids on the anticipated approval of a request to excavate or remove material that is not within the above described excavation limits.

(3) Take ownership of all materials required to be removed and not necessary for the work.

104.9 Final Cleanup

(1) Upon completion of the work and before the department accepts the work as specified in 105.11.2 and makes final payment as specified in 109.7, the contractor shall remove from the right-of-way, and to the extent that the contractor is responsible therefore, from the adjacent property, all surplus and discarded materials, rubbish, and temporary structures. Leave the right-of-way in a neat and presentable condition. The contractor shall restore, at no expense to the department and in general conformity with the contract for the bid item or bid items involved, all work completed under previous contracts that the contractor has damaged.

(2) If the contractor procures or produces material from a pit, quarry, or deposit which is not an active commercial source or is not naturally submerged, the contractor shall do work as necessary and practicable to shape, slope, and trim and drain the site, including associated haul roads and adjacent areas disturbed by the contractor's operations, so that it presents a stable, neat, trimmed appearance and that no water collects or stands therein. Do not create or enlarge an area of open water except as allowed under 208.2.2.

(3) The cost of final cleanup is incidental to the contract.

104.10 Cost Reduction Incentive

104.10.1 General

Revise 104.10.1(1) to eliminate CRIs for department generated ideas. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Subsection 104.10 specifies a 2-step process for contractors to follow in submitting a cost reduction incentive (CRI) for modifying the contract in order to reduce direct construction costs computed at contract bid prices. The initial submittal is referred to as a CRI concept and the second submittal is a CRI proposal. The contractor and the department will equally share all savings generated to the contract due to a CRI as specified in 104.10.4.2(1). The department encourages the contractor to submit CRI concepts.

(2) Follow the procedures specified in 104.10.2 for submitting a CRI concept. If the department determines a CRI concept has merit, the department will encourage the contractor to submit a CRI proposal. Follow the procedures specified in 104.10.3 for submitting a CRI proposal.

(3) The contractor may submit a CRI concept from a subcontractor. Subcontractors may not submit a CRI except through the contractor.

(4) The contractor may submit a CRI concept only after the execution of the contract. Do not base bid prices on the anticipated approval of a CRI proposal. If the department rejects a CRI proposal, complete the contract as specified in the original terms or as otherwise modified.

Revise 104.10.1(5) to explicitly list pavement design changes the department will not allow under a CRI.

(5) The department will consider a CRI that changes but does not impair the essential functions or characteristics of the project. These functions or characteristics include, but are not limited to, appearance, service life, economy of operations, ease of maintenance, design, and safety of structures and pavements, construction phasing or procedures, or other contract requirements. The department will not consider a CRI that changes the following:

- Permanent or temporary pavement type.
- Permanent or temporary structural cross section.

(6) The department will decide whether or not to approve a CRI. The department will bear no liability for causing a delay to the project in considering a CRI or for refusing to approve a CRI. The department may consider a noncompensable time extension as specified in 104.10.2(3). The department will consider no contractor claims for additional costs related to the acceptance or rejection of a CRI, including loss of anticipated profits, or increased material or labor costs. The department will reimburse the contractor for the development costs of CRI proposals as specified in 104.10.4.1(3).

(7) A CRI, approved or not approved by the department, applies only to the contract for which the contractor submits it. Impose no restrictions on the CRI for its use or disclosure. The department has the right to use, duplicate, and disclose in whole or in part all data necessary for the utilization of the CRI. The department may use an accepted CRI or part of an accepted CRI on other projects without obligation to the contractor. This provision does not deny rights granted by law with respect to patented materials or processes. The department will not use this provision as the basis for rejecting the contractor's submittal of a CRI concept from past projects.

(8) Continue to perform the work as the contract specifies until receipt of the engineer's written acceptance or rejection of the CRI Proposal.

(9) Work produced under an approved CRI contract change order is subject to the provisions of 105.3.2 for nonconforming work.

104.10.2 Submittal and Review of a CRI Concept

(1) Initially, submit a brief letter with graphics as necessary to the engineer to describe and illustrate the CRI concept. Estimate the overall CRI savings and the costs to develop the CRI proposal specified in 104.10.3. The engineer will use the contractor's estimate of the CRI proposal development costs as specified in 104.10.4.1(3). Indicate whether adequate time is available in the project schedule for submitting a complete CRI proposal and for the department's review before implementation.

(2) The department will review the CRI concept and, within 5 business days of the contractor's initial submittal, notify the contractor in writing whether the CRI concept has merit and whether the contractor should submit it as a CRI proposal. The contractor and the department can mutually agree to extend this 5-day review requirement. The department will notify the contractor if a professional engineer registered in the state of Wisconsin should seal the CRI proposal. If the department informs the contractor to submit the CRI proposal, the department will share in the cost for developing the CRI proposal as specified in 104.10.4.1(3).

(3) If the department determines the time for response indicated in the CRI concept letter is insufficient for review, the department may choose to evaluate the need for a noncompensable time extension to the contract. The department will base its evaluation on the additional time that the department needs for its review of the CRI proposal and the effect on the contractor's schedule caused by the added review time.

(4) If the department has already taken action to implement revisions to the contract subsequently proposed in a CRI concept, the department may reject the CRI concept and revise the contract without obligation to the contractor.

(5) The department may reject a CRI concept if it addresses a potential contract change situation as specified in 104.2.

(6) The savings generated by the CRI must be sufficient to warrant its review and processing and offset the level of risk. The department will assess the risk of the CRI relative to departmental design policies and criteria for the project. The department may reject a CRI concept for the following reasons:

1. It requires excessive time or costs for the contractor to develop the CRI proposal.
2. It requires excessive time or costs for review, evaluation, investigation, or implementation.
3. It introduces an inappropriate level of risk.

104.10.3 Submittal of the CRI Proposal

(1) Within 10 business days after the department has determined that the CRI concept has merit, submit the CRI proposal. The contractor and department can mutually agree to extend this 10-day submittal requirement. Ensure that the CRI proposal includes sufficient data for the department to make an informed decision regarding the proposal and includes, at a minimum, the following information:

1. A statement that the proposal is submitted as a CRI.
2. A description of the difference between the existing contract and the proposed change and the advantages and disadvantages of each, which may include effects on service life, economy of operations, ease of maintenance, benefits to the traveling public, desired appearance, and safety.
3. A complete set of plans and specifications showing the proposed revisions relative to the original contract features and requirements. Support the proposed revisions with design computations as necessary for a thorough and expeditious evaluation.
4. A complete analysis indicating the final estimated costs and quantities to be replaced by the CRI compared to the new costs and quantities generated by the CRI. The department will use these costs as specified in 104.10.4.2(1) to compute the proposed net savings.
5. A statement specifying the time within which the department must make a decision.
6. A statement detailing the effect the CRI will have on interim completion dates and the time for completing the contract.
7. A description of a previous use or testing of the CRI and the conditions and results. If the contractor previously submitted the CRI on another department project, the contractor shall indicate the date, contract number, and action taken by the department.
8. A detailed statement that indicates the costs for developing the CRI proposal and implementing the changes. The department will use these costs as the contractor's CRI development and implementation costs as specified in 104.10.4.1(3) and 104.10.4.2(1).
9. Ensure that a professional engineer registered in the state of Wisconsin seals the CRI proposal if the department requires it as specified in 104.10.2(2).

10. If proposing design changes, the contractor may include with the additional information, results of field investigations and surveys, design computations, and field change sheets.

104.10.4 Acceptance, Rejection, and Payment

104.10.4.1 Acceptance, Rejection, and Payment of a CRI Proposal

(1) Within 10 business days of the contractor's submission of the CRI proposal, the department will accept or reject the CRI proposal in writing. The contractor and the department can mutually agree to extend this 10-day review requirement. Provide requested additional information needed to evaluate the CRI proposal in a timely manner. The department may reject a CRI proposal for untimely submittal of additional information.

(2) After accepting the CRI proposal, the department will execute a change order reimbursing the contractor for the cost of preparing the CRI proposal. The department will limit reimbursement to the contractor's estimate of the CRI proposal development costs provided in the CRI concept submittal. The change order will also state the conditions for the department's acceptance and which of the following the net savings will be based on:

1. Agreed lump sum prices before the contractor performs the CRI.
2. Agreed unit prices before the contractor performs the CRI in conjunction with quantities that the department will measure after the contractor completes the CRI.

(3) If the department informs the contractor to submit a CRI proposal as specified in 104.10.2 and later rejects the CRI proposal, the department will execute a contract change order to adjust the contract for the contractor's CRI development costs as listed in item 8 of 104.10.3(1). The department will limit the contract revision amount to the contractor's estimate of the CRI proposal development costs provided in the CRI concept submittal. The contract change order will terminate the department's review of the CRI.

(4) Rejection of a CRI proposal is not an allowable basis for a claim against the department for delay or for other costs.

104.10.4.2 Payment for the CRI Work

Revise 104.10.4.2(1) to clarify that the department may adjust bid prices that do not represent the fair value of work when computing CRI savings. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) The department will pay for completed CRI work as specified for progress payments under 109.6. The department will pay for CRI's under the Cost Reduction Incentive administrative item. When all CRI costs are determined, the department will execute a contract change order that does the following:

1. Adjusts the contract time, interim completion dates, or both.
2. Pays the contractor for the unpaid balance of the CRI work.
3. Pays the contractor 50 percent of the net savings resulting from the CRI, calculated as follows:

$$NS = CW - CRW - CC - DC$$

Where:

NS = Net Savings

CW = The cost of the work required by the original contract that is revised by the CRI. CW is computed at contract bid prices if applicable.[1]

CRW = The cost of the revised work, computed at contract bid prices if applicable.[1]

CC = The contractor's cost of developing the CRI proposal.

DC = The department's cost for investigating, evaluating, and implementing the CRI proposal.

[1] The department may adjust contract bid prices that, in the engineer's judgement, do not represent the fair value of the work deleted or proposed.

(2) The department is the sole judge of the acceptability of a CRI proposal and of the agreed net savings in construction costs from the adoption of all or part of the CRI proposal. The department will not include time savings resulting from the CRI in the calculation of net savings.

Section 105 Control of the Work

105.1 Engineer's Authority

(1) The engineer decides all questions regarding:

1. Interpretation of the contract.
2. The quantity, quality, and acceptability of materials furnished and work performed.
3. Rate of progress of the work.
4. Payment, contract administration, and the acceptable fulfillment of the contract.
5. Disputes.
6. Mutual rights under the contract.

(2) The engineer may suspend the work in writing for any reason at any time during the contract. Except as specified in 104.2.2.3 for engineer-ordered suspensions, the department will allow no additional payment or time extension due to a suspension of work.

(3) The engineer will determine estimated quantities for progress payments as specified in 109.6.

105.2 Supplemental Plans and Drawings

Revise 105.2 to incorporate fabrication library electronic submittal requirements for specified structures.

105.2.1 General

(1) Submit to the engineer supplements to the approved contract plans, shop drawings, and the computations necessary to control the work. Do not change the approved contract plans without the engineer's written authorization.

(2) If sufficient detail is not provided on the structure plans produced by the department, submit to the engineer plans, shop drawings and the computations required to successfully prosecute the work.

(3) If required in the contract, submit plans for temporary structures, cribs, cofferdams, falsework, shoring, and form work. Ensure that these plans and accompanying drawings and computations are signed and sealed by a professional engineer registered in the state of Wisconsin.

(4) Include a transmittal letter with each submittal made under 105.2. Indicate on shop drawings all deviations from the contract drawings and itemize these deviations in the transmittal letter. The department will file and may review these submittals. The department's review does not relieve the contractor of the responsibility for obtaining satisfactory results, for the accuracy of dimensions and details, or for conformity of these drawings with the contract. The contractor may begin work on associated items without the department's review.

(5) Include the cost of furnishing all shop drawings in the unit price for one or more associated bid item.

105.2.2 Fabrication Library Submittals

(1) If specific contract provisions require submittals under 105.2.2, also check and electronically submit shop drawings and computations to the department's fabrication library a minimum of 2 weeks before the start of fabrication. Conform to the fabrication library submission standards. Procedures for accessing the fabrication library are located at:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/fab-sharepoint.aspx

105.3 Conformity with the Contract

105.3.1 General

(1) Perform all work the contract specifies. Produce quality work within limits of precision reasonably expected of good construction. Produce work conforming to the lines, grades, cross-sections, dimensions, and material requirements the contract specifies or the engineer establishes. Monitor construction operations to identify potential unacceptable work as defined in 101.3. Promptly remove and replace, or otherwise correct, unacceptable work at no expense to the department.

(2) The contractor may request a plan dimension change between US standard and SI metric dimensions for a portion of the work. The engineer will only consider this dimension change if the modified work is essentially equivalent to the specified work. The department will pay for this modified work as specified in item 4 of 109.1.1.1(2). Do not proceed with the modified work without the engineer's written permission.

(3) The contract may specify specific values with allowable tolerances, ranges, minimums, or maximums. Control operations to produce work that falls within the specified tolerance or range, falls above a specified minimum, or falls below a specified maximum. If the contract does not specify a tolerance, range, minimum, or maximum value, control operations to produce work conforming to the contract within accepted manufacturing or construction industry standards.

(4) The contract may specify standard manufactured items such as fences, wire, plates, rolled shapes, pipe conduit, etc. If these items are identified by gauge, unit weight, section, dimensions, etc., these identifications are nominal weights or dimensions.

105.3.2 Nonconforming Work

105.3.2.1 Engineer-Accepted Nonconforming Work

(1) If the work does not conform to the contract, the engineer will determine the circumstances under which that nonconforming work may be accepted and allowed to remain in place. The engineer will document the basis of acceptance and may execute a contract change order to adjust the contract unit prices for the nonconforming work. If the contract does not specify a price adjustment, the engineer may adjust the price.

105.3.2.2 Unacceptable Work

(1) The engineer will issue a written order to remove and replace or otherwise correct nonconforming work that the engineer deems unacceptable, as defined in 101.3. If the contractor does not comply with the engineer's written order, the engineer may effect a remedy and deduct the cost from payments due the contractor.

105.3.2.3 Unauthorized Work

(1) Unauthorized work is work performed as follows:

1. Without the lines and grades being given.
2. Beyond the lines and grades the contract shows or the engineer provides.
3. Without the engineer's prior approval.
4. After the inspector has temporarily suspended the work in writing as specified in 105.8.
5. In violation of a written direction the engineer issues.

(2) The department may elect to not measure or pay for unauthorized work. The engineer may issue a written directive to remove unauthorized work at no expense to the department. If the contractor does not comply with the engineer's written directive, the engineer may remove unauthorized work and deduct the cost from payments due the contractor.

105.4 Coordination of the Contract Documents

(1) All documents included under the definition of contract in 101.3 are essential parts of the contract. A requirement occurring in one is binding as though occurring in all. These documents provide for and describe the complete contract. These documents are available to the contractor at no cost.

(2) During the progress of the work, the contractor may request that the engineer interpret or provide information relative to the contract.

(3) If there is a discrepancy between documents, the governing order is as follows:

1. Addenda.
2. Special Provisions.
3. Plans.
4. Additional Special Provisions.
5. Standard Specifications.

(4) If there is a discrepancy on a drawing, the drawing dimensions, unless obviously incorrect, govern over scaled dimensions. If there is a discrepancy in the plans, the typical sections or details govern over the standard detail drawings.

(5) Neither the contractor nor the department may take advantage of an error or omission in the contract. Notify the engineer immediately as specified in 104.3 upon discovering an error or omission. The engineer will offer an interpretation and make the necessary corrections.

105.5 Coordination with the Contractor

105.5.1 Contractor Obligations

(1) Give the work the constant attention necessary to promote the progress of the work. Promptly supply the materials, tools, plant, equipment, labor, and incidental items required to perform the work.

(2) Cooperate with the engineer and with third parties engaged upon or near the work. If the department grants a third party a permit to do utility work, the engineer may issue a change order directing the contractor to make or repair required roadway openings. The department will pay the contractor as specified in 104.2 for extra work.

(3) Maintain one copy each of the plans and specifications at the site of work at all times. The engineer will supply the contractor with copies of the contract. If the department has electronically computed

estimated grading quantities, the department will furnish that information to the contractor upon request.

(4) Supervise and direct the work competently and efficiently. Devote the attention and apply the expertise necessary to perform the work as the contract specifies. Monitor the work in progress to ensure that the work conforms to the contract. The contractor is solely responsible for the means, methods, techniques, sequences, and procedures of construction. The contractor is not responsible for the negligence of others in the design or specification of specific means, methods, techniques, sequences, or procedures of construction described in and expressly required under the contract.

(5) Employ a competent superintendent or designate a representative capable of reading and understanding the contract and experienced in the type of work being performed. The superintendent or designated representative shall be the authorized agent of the contractor and shall have full authority to execute the engineer's directions or instructions without delay. Ensure that the superintendent or designated representative is on the project or accessible to the engineer during all hours of each work day. Notify the engineer promptly when replacing the superintendent or designated representative.

105.5.2 Cooperation Between Contractors

(1) The department may, at any time, contract for or perform other work on or near the work covered under the contract. Cooperate with other contractors engaged upon or near the work.

(2) The contractor shall, or the engineer may, direct the contractor to:

1. Schedule and conduct the work to avoid interference with the operations of other contractors engaged upon or near the work.
2. Perform the work in the proper sequence in relation to that of other work in the area.
3. Join the work to that of others in a manner consistent with accepted manufacturing or construction industry practices.
4. Conduct operations and maintain the work so that adequate drainage is provided at all times.

(3) The contractor is responsible for damage done by the contractor or the contractor's agents to work performed by other contractors. The engineer will resolve disputes between 2 or more contractors, engaged upon or near the work, regarding the rights of each under their respective contracts.

105.6 Construction Staking

105.6.1 General

(1) The department is responsible for errors or discrepancies found in previous department surveys, plans, specifications, special provisions, or work constructed under other department contracts. The department will pay for further studies and redesign required due to these errors or discrepancies.

(2) The department will furnish and set original horizontal and vertical control points the plans show. Prosecute the work using these points for field control. The department is responsible for the accuracy of lines, slopes, and grades it provides. The engineer and contractor shall agree on the meaning of all stakes, measurements, and marks before the contractor begins work.

105.6.2 Contractor Staking

(1) Provide and maintain the horizontal and vertical control, construction stakes, and marks needed to prosecute the work as follows:

1. Staking required under 650 to lay out and construct the work for the individual construction staking bid items the contract includes.
2. Additional horizontal and vertical control, staking, and markings that might be needed to support the contractor's specific method of operations.
3. Other staking or markings as required to successfully prosecute the work.

Provide documentation to the engineer describing the location of and methods used to establish and modify the contractor's horizontal and vertical field control network throughout construction.

(2) The contractor is responsible for the accuracy of lines, slopes, and grades the contractor provides. Construct the work conforming to the lines, grades, cross-sections, and dimensions the contract specifies or the engineer establishes.

(3) Notify the engineer immediately when finding errors or discrepancies in previous surveys, plans, specifications, special provisions, or work constructed under other contracts. Suspend related operations until the engineer gives approval to proceed.

(4) The engineer may check the control of work, as established by the contractor, at any time. The engineer will provide the results of these checks to the contractor, but by doing so in no way relieves the contractor of the responsibility for the accuracy of their layout work.

(5) Correct or replace deficient layout and construction work resulting from:

1. Inaccuracies in the contractor's staking operations
2. Inaccuracies in the contractor's horizontal or vertical field control network.
3. Not reporting inaccuracies found in work done by the department or by others.

(6) If, due to the inaccuracies in 105.6.2(5), the department is required to make further studies, redesign, or both, the department will deduct all expenses incurred from the payment due the contractor.

105.7 Authority and Duties of Project Engineer

(1) As the engineer's direct representative, the project engineer has immediate charge of the engineering details of each construction project. The project engineer is responsible for field administration of the project. The engineer authorizes the project engineer to reject defective material and to suspend all work being improperly performed. The engineer may delegate additional authority, granted under 105.1, to the project engineer.

105.8 Authority and Duties of Inspectors

(1) As the engineer's authorized representatives, inspectors may inspect all work done and all materials furnished.

(2) The department authorizes inspectors to:

1. Call the contractor's attention to work or materials that do not conform to the contract.
2. Reject materials until the engineer is notified and decides all questions at issue.
3. Temporarily suspend work, in writing, until the engineer is notified and decides all questions at issue.

(3) The department does not authorize inspectors to do the following unless the engineer specifically delegates:

1. Revoke, alter, or waive any requirements of the contract.
2. Approve or accept any portion of the completed project.
3. Act as foreperson or perform other duties for the contractor.

(4) The engineer may delegate additional authority to the inspector.

105.9 Inspecting Work

(1) The engineer may inspect, at any time, all materials and all parts of the work. This inspection may include the preparation, fabrication, or manufacture of materials or components on or off the project site. Allow the engineer safe access to all parts of the work. Furnish the information and assistance needed to make a complete inspection.

(2) If the engineer requests, uncover or remove portions of finished work for inspection. After inspection, restore that work to the contract requirements. If the department finds the work acceptable, the department will pay for uncovering, removing, and restoring that work as extra work. If the department finds the work unacceptable, the contractor shall pay for uncovering, removing, and restoring that work.

(3) Failure to reject defective work or materials does not prevent the department from rejecting defective work discovered later.

105.10 (Vacant)

105.11 Inspection and Acceptance

105.11.1 Partial Acceptance

(1) Upon completion of a portion of the work, the contractor may request partial acceptance of that work. The engineer will conduct an inspection to determine if the contractor has satisfactorily completed operations in that area. Within 5 business days, the engineer will grant, in writing, partial acceptance for that portion of the work or reject the contractor's request. If the engineer grants partial acceptance, the engineer will designate, in writing, what portion of the work is partially accepted and the effective date for that partial acceptance.

(2) Partial acceptance will relieve the contractor of maintenance responsibility for the designated portion of the work. By relieving the contractor of maintenance, the department does not relieve the contractor of responsibility for defective work or damages caused by the contractor's operations. Do not construe partial acceptance to be conditional final acceptance or final acceptance of any part of the project, or a waiver of any legal rights specified under 107.16.

105.11.2 Project Acceptance

105.11.2.1 Inspection

105.11.2.1.1 General

(1) Notify the engineer when the project is substantially complete as defined in 105.11.2.1.3. As soon as practicable, the engineer will inspect the work and categorize it as one of the following:

1. Unacceptable or not complete.
2. Substantially complete.
3. Complete.

105.11.2.1.2 Unacceptable or Not Complete

(1) The engineer will identify, in writing, work that is unacceptable or not complete. Immediately correct or complete that work. The engineer will assess contract time until the work is corrected or completed.

(2) Proceed as specified in 105.11.2.1.1 until the engineer determines that the work is complete.

105.11.2.1.3 Substantially Complete

(1) The project is substantially complete and the engineer will no longer assess contract time if the contractor has completed all contract bid items and change order work, except for the punch list. As applicable, the following must have occurred:

1. All lanes of traffic are open on a finished surface.
2. All signage and traffic control devices are in place and operating.
3. All drainage, erosion control, excavation, and embankments are completed.
4. All safety appurtenances are completed.

(2) The engineer will provide a written punch list enumerating work the contractor must perform and documents the contractor must submit before the engineer will categorize the work as complete.

1. Punch list work includes uncompleted cleanup work required under 104.9 and minor corrective work. Immediately correct or complete the punch list work. The engineer may restart contract time if the contractor does not complete the punch list work within 5 business days after receiving the written punch list. The engineer and contractor may mutually agree to extend this 5-day requirement.
2. Punch list documents include whatever contract required documentation is missing. The engineer may restart contract time if the contractor does not submit the punch list documents within 15 business days after receiving the written punch list. The engineer and contractor may mutually agree to extend this 15-day requirement.

(3) Proceed as specified in 105.11.2.1.1 until the work is complete.

105.11.2.1.4 Complete

(1) The project is complete when the contractor has completed all contract bid items, change order work, and punch list work including the submission of all missing documentation.

105.11.2.2 Conditional Final Acceptance

(1) When the engineer determines that the project is complete, the engineer will give the contractor written notice of conditional final acceptance relieving the contractor of maintenance responsibility for the completed work.

105.11.2.3 Final Acceptance

(1) The engineer will grant final acceptance of the project after determining that all contract work is complete; all contract, materials, and payroll records are reviewed and approved; and the semi-final estimate quantities are final under 109.7.

(2) Failure to discover defective work or materials before final acceptance does not prevent the department from rejecting that work or those materials later. The department may revoke final acceptance if the department discovers defective work or materials after it has accepted the work.

105.12 (Vacant)

105.13 Claims Process for Unresolved Changes

105.13.1 General

Revise 105.13.1 to add a reminder that a claim may be avoided if a 3rd party advisory opinion is sought under 104.3.6.

(1) Before submitting a claim, the department and contractor can mutually agree to have the department get a third-party advisory opinion as specified in 104.3.6.

(2) The department and contractor can mutually agree to extend any time frame specified throughout 105.13 and can mutually agree to utilize an alternate dispute resolution method at any point before the department renders its final decision.

(3) The department and contractor share costs related to referral to a dispute review board (DRB) as prescribed in the department's dispute resolution procedures.

105.13.2 Notice of Claim

(1) If the contractor has followed the procedures for revising the contract specified in 104.2 and provided the notification specified in 104.3, but still disagrees with the project engineer, the contractor may pursue the issue as a claim. File a notice of claim with the project engineer concerning the disagreement within 14 calendar days of receiving the project engineer's decision under 104.3.6(1) or 104.3.6(3) whichever comes last. Update the previously submitted information if something has changed that may affect the project engineer's previous decision.

(2) The project engineer may deny the applicable portion of a claim if the contractor does not do the following:

1. File the notice of claim within 14 calendar days as specified in 105.13.2(1).
2. Give the project engineer sufficient access to keep a record of the actual labor, materials, and equipment used to perform the claimed work.

(3) Upon filing the notice of claim, maintain records as specified for force account statements in 109.4.5.1(3). Unless the project engineer issues a suspension, the contractor shall continue to perform the disputed work. The department will continue to make progress payments to the contractor as specified in 109.6.

105.13.3 Submission of Claim

(1) Submit the claim to the project engineer as promptly as possible following the submission of the Notice of Claim, but not later than final acceptance of the project as specified in 105.11.2.3. If the contractor does not submit the claim before final acceptance of the project, the department will deny the claim.

105.13.4 Content of Claim

(1) Include the following 5 items in the claim.

1. A concise description of the claim.
2. A clear contractual basis for the claim. This should include reference to 104.2 on revisions to the contract and as appropriate, specific reference to contract language regarding the bid items in question.
3. Other facts the contractor relies on to support the claim.
4. A concise statement of the circumstances surrounding the claim and reasons why the department should pay the claim. Explain how the claimed work is a change to the contract work.
5. A complete breakdown of the costs used to compile the claim. Include copies of all EquipmentWatch equipment rental rate sheets used, with the applicable number highlighted.

(2) The department may refer the claimant of a false claim to the appropriate authority for criminal prosecution. Certify the claim using the following form:

The undersigned is duly authorized to certify this claim on behalf of (the contractor).

(The contractor) certifies that this claim is made in good faith, that the supporting data are accurate and complete to the best of (the contractor's) knowledge and belief, and that the amount requested accurately reflects the contract adjustment for which (the contractor) believes that the department is liable.

(THE CONTRACTOR)

By:_____
(Name and Title)

Date of Execution:_____

105.13.5 Review by the Region

(1) In the initial review phase, the contractor and the region will have up to 28 calendar days, from the contractor's submission of the claim, for the contractor to submit all additional information required and for the region to review the claim and conduct all meetings. The region may request, in writing, that the contractor submit additional information related to the claim. The contractor shall submit that additional information, or notify the region in writing to base its decision on the information previously submitted. Either party may request a meeting to present their views. Before the meeting, the region will distribute written ground rules for the meeting to both parties.

(2) Upon completion of the initial review phase, the region will notify the contractor in writing that it has begun the decision phase.

(3) In the decision phase, the region will have up to 28 calendar days to render a written decision. The region will consider both parties' written and oral submissions and may consider other relevant information in the project records. The region will provide the following in its decision:

1. A concise description of the claim.
2. A clear, contractual basis for its decision that includes a reference to 104.2 on revisions to the contract and as appropriate, specific reference to language regarding the bid items in question.
3. Other facts the region relies on to support its decision.
4. A concise statement of the circumstances surrounding the claim and reasons for its decision. If the region rejects the claim in whole or in part, the region will explain why the claimed work is not a change to the contract work.
5. The amount of money or other relief, if any, the region will grant the contractor.

(4) In the appeal phase, the contractor will have up to 28 calendar days from the date of the region's decision to appeal to the bureau. If the contractor does not submit a written appeal to the region within those 28 days, the region's decision is final. If the region does not render a decision within the 28 calendar days specified in 105.13.5(3), the region will forward the claim to the bureau as if the region had rejected the contractor's claim.

105.13.6 Review by the Bureau

105.13.6.1 General

(1) The bureau will act on claims either appealed or forwarded from the region level. The region will forward the claim to the bureau and give the bureau all documents and evidence regarding the claim previously submitted to the region. The department will do one of the following:

- Proceed with the bureau's review.
- Waive the bureau's review and refer the claim directly to the review panel.
- If the department and contractor mutually agree to a third-party review, refer the claim to a neutral third-party DRB for review according to the department's dispute resolution procedures.

105.13.6.2 Bureau Review

(1) In the initial review phase, the contractor and the region will have up to 28 calendar days, from the date of the appeal, to submit all additional information required to review the claim and to conduct all meetings. The bureau may request, in writing, that the contractor submit additional information related to the claim. The contractor shall submit that additional information, or notify the bureau in writing to base its decision on the information previously submitted. Either party may request a meeting to present their views. Before the meeting, the bureau will distribute written ground rules for the meeting to both parties.

(2) Upon completion of the initial review phase, the bureau will notify the contractor in writing that it has begun the decision phase.

(3) In the decision phase, the bureau will have up to 28 calendar days to render a written decision. The bureau will consider both parties' written and oral submissions, and may consider other relevant information in the project records. The bureau may affirm, overrule, or modify, in whole or in part, the region's decision.

(4) In the appeal phase, the contractor will have up to 28 calendar days, from the date of the bureau's decision, to appeal to the review panel. If the contractor does not submit a written appeal to the bureau within those 28 days, the bureau's decision is final. If the bureau does not render a decision within the 28-day period specified in 105.13.6.2(3), the bureau will forward the claim to the review panel as if the bureau had rejected the contractor's claim.

105.13.6.3 Referred to Review Panel

(1) At any point in the bureau's review the department may unilaterally refer the claim directly to the review panel.

105.13.6.4 Referred to Dispute Review Board

(1) Either the department or the contractor may request in writing that the claim be referred to a neutral third party. The requesting party shall provide that request to the other party within 14 calendar days of the bureau's receipt of the claim from the region. The other party shall respond in writing by either accepting or rejecting the request within 14 calendar days of their receipt of the request.

(2) If the request for third-party review is rejected, the bureau will proceed with their review.

(3) If the request for third-party review is accepted, the bureau will give the third party all documents and evidence regarding the claim previously given to the bureau. The third party may request that the contractor and the region submit additional evidence or documents related to the claim. The third party will consider both parties' written and oral submissions, and may consider other relevant information in the project records. The third party will review the claim and render a written recommendation.

(4) The third-party recommendation is not binding on either party. The department and the contractor shall respond, in writing to each other, either accepting or rejecting the third party's recommendation within 14 calendar days of their receipt of the recommendation.

(5) Upon expiration of the 14 calendar days allowed for a response to the third-party recommendation, the bureau has 28 calendar days to render a written decision that does one of the following:

- Confirms the third-party recommendation.
- Overrules the third-party recommendation.
- Modifies, in whole or in part, the third-party recommendation.

(6) If if the contractor disagrees with the bureau's decision, the contractor has 28 calendar days from receipt of that decision to appeal to the review panel. If the contractor does not file a written appeal within those 28 calendar days, the bureau's decision is final. If the bureau does not render a decision within the 28-day period specified in 105.13.6.4(5), the bureau will forward the claim to the review panel as if the bureau had rejected the contractor's claim.

105.13.7 Review Panel

105.13.7.1 General

(1) The review panel will act on claims either appealed or forwarded from the bureau level. The bureau will forward the claim to the review panel along with all documents and evidence regarding the claim previously given to the bureau. The department will do one of the following:

- Proceed with the review panel review.
- If either the department or contractor request a third-party review and no formal third-party review was conducted at the bureau level, refer the claim to a neutral third-party DRB for review according to the department's dispute resolution procedures.

105.13.7.2 Review Panel Review

(1) The review panel may request that the contractor and the region submit additional evidence or documents related to the claim. The review panel will consider both parties' written and oral submissions, and may consider other relevant information in the project records.

(2) The review panel will conduct a hearing with the contractor and the region. Before the hearing, the department will distribute written ground rules for the hearing to both parties.

(3) The review panel may affirm, overrule, or modify, in whole or in part, the region's decision or the bureau's decision. The review panel will render a decision within 60 calendar days from the date of the appeal. Within 14 calendar days of the review panel's decision, the contractor shall accept or reject their decision in writing. If the contractor does not respond within those 14 calendar days, the review panel's decision is final.

(4) If the contractor disagrees with the review panel's decision, the contractor may initiate a legal action pursuant to state statutes.

105.13.7.3 Referred to Dispute Review Board

(1) Either the department or the contractor may request in writing that the claim be referred to a neutral third party. The requesting party shall provide that request to the other party within 14 calendar days of the review panel's receipt of the claim from the bureau.

(2) The review panel will give the third party all documents and evidence regarding the claim previously given to the review panel. The third party may request that the contractor and the region submit additional evidence or documents related to the claim. The third party will consider both parties' written and oral submissions, and may consider other relevant information in the project records. The third party will review the claim and render a written recommendation.

(3) The third-party recommendation is not binding on either party. The department and the contractor shall respond, in writing to each other, either accepting or rejecting the third party's recommendation within 14 calendar days of their receipt of the recommendation.

(4) Upon expiration of the 14 calendar days allowed for a response to the third-party recommendation, the review panel has 28 calendar days to render a written decision that does one of the following:

- Confirms the third-party recommendation.
- Overrules the third-party recommendation.
- Modifies, in whole or in part, the third-party recommendation.

(5) The review panel's decision is the department's final and standing decision regarding the claim. If the contractor disagrees with the department's final decision, the contractor may initiate a legal action pursuant to state statutes.

Section 106 Control of Materials

106.1 General

106.1.1 Materials

(1) Provide materials conforming to the contract. Use new products and materials for items permanently incorporated into the work unless the contract specifies or allows otherwise. Use materials the contract specifies unless the engineer authorizes substitutes under 108.8. Monitor construction operations to identify potential nonconforming materials and prevent their incorporation into the work.

(2) All materials are subject to the engineer's approval before incorporation into the work. The engineer may inspect or test all materials at any time during their preparation, storage, and use. Notify the engineer of the proposed source of materials before delivering those materials to the project site. If the engineer requests, provide samples of material and access to facilities that the engineer needs to assess the acceptability of all materials. The department will, on request, share with the contractor available information on a source or material. The department will maintain a web-based list of approved aggregate sources. Aggregate producers must provide test results as required in the department policy for aggregate source approval to have their source approved and to keep that approval over time.

(3) For fabricated components, the materials and the fabricator are subject to the department's approval before delivery of those components to the project site. The engineer may require the contractor to obtain components from another department-approved source if the department determines a fabricator's product does not conform to the contract.

(4) Do not incorporate materials into the work until the engineer approves those materials. However, the contractor may request permission to incorporate materials not already approved. The engineer will grant this permission only if the contractor can provide convincing evidence that the engineer will subsequently find those materials conforming. Incorporation of materials before approval is at the contractor's risk and permission to do so does not imply that the department will subsequently approve those materials.

(5) Except as required under the contract, ensure that products incorporated into the work, either temporarily or permanently, do not display advertising or messages not directly related to the manufacturer, properties, or function of those products; or advertising or messages in violation of state statutes.

106.1.2 Project Materials Coordinator

(1) Designate one person, either a member of the contractor's own organization or acting as an agent for the contractor, to act as the contractor's materials coordinator for the project. Ensure that this person is certified, before assuming the role of project materials coordinator, by successfully completing the HTCP online materials coordinator training available at:

http://www.uwplatt.edu/htcp/materials-coordinators-training

(2) The contractor's project materials coordinator is responsible for the following:

- Communicating contract sampling and testing requirements to subcontractors at all tiers.
- Reporting out-of-specification test results to the department as soon as the information is available.
- Providing certified reports of test or analysis and manufacturers' certificates of compliance from subcontractors at all tiers and maintaining certification records as specified in 106.3.3.2.

(3) Ensure that the contractor's project materials coordinator submits materials information required under the contract to a person the engineer designates. Also ensure that the contractor-designated materials person participates in scheduled weekly construction meetings or meets with their department counterpart as requested.

106.2 Supply Source and Quality

106.2.1 Waste Materials

(1) The department encourages the contractor to incorporate material from the WDNR list of special wastes, cited in section 895.58 of the Wisconsin statutes, into the work. The department encourages maximizing use of special waste consistent with the contract and standard engineering practice.

http://docs.legis.wi.gov/statutes/statutes/895

(2) For materials used during construction but not incorporated into the work, use multiple-use or biodegradable products, if practicable, to minimize the quantity of solid waste generated during construction operations.

106.2.2 Preference for US-Made Materials

(1) Furnish materials manufactured to the greatest extent in the United States as provided in Wisconsin statute 16.754.

http://docs.legis.wi.gov/statutes/statutes/16

106.2.3 Product Substitution

(1) Provide US standard or SI metric system products as the contract specifies. The department will allow substitutions for the specified product if both of the following conditions are met:

1. The substitute product is made from the same material as the original product, and complies with the corresponding specification requirements for the substitute product.
2. Dimensions of the substitute product are essentially equal to dimensions of the original product. The department will allow established manufacturing and fabrication tolerances unless the contract specifies absolute maximum or minimum dimensions.

(2) Certify to the engineer, in writing, that the substitute product complies with the requirements of 106.2.3(1). The contractor shall not furnish the substitute product until the engineer approves the substitution in writing. The department will pay for the installed quantity of the substitute product at the contract price for the original product.

106.2.4 Conditional Approval of Materials

(1) The department may require, by contract or at the discretion of the engineer, inspection of materials at the point of manufacture or source of supply. The department may conditionally approve materials found to be in compliance at the point of manufacture or source of supply.

(2) If inspection is required at a manufacturing or source plant, do the following:

1. Provide the engineer with the results of relevant tests the contractor or producer performs.
2. Cooperate with and assist the engineer.
3. Secure for the engineer full access to parts of the plant used to manufacture or produce materials when contract work is in progress.
4. If the engineer requires, secure acceptable working space in or near the plant.
5. Provide advance notice of production schedules as the engineer requests.
6. Provide and maintain adequate safety measures at the plant for the engineer.

(3) The engineer may prohibit project site delivery of materials requiring inspection at the point of manufacture or source of supply until the engineer grants conditional approval.

106.3 Approval of Materials

106.3.1 General

(1) The department will approve materials or components demonstrated to conform to the contract. The department will base its approval on conformance with the contract as close as practicable to the point of incorporation into the work. The department approves materials based primarily on the engineer's tests, tests the contractor performs under the quality management program, or tests the manufacturer performs and certifies. For materials conditionally approved at the point of manufacture or source of supply, the engineer may:

1. Retest or re-inspect materials after delivery to the project site.
2. Reject material subsequently found to be non-complying.

(2) Material sampling, testing, and documentation requirements are specified in CMM chapter 8. The department may augment test results with documented performance history or inspection of processing, storage, handling, and construction operations. If the contract requires or the engineer requests, provide written documentation of the origin, composition, or process of manufacture of a material.

(3) Conform to manufacturer-recommended procedures for products incorporated into the work unless the contract specifies otherwise. Provide copies of those procedures if the engineer requests. The contractor may request that the department approve alternate procedures.

(4) The department's approval of materials or components does not constitute acceptance of the work incorporating those materials or components.

106.3.2 Approved Product Lists (APL)

(1) The department maintains lists of approved products and approved manufacturers or suppliers. The department includes products on these lists based on the results of prior testing and a satisfactory performance history on department projects. The department may retest or re-inspect products after delivery to the project site to verify that they conform to the contract. A product is nonconforming if

verification test results indicate the product does not meet the requirements for inclusion in the department's APL.

106.3.3 Approval by Certification

106.3.3.1 General

(1) For manufactured products or assemblies, the department may base approval on a product certification or require both a product certification and production plant certification.

106.3.3.2 Product Certifications

(1) For manufactured products or assemblies, the engineer may accept a certified report of test or analysis, or a certificate of compliance instead of performing tests on samples. If not designated in the contract for the specific material involved, the engineer will determine the form, content, and distribution of the required documents. Submit the number of copies of each document that the engineer specifies.

(2) For testing documented by certificate, all sampling and testing procedures and testing facilities are subject to the review and approval of the department. The department may sample and test products to verify the certified test results. Provide samples as the department directs.

(3) Create a file of manufacturers' certificates of compliance for the contract. Maintain these certifications on file for a period of 5 years after completing the contract work. If the department requests, provide the requested certification within 5 business days.

(4) Products are nonconforming if one or more of the following apply:

1. Certifications are not provided within the specified time or in the specified form.
2. Certified properties do not conform to the contract.
3. Verification test results indicate the products do not conform to the contract.

106.3.3.3 Plant Certifications

106.3.3.3.1 Precast Concrete Products

(1) The department specifies precast concrete components and will allow precast alternates for cast-in-place concrete components. Ensure that precast concrete conforms to all of the following:

1. All specific contract requirements for individual components.
2. Components are manufactured in a plant certified, at the time of the letting and during production of components provided under the contract, by the department to produce those specific components. Department's approved vendors list for precast concrete products is available at: https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/appr-prod/default.aspx
3. Submit design and construction details to the engineer for approval before installation.

106.3.3.3.2 Prestressed Concrete Products

(1) Conform to the prestress plant certification requirements specified in 503.2.4.

106.3.4 Approval By Sampling and Testing

106.3.4.1 General

(1) Except as specifically provided in the contract, the engineer will determine sampling and testing frequencies and sample locations, both on and off the project site.

(2) The department will determine the sampling and testing methodology using the following order of precedence. The department will:

1. Use specific methods the contract references.
2. Use CMM specified methods if the contract does not reference specific methods.
3. Use department standard practices if the contract does not reference specific methods and the CMM does not specify a method.

(3) The department will maintain copies of all AASHTO and ASTM sampling and testing standards referenced in the contract. Contractors, bidders, or the suppliers of materials may examine those standards at the department's central office in Madison. The department will also make available for examination all other standards referenced in the contract as well as the department's sampling and testing standard practices.

(4) All department and contractor personnel engaged in sampling and testing of materials incorporated into the work must be qualified under a department-accepted program for the specific tasks they are performing.

(5) All laboratory facilities sampling and testing materials incorporated into the work must be qualified, for the specific tests they are performing, by the department under its laboratory qualification program.

106.3.4.2 Department's Material Testing Program

106.3.4.2.1 General

(1) Furnish without charge all samples that the engineer requires and provide the facilities and staff required for collecting and forwarding them to the department. The department will, on request, share with the contractor test results obtained on contractor-furnished samples of materials.

106.3.4.2.2 Department-Approved Aggregate Sources

106.3.4.2.2.1 General

(1) Coordinate with the department to collect sample aggregates. The department and contractor will jointly obtain and split samples with the department taking immediate possession of the department's splits. Ensure that samplers are HTCP certified to sample aggregates. Costs associated with the required aggregate quality sampling and testing are incidental to the work.

(2) Test coarse aggregate sources a minimum of every 5 years for pits and a minimum of every 3 years for quarries. Marginal sources; those with LA wear loss within 4.0 percent, sodium sulfate loss within 3.0 percent, or freeze-thaw soundness loss within 3.0 percent of a specification limit, may require annual testing. The department and contractor will jointly obtain and split samples to test marginal sources. The department maintains a list of current approved aggregate sources at:

http://www.atwoodsystems.com/iibv2/default.cfm

(3) Ensure that testing is performed at a facility conforming to the department's laboratory qualification program by a HTCP-certified technician certified to test aggregate quality and that testing is performed.

(4) Perform testing on the split of the sample conforming to the following:

LA Wear (100 & 500 revolutions) ..... AASHTO T96
Sodium sulfate soundness (R-4, 5 cycles) ..... AASHTO T104
Fracture ..... ASTM D5821 as modified in CMM 8-60
Liquid limit[1] ..... AASHTO T89
Plasticity[1] ..... AASHTO T90
Coarse aggregate specific gravity and absorption ..... AASHTO T85

[1] Prepare samples according to AASHTO R74, Method A for the P-4 fracture.

(5) Provide test results to the department's laboratory. The department may perform verification testing on their split of the sample.

106.3.4.2.2.2 Freeze-Thaw Soundness

(1) Perform freeze-thaw soundness testing according to AASHTO T103. Provide freeze/thaw soundness test results based on the fraction retained on the No. 4 sieve as follows:

1. Using virgin crushed stone aggregates produced from limestone/dolomite sources in one or more of the following counties or from out of state:

Brown	Columbia	Crawford	Dane	Dodge
Fond du Lac	Grant	Green	Green Lake	Iowa
Jefferson	Lafayette	Marinette	Oconto	Outagamie
Rock	Shawano	Walworth	Winnebago	

2. Using gravel aggregates produced from pit sources in one or more of the following counties or from out of state:

Dodge	Washington	Waukesha

(2) The department may waive freeze/thaw testing for existing quarries determined to be in either the Silurian system or the Prairie du Chien group of the Ordovician system of rocks.

106.3.4.2.2.3 Quality Assurance

(1) The department will approve an aggregate source and post contractor test results if either of the following conditions are met:

- Both contractor and department results for split sample testing are within specifications.
- Contractor results are within specifications and department split sample results are within tolerances.

(2) The department will accept the contractor's test results if department split sample results are within specified tolerances as follows:

TEST METHOD	TOLERANCE
LA wear (500 revolutions)	+/- 4.0%
Sodium sulfate soundness (R-4, 5 cycles)	+/- 3.0%

Coarse aggregate specific gravity	+/- 0.04
Coarse aggregate absorption	+/- 0.4%
Freeze-thaw soundness	+/- 3.0%

(3) The contractor may request re-sampling and re-testing by both the contractor and department. If requesting a second re-test, submit a written description of corrective action and additional process control measures taken during production to change the resulting material properties.

(4) If the contractor disputes the department's test results, the department will initiate the dispute resolution process.

106.3.4.2.2.4 Dispute Resolution

(1) The department and contractor will investigate discrepancies between department and contractor split sample test results.

(2) If the department and contractor cannot resolve a discrepancy that could result in incorporating nonconforming work, the department and the contractor will use third-party tests by a mutually agreed on independent laboratory. The department will obtain, maintain custody of, and send samples to a third party for testing. The department and contractor will abide by a third-party test result if within either the department's or the contractor's test result by the tolerance specified in 106.3.4.2.2.3(2). The party in error will pay independent laboratory costs.

(3) For non-conforming material placed before acceptance testing or completion of the dispute resolution process, the engineer will do one of the following:

1. Reject that material subject to the provisions of 105.3.2.2 for unacceptable work.
2. Approve those materials and adjust the contract price as provided in 105.3.2.1 for engineer-accepted nonconforming work.

106.3.4.3 Quality Management Program

106.3.4.3.1 General

(1) Under the contract QMP provisions, the department will base approval of the covered materials on a combination of the results of the following:

1. Contractor quality control testing.
2. Departmental verification testing.
3. Inspections of the materials production, storage, handling, and construction processes.
4. Dispute resolution procedures.

(2) If disputed, approval of materials and components, as well as acceptance of the work incorporating those materials or components, is subject to review under the QMP dispute resolution process.

106.3.4.3.2 Process Control

(1) Process control is the contractor's responsibility. Perform and document inspections, additional testing, and corrective action required to ensure materials incorporated into the work conform to the contract.

106.3.4.3.3 Department Verification

(1) The department will periodically conduct independent verification tests to validate the quality of the materials incorporated into the work.

106.3.4.3.4 Independent Assurance

(1) The department may evaluate all personnel engaged in sampling and testing of materials incorporated into the work. The department will base its evaluation on observation of procedures, required documentation, and spilt-sample testing.

(2) The department may evaluate the contractor's sampling and testing equipment. The department will base its evaluation on visual inspection, calibration checks, or split sample or proficiency testing.

106.3.4.3.5 QMP Dispute Resolution

(1) The engineer and contractor should make every effort to avoid conflict by investigating substantive discrepancies in their respective test results.

(2) For potentially nonconforming materials, the department and contractor will thoroughly investigate to determine the quality and extent of material at risk. The department and contractor will review contract required data, examine data reduction and analysis methods, evaluate sampling and testing procedures, and may perform additional testing. Use ASTM E178 to evaluate potential statistically outlying data.

(3) If project personnel cannot resolve a dispute that affects payment or could result in incorporating nonconforming work, the department will resolve the dispute using third-party testing by the department's central office laboratory or a mutually agreed on independent laboratory. The engineer and contractor will abide by third-party test results. The party in error will pay independent laboratory costs. The department may use third-party tests to evaluate questionable materials and determine appropriate payment. The department will determine the final disposition of nonconforming material as specified in 106.5.

106.4 Storing and Handling Materials

(1) Store and handle materials to preserve their quality and fitness for the work. Provide easy access for the department to inspect and test stored materials. Even if approved before storage, the engineer may find materials nonconforming based on re-inspection before incorporation into the work.

(2) Provide the engineer with the storage locations of materials intended for the work. If the engineer allows, the contractor may store materials on portions of the right-of-way not required for public travel. Provide additional off-site storage space at no additional expense to the department. Off-site storage areas for approved or conditionally approved materials are subject to the department's inspection and approval.

106.5 Nonconforming Materials

(1) For nonconforming materials identified before incorporation into the work, the engineer will do one of the following:

1. Reject those materials. Unless the engineer allows otherwise, the contractor shall remove rejected materials from the project site at no cost to the department. The engineer may allow the contractor to correct rejected materials. The contractor shall obtain the engineer's approval for previously rejected, but subsequently corrected, materials before incorporating those materials into the work.
2. Approve those materials subject to potential reduced payment. The engineer will determine the circumstances under which those nonconforming materials may be approved for incorporation into the work. The engineer will document the basis of approval and may execute a contract change order to adjust the contract unit prices for the nonconforming materials. If the contract does not specify a price adjustment, the engineer may adjust the price.

(2) For materials incorporated in the work and later found to be nonconforming, the engineer will do one of the following:

1. Reject those materials subject to the provisions of 105.3.2.2 for unacceptable work.
2. Approve those materials and adjust the contract price as provided in 105.3.2.1 for engineer-accepted nonconforming work.

Section 107 Legal Relations and Responsibility to the Public

107.1 Laws to be Observed

(1) At all times, observe and comply with all applicable federal and state laws and administrative rules, codes, local laws, ordinances, and regulations that affect the conduct of the work, and applicable orders or decrees of bodies or tribunals having jurisdiction or authority over the work. The department will consider no plea of misunderstanding or ignorance thereof. The contractor shall indemnify and save harmless the state and all of its officers, agents, and employees against any claim or liability arising from or based on the violation of any applicable law, ordinance, regulation, order, or decree, whether by the contractor or the contractor's employees, subcontractors, or agents.

(2) Comply with all applicable federal, state, and local health official rules and regulations governing safety, health, and sanitation. Provide all necessary safeguards, safety devices, and protective equipment. Take all other actions reasonably necessary to protect the life and health of employees on the project and the safety of the public.

107.2 Haul Road Notification

(1) Notify the engineer in writing at least 3 business days before hauling project materials over a public road or street not a part of the state trunk highway system. The department will subsequently survey the existing condition of that haul route to establish a baseline for assessing damage that the contractor's hauling operations might cause.

107.3 Permits and Licensing

(1) Obtain all permits and licenses, pay all charges and fees, and give all notices necessary to perform the work. The contractor shall comply with all permit requirements whether the permit is issued to the contractor, the state, or the maintaining authority.

107.4 Patented Devices, Materials, and Processes

(1) Include in the bid prices royalties and costs arising from patents, trademarks, and copyrights. Before using a design, device, material, or process covered by letters, patents, or copyrights, provide for its use by suitable legal agreement with the patentee or owners. Provide proof of this agreement with the engineer if necessary. The contractor and the contractor's surety shall provide indemnification from all claims for infringement of patents, trademarks, or copyrights as specified in 107.12.

107.5 Labor Compliance

(1) Comply with all contract labor compliance provisions and take responsibility for subcontractor and lower tier subcontractor compliance. Submit department-requested documentation within the time the department specifies in a written notice. Resolve all labor compliance issues within 90 days after receiving the department's first written notice. The department and the contractor can mutually agree to extend this 90-day requirement. Actively pursue resolution of contract labor compliance issues and attend all contract labor compliance meetings and hearings.

107.6 Federal Participation

(1) If the federal government participates in the cost of the contract:

1. The work is subject to the inspection and approval of the proper officials of the federal government.
2. The work shall conform to the applicable federal statutes, rules, and regulations.

(2) The federal government is not a party to the contract and will not interfere with the rights of either party under the contract.

107.7 Nighttime Operations

(1) Do not perform work when there is insufficient light to conduct that work safely. If the contract requires or the engineer allows nighttime operations, provide artificial illumination as necessary to safely perform the work. Locate work lights within and around the work zone in a way that provides adequate illumination to perform the work, makes the workers and construction operations visible to the traveling public, and ensures that glare and brightness transition through the work site does not interfere with driver visibility. Provide additional hazard lighting on equipment as well as high visibility apparel conforming to ANSI/ISEA guidelines for workers.

107.8 Public Convenience and Safety

(1) Maintain the safety of the traveling public and control traffic using barricades, warning signs, flaggers, and temporary barrier as specified in 104.6.1.

(2) If the contract provides that the road or portions of the road are closed to public traffic during construction, the engineer may direct or authorize the contractor to open sections of the road to public traffic before the work is completed as specified in 104.6.5.

(3) When hauling materials on public roads or streets, equip vehicles subject to spillage with tailgates and adequate sideboards. Use covers and other protective devices necessary to prevent spillage. The contractor is responsible for removing spillage from the entire area within the right-of-way of the haul route. Immediately remove spillage that interferes with or creates a hazard for traffic.

(4) Notify the responsible fire department and police department at least 24 hours before closing a road, street, or highway.

(5) If excavating adjacent to a building or wall, give the property owner sufficient written notice of the impending excavation. The contractor and the contractor's surety shall hold the state and the municipality in which the work is done harmless from damage to the building or wall.

(6) Check for and comply with local ordinances governing the hours for operation of construction equipment. Obtain the engineer's written approval for operations from 10:00 P.M. until 6:00 A.M.

107.9 Contractor's Use of the Highway Right-of-Way

(1) The department has sole authority to grant the contractor permission to occupy and use the right-of-way. All activity within the right-of-way is subject to the engineer's approval.

(2) If the engineer allows, the contractor may store materials and equipment or locate the contractor's plant on portions of the right-of-way not required for public travel. Post warning signs in advance of points of ingress and egress and provide other traffic control the engineer deems necessary to minimize hazards to motorists, pedestrians, and workers. Do not park vehicles or equipment, store materials, or create other obstructions where the engineer determines the required safety measures may distract motorists.

107.10 Use of Explosives

(1) Observe the utmost care when using explosives so as not to endanger life and property. Use, store, and handle explosives and highly inflammable materials conforming to applicable federal, state, and local laws and regulations including the rules of the Wisconsin department of commerce.

107.11 Protecting and Restoring Property

107.11.1 General

(1) Notify, in writing, all public and private property owners whose property interferes with the work. Advise them of the nature of the interference, and arrange with them for the disposition of the property. Upon request, furnish the engineer with copies of all notifications and final agreements.

(2) Use every reasonable precaution to prevent damage to all property including poles, trees, shrubbery, crops, and fences adjacent to or interfering with the work; all overhead structures including wires, cables, etc.; and all underground structures including water or gas shut-off boxes, water meters, pipes, conduits, etc.; within or outside the right-of-way.

(3) Assume liability for all damage to public or private property resulting from contractor operations, defective work or materials, or non-execution of the contract. Restore property, to a condition similar or equal to that existing before causing the damage, as the engineer directs or in a manner acceptable to the property owner. If the contractor fails to restore property within a reasonable time, the department may, upon 48 hours written notice, restore that property as the engineer deems necessary. The department will deduct restoration costs from payments due the contractor under the contract.

107.11.2 Freeway Traffic Management Systems

(1) If the contractor's operations interrupt FTMS service, notify the engineer immediately and take the action required to restore service within 24 hours. Repair damaged facilities to the condition existing before interruption. If the contractor does not restore service within 24 hours, the department may restore service and deduct restoration costs from payments due the contractor under the contract.

107.11.3 Property Marks

(1) Protect and carefully preserve all known property and survey marks and land monuments, and notify the engineer of the nature and location of these markers. Do not disturb or destroy markers until the engineer has arranged for their referencing, perpetuation, or replacement.

107.11.4 Burning

(1) Do not start fires without first securing the necessary permits and the approval of the local authority having jurisdiction, or the county forest ranger, or the WDNR bureau of forestry. Comply with applicable requirements of the WDNR's air pollution control rules, including the limitations on open burning. When burning brush, stumps, or rubbish, take care not to damage standing trees, shrubs, or other property. Assume liability for all damage caused by fires.

107.12 Responsibility for Damage and Tort Claims

(1) The contractor and their insurer shall defend, indemnify, and save harmless governmental entities involved in the project, or in which all or part of the project site is located, including officers, agents except for consulting firms, and employees of any of the foregoing from suits, actions, or claims brought because of injuries or damages sustained by any person or property arising from one or more of the following:

1. Contractor operations.
2. Contractor neglect in safeguarding the work.
3. Contractor use of unacceptable materials in constructing the work.
4. Acts or omissions, neglect, or misconduct of the contractor.
5. Claims or amounts recovered for an infringement by the contractor of patent, trademark, or copyright.
6. Claims or amounts arising or recovered under the workers compensation act, relating to the contractor's employees.
7. The contractor's noncompliance with a law, ordinance, order, or decree relating to the contract.

(2) The department may retain payments due the contractor in amounts the engineer deems sufficient to cover the cost of suits, actions, or claims caused by the reasons specified in 107.12(1). The department will not release this retainage until the contractor furnishes satisfactory evidence of one of the following:

1. The contractor is adequately protected from the suits, actions, or claims with the insurance coverages specified in 107.26 or other insurance.
2. The parties have settled the suits, actions, or claims.

(3) The state is not liable to the contractor for damages or delays resulting from third-party work, except for excusable delays as specified in 108.10.2 and 108.10.3. The state also is exempt from liability to the contractor for damages or delays resulting from injunctions or other restraining orders obtained by third parties except where the damage or delay is a direct result of an injunction or restraining order obtained by a citizen's action alleging violations of 42 U.S.C. 4331-4332, 23 U.S.C. 138, or public law 91-646.

107.13 Third-party Beneficiary

(1) This contract does not create anyone as a third-party beneficiary. This contract does not authorize non-parties to the contract to maintain actions for damages under the contract.

107.14 Contractor's Responsibility for Work

(1) Until the engineer accepts the work as specified in 105.11 the contractor shall maintain charge and care of the work except as specified in 104.6. Within 107.14, the term "work" is redefined to mean "the work product that is completed in its final position and is incorporated in the project." Protect all the work against injury or damage caused by the action of the elements, or from other causes, whether arising from the execution or non-execution of the work. Rebuild, repair, restore, and make good all injuries or damages to portions of the work occasioned by the above causes at no additional cost to the department.

(2) The contractor shall not bear the expense for damage to the work caused by abnormal and unforeseeable occurrences beyond the control of, and without the fault or negligence of, the contractor. These abnormal and unforeseeable occurrences include but are not limited to the following:

1. Cataclysmic phenomena of nature.
2. Acts of the public enemy.
3. Acts of government authorities.

(3) Before suspending the work, take the necessary precautions to prevent damage to the project, prevent traffic accidents, and provide for normal drainage. Erect necessary temporary barrier, barricades, signs, or other facilities at no expense to the department except as specified in 104.6.

(4) The contractor is responsible for all damages to equipment and supplies regardless of the circumstances.

107.15 Personal Liability of Public Officials

(1) In carrying out contract provisions, or in exercising power or authority granted to them by or within the scope of the contract, the department, the engineer, or their authorized representatives have no liability, either personally or as officials of the state. In all of these matters, they act solely as agents and representatives of the state. The contractor waives all rights of action against the department, its agents, or employees.

107.16 No Waiver of Legal Rights

(1) The department may correct a measure, estimate, or certificate at any time before or after final acceptance. The department may recover from the contractor, surety, or both, overpayments upheld for a breach (failure to fulfill contract obligations). A waiver on the part of the department of a breach of a part of the contract is not a waiver of another or subsequent breach.

(2) The following department actions do not waive the department's rights or power under the contract:

1. Payment for or acceptance of all or portions of the work.
2. Extension of contract time.
3. Possession of the work.

(3) Assume liability for latent defects, fraud, gross mistakes as may amount to fraud, or as regards to the department’s rights under a warranty or guaranty without prejudice to the terms of the contract.

107.17 Railroad-Highway Grade Separations and Approaches, New Railroad Crossings, and Operations on Railroad Right-of-Way

107.17.1 General

(1) Coordinate with the railroad for all work performed on or near the railroad right-of-way. Include the following on all submittals and other written communications with the railroad:

- WisDOT crossing number.
- Railroad milepost.
- Railroad subdivision.

(2) The railroad's chief engineering officer may inspect the work and contractor operations on grade separations and their approaches, grade crossings, or on railroad right-of-way. Perform the work in a manner satisfactory to the railroad's chief engineering officer.

(3) Perform all work within the railroad's right-of-way in a way that does not interfere with the safe and uninterrupted operation of railroad traffic. Maintain clearances during construction as follows:

1. Do not operate equipment closer than 25 feet horizontally from a track centerline or 22 feet vertically above the top of a rail, except under the protection of railroad flaggers.
2. Do not store materials or equipment closer than 25 feet horizontally from a track centerline.
3. Provide an obstruction-free work zone adjacent to a track extending 12 feet or more horizontally on both sides of the track centerline. Keep this work zone free of construction debris.
4. Unless the railroad's chief engineering officer approves otherwise in writing, maintain minimum clearances from falsework, forms, shoring, and other temporary fixed objects as follows:
   - 4.1 Provide 12 feet, plus 1.5 inches per degree of track curvature, measured horizontally from the track centerline.
   - 4.2 Provide 21 feet, plus compensation for super-elevated track, measured vertically above the top of the highest rail.

(4) Comply with the railroad's rules and regulations regarding operations on railroad right-of-way. If the railroad's chief engineering officer requires, arrange with the railroad to obtain the services of qualified railroad employees to protect railroad traffic through the work. Bear the cost of these services and pay the railroad. Notify the railroad's chief engineering officer in writing at least 5 business days before starting work near a track. Provide the specific time planned to start the operations.

(5) Do not blast on the railroad's right-of-way without the written permission of the railroad's chief engineering officer. At least 3 business days before blasting, notify the responsible railroad official if explosives will be detonated within 100 yards of a track. Provide specific dates, times, and locations for all blasting.

(6) Develop shop drawings, with detailed plans and computations, for the following temporary construction:

1. Falsework and forms of highway structures spanning a track.
2. Forms for piers and abutments adjacent to a track.
3. Shoring, if the contract requires shoring of an excavation near a track.

(7) Have a professional engineer registered in the state of Wisconsin sign and seal the shop drawings. At least 30 calendar days before starting falsework, form, or shoring construction; submit 3 sets of shop drawings to the railroad's chief engineering officer and one set to the engineer. The engineer and the railroad may review the shop drawings. If the engineer or the railroad finds the shop drawings unsatisfactory, the contractor shall make the required changes. A satisfactory shop drawing review does not relieve the contractor of responsibility and liability for the structural integrity and proper functioning of the falsework, forms, or shoring.

(8) Make all necessary arrangements for crossing a railroad's track at a location other than an existing public crossing. Bear all costs incident to that crossing, including flagging costs.

107.17.2 Work by Railroad

(1) The railroad company may perform work or operations incident to the project that are the subject of an agreement between the department and the railroad company. Do not alter this work without the consent of the railroad company. If the railroad company makes contractor-requested alterations with railroad company forces, pay the railroad company for those alterations.

(2) Bear the cost of the movement or adjustment of telegraph, telephone, or signal facilities owned, operated, or maintained by the railroad company and not otherwise provided for in the contract or in agreements between the department and the railroad company.

107.17.3 Railroad Insurance Requirements

(1) If required by the special provisions, provide or arrange for a subcontractor to provide railroad protective liability insurance in addition to the types and limits of insurance required in 107.26. Keep railroad protective liability insurance coverage in force until completing all work, under or incidental to the contract, on the railroad right-of-way or premises of the railroad and until the engineer determines that the work is complete as specified in 105.11.2.1.4.

(2) Provide railroad protective liability insurance coverage written as specified in 23 CFR part 646 subpart A. Provide a separate policy for each railroad owning tracks on the project. Ensure that the railroad protective liability insurance policies provide the following minimum limits of coverage:

http://www.fhwa.dot.gov/legsregs/directives/cfr23toc.htm

1. Coverage A, bodily injury liability and property damage liability; $2 million per occurrence.
2. Coverage B, physical damage to property liability; $2 million per occurrence.
3. An annual aggregate amount of $6 million that shall apply separately to each policy renewal or extension.

(3) Obtain coverage from insurance companies licensed to do business in Wisconsin that have an A.M. Best rating of A- or better. The cost of the required insurance coverage and limits is incidental to the contract.

(4) Submit the following to each railroad owning tracks on the project as evidence of that railroad's respective coverage:

1. A certificate of insurance for the types and limits of insurance specified in 107.26.
2. The railroad protective liability insurance policy or other documentation acceptable to the railroad company.

(5) Submit the following to the region as evidence of the required coverage:

1. A copy of the letter to the railroad company transmitting the submittal documents specified in 107.17.3(4).
2. A certificate of insurance for the required railroad protective liability coverages.

(6) Do not begin work on the right-of-way or premises of the railroad company until the region receives the submittals specified in 107.17.3(5) and notification from the railroad company that the contractor has provided sufficient insurance information to begin work.

(7) Notify the railroad and the region immediately upon cancellation or initiating cancellation, whichever is earlier, or any material change in coverage. Cease operations within 50 feet of the railroad right-of-way immediately if insurance is cancelled or reduced. Do not resume operations until the required coverage is in force.

107.18 Environmental Protection

(1) Comply with all applicable federal, state, and local laws and regulations that control the prevention of pollution of the environment including those related to the introduction or spread of invasive species or pathogens in waterways.

(2) Comply with laws relating to solid waste disposition and air pollution. Control and minimize the dispersion of dust and particulate matter and other pollutants into the atmosphere.

(3) Take all necessary precautions to prevent pollution of streams, lakes, wetlands, and reservoirs with fuels, oils, bitumens, calcium chloride, magnesium chloride, paint, or other harmful materials. Conduct and schedule work operations to avoid or minimize siltation of streams, lakes, and reservoirs. Protect drainage ways, culverts, and drainage structures from debris caused by a contractor operation.

(4) Do not ford live streams unless a plan for the fording operation meets the engineer’s approval and results in minimum siltation to the streams. Do not operate machinery on the bed of live streams.

(5) Remove existing structures over live streams in large pieces, minimizing the number of smaller pieces that may drop into the water or wetlands. Remove from the water or wetlands all steel and all concrete pieces or other debris larger than 5 inches in any dimension.

(6) If work areas or pits are located in or adjacent to live streams, lakes, or wetlands, separate the work areas or pits from the stream, lake, or wetland by a dike, silt fence, or other barrier to keep sediment from entering these locations. Take care during the construction and removal of these barriers to minimize the siltation or filling of the stream, lake, or wetland.

(7) Treat water from aggregate washing or other sediment producing operations by filtration, a settling basin, or other means sufficient to reduce the sediment content to not more than that of the stream or lake into which the water is discharged.

107.19 Construction Over or Adjacent to Navigable Waters

(1) Within 107.19, the term "governmental authority" means the U.S. Army Corps of Engineers, the U.S. Coast Guard, the WDNR, or other agency having jurisdiction over the navigable waters within the project limits and empowered to take the actions specified in 107.19.

(2) Conduct all work over, on, or adjacent to navigable waters so that free navigation of the waterways is not impeded and existing navigable depths are not impaired except as allowed by permit issued by the governmental authority. Obtain all permits before beginning construction.

(3) Obtain all permits required by 107.3. Submit applications for U.S. Coast Guard and WDNR permits to the boating law administrator of the WDNR bureau of law enforcement. Provide one copy of each permit to the project engineer for posting in the field office before construction activities affecting navigation begin.

(4) The governmental authority may supervise all construction and related operations as is customary for operations in navigable waters. Conform to special requirements or directions from the governmental authority.

(5) Ascertain from the governmental authority the minimum horizontal and vertical clearance requirements for navigation during construction, and maintain those clearances during the period of construction.

(6) If the governmental authority during progress of the work issues directions or orders affecting the contractor's operations or order of procedure, the contractor shall promptly file with the engineer a written copy of the directions or orders.

(7) Should the contractor during the progress of the work lose, dump, throw overboard, sink, or misplace material or equipment, which in the opinion of the governmental authority may interfere with or obstruct navigation, the contractor shall promptly recover or remove the same. Give immediate notice with descriptions and locations of possible obstructions to the governmental authority. If the governmental authority requires, mark or buoy the obstructions until their removal. Should the contractor refuse, neglect, or delay compliance with the above requirements, the governmental authority may remove the obstructions. The department may deduct the cost of this removal from payments due to the contractor, or may recover the cost under the bond deposited by the contractor.

(8) During construction, provide temporary lights, waterway markers, other devices, or combination thereof as the governmental authority specifies and requires.

(9) All expenses the contractor incurs to maintain navigation are incidental to the contract cost.

107.20 Erosion Control

(1) Perform the temporary and permanent erosion control measures and the storm water management measures required by Trans 401 of the Wisconsin administrative code, the contract, and as the engineer directs.

(2) Coordinate temporary erosion control measures with the permanent erosion control measures to ensure economical, effective, and continuous erosion control.

(3) Submit an ECIP for the project, including borrow sites and material disposal sites, according to Trans 401 of the Wisconsin administrative code. Perform the work according to the ECIP. Prepare the ECIP according to CMM 6-45 and provide the information enumerated in department worksheet WS1073 available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/environment/ws1073.doc

(4) The engineer may limit the area of erosive land the contractor may expose to the elements by grubbing, excavation, borrow, or fill operations at any one time. Provide the shortest practicable duration for this exposure before final trimming, finishing, and seeding, or applying temporary erosion control measures.

(5) Perform construction in and adjacent to rivers, streams, lakes, or other waterways in a manner to avoid washing, sloughing, or deposition of materials into the waterways that would obstruct or impair the flow of the waterways and thus endanger the roadway or stream banks, or that would result in undue or avoidable contamination, pollution, or siltation of these waterways.

(6) The engineer has full authority to suspend or limit grading and other operations pending adequate performance of permanent erosion control measures, such as finish grading, topsoiling, mulching, matting, and seeding, and all temporary erosion control measures that the engineer orders.

(7) Perform grubbing and grading operations in sequence with other work to minimize erosion. Construct intercepting ditches or dikes as soon as practicable after completing clearing and grubbing operations and before or during the operations of excavating the cuts. Where erosion is likely to be a problem, provide the permanent erosion control measures immediately after performing grading operations, unless the engineer authorizes temporary erosion control measures.

(8) Except as limited under 628.4.1.1 and 628.5.1 for borrow sites and material disposal sites, the engineer will measure, and the department will pay for, temporary and permanent erosion control as provided for by the various contract bid items or as extra work, if this work is not specified in the contract. However, the department will not pay for this work if the engineer requires temporary erosion control because of the contractor's negligence, carelessness, or failure to install permanent controls.

107.21 Use of Fire Hydrants

(1) If the contractor desires to use water from public hydrants, the contractor shall make application to the proper authorities and conform to their ordinances, rules, and regulations concerning fire hydrant use.

(2) Ensure that fire hydrants are accessible at all times to the fire department. Do not place material or other obstructions closer to a fire hydrant than allowed by ordinances, rules, or regulations, or within 5 feet of a fire hydrant in the absence of specific ordinances, rules, or regulations.

107.22 Contractor's Responsibility for Utility Facilities, Property, and Services

(1) The department expressly reserves for the proper authorities of the municipality in which the work is done the right to construct utility services in the highway or street, or to grant permits for the same, at any time. Coordinate and cooperate with utilities in the removal and rearrangement of existing facilities to minimize their service interruption and duplication of work by the utilities. At least 3 business days before breaking ground, the contractor shall notify the proper utility authorities that the contractor's operations may affect their facilities including: streets, gas and water pipes, electric and other conduits, railroads, poles, manholes, catch basins, sewers, and other property. Never hinder or interfere with utility representatives in the protection or operation of their facilities. Obtain all necessary information regarding existing facilities. Protect existing facilities from damage and unnecessary exposure.

(2) Obtain all necessary information regarding the planned installation of new facilities identified in the contract. Make proper provision and give proper notification so the utilities can install new facilities at the proper time without delay or unnecessary inconvenience. Do not pave over the location of a new underground facility, planned for installation concurrently with this contract, before installing the facility.

(3) If the contractor damages or interrupts service, the contractor shall notify the utility promptly. Coordinate and cooperate with the utility in the repair of the facility. Determine who is responsible for repair costs according to Wisconsin statutes 66.0831 and 182.0175(2).

http://docs.legis.wi.gov/statutes/statutes/66

http://docs.legis.wi.gov/statutes/statutes/182

(4) If the contractor finds facilities not identified in the contract, the engineer will determine whether adjustment or relocation of the facility is necessary to accommodate contract work. The engineer will arrange with the utility or the contractor to adjust or relocate the facility. If deemed necessary, the engineer will revise the contract as specified in 104.2.

(5) If specified in the contract, the contractor and the department will comply with administrative rule, Trans 220 of the Wisconsin administrative code.

107.23 Antitrust Assignment Clause

(1) The contractor hereby assigns to the department all claims for overcharges resulting from antitrust violations as to goods and materials purchased in connection with this contract, except as to overcharges that result from antitrust violations commencing after the price is established under this contract and any change order. In addition, the contractor warrants and represents that each of the contractor's first tier suppliers and subcontractors shall assign all antitrust violation claims to the state subject to the aforementioned exception.

107.24 Hazardous Substances

(1) Whenever the construction operations encounter or expose an abnormal condition that may indicate the presence of a hazardous substance, immediately discontinue construction operations near the abnormal condition and notify the engineer. Treat all abnormal conditions with extreme caution. Abnormal conditions include, but are not limited to, the following:

1. The presence of a tank or barrel.
2. An obnoxious odor.
3. Excessively hot earth.
4. Smoke.
5. Visible fumes.
6. Discolored earth or sheen on groundwater.

(2) Do not resume construction operations in this area until the engineer so directs. The contractor may continue work in other areas of the project unless the engineer otherwise directs.

(3) Take actions to prevent the hazardous substance from spreading into an uncontaminated area.

(4) Dispose of hazardous substances conforming to the requirements and regulations of the responsible state or federal agencies. If the engineer requires the contractor to dispose of the hazardous substance and the contract does not provide for this work, the work is extra work as specified in 104.2. If the responsible state or federal agency requires special procedures for the disposal, the department will arrange with qualified persons to dispose of the substance.

107.25 Archaeological and Historical Findings

(1) For construction operations on the project, if encountering human remains or if encountering artifacts of potential archaeological or historical significance, immediately stop operations at the encounter site and notify the engineer. Cooperate, as necessary, by moving construction operations from the encounter site and complying with the engineer's directions. The contractor may continue work elsewhere on the project unless the engineer directs otherwise. Do not resume operations at the encounter site without the engineer's permission.

(2) For operations on private property, if encountering human remains or if encountering artifacts of potential archaeological or historical significance, immediately stop operations at the encounter site and notify the engineer and the responsible state agencies. Cooperate, as necessary, by moving construction operations from the encounter site and complying with the responsible state agencies' directions. Do not resume operations at the encounter site without the responsible state agencies' permission.

107.26 Standard Insurance Requirements

(1) Maintain the following types and limits of commercial insurance in force until the engineer determines that the work is complete as specified in 105.11.2.1.4.

TABLE 107-1 REQUIRED INSURANCE AND MINIMUM COVERAGES

TYPE OF INSURANCE	MINIMUM LIMITS REQUIRED[1]
1. Commercial general liability insurance endorsed to include blanket contractual liability coverage.[2]	$2 million combined single limits per occurrence with an annual aggregate limit of not less than $4 million.
2. Workers' compensation.	Statutory limits
3. Employers' liability insurance.	Bodily injury by accident: $100,000 each accident Bodily injury by disease: $500,000 each accident $100,000 each employee
4. Commercial automobile liability insurance covering all contractor-owned, non-owned, and hired vehicles used in carrying out the contract.[2]	$1 million-combined single limits per occurrence.

[1] The contractor may satisfy these requirements with primary insurance coverage or with excess/umbrella policies.

[2] The Wisconsin Department of Transportation, its officers, agents, and employees shall be named as an additional insured under the general liability and automobile liability insurance.

(2) For a joint venture, limited liability company, or partnership; ensure that the bidding entity is the named insured and that coverages apply jointly and severally to its member entities.

(3) Obtain coverage from insurance companies licensed to do business in the state that have an A.M. Best rating of A- or better. The cost of providing the required insurance coverage and limits is incidental to the contract.

(4) The department may request proof of insurance at any time. Submit copies of insurance policies as well as associated certificates of insurance upon department request.

(5) Notify the department immediately upon cancellation or initiating cancellation, whichever is earlier, or any material change in coverage. Cease operations immediately if any insurance is cancelled or reduced. Do not resume operations until the required coverage is in force.

(6) The above insurance requirements apply with equal force whether the contractor or a subcontractor, or anyone directly or indirectly employed by either, performs work under the project.

Section 108 Prosecution and Progress

108.1 Subletting the Contract

108.1.1 General

(1) Do not sublet, sell, transfer, assign, or otherwise dispose of the contract, a portion of the contract, or a right, title, or interest in the contract without the engineer's written consent. If the engineer consents to the contractor subletting a portion of the contract, the contractor is relieved of no responsibility for the fulfillment of the contract or of no liability under the contract and bond. Do not allow a subcontractor to proceed with work without the engineer's written consent.

(2) Request permission in writing to sublet a portion of the contract. If the engineer requires, submit evidence that the proposed subcontractor is experienced and equipped for the work. The engineer may also require submission of a copy of the proposed subcontract. Submit all subsequent changes in the terms of a subcontract for the engineer's consent.

(3) If proposing to have a party other than a subcontractor perform work, notify the engineer and submit details of this arrangement in writing. The engineer will determine if that arrangement constitutes subcontracting. The engineer may also require the contractor to file, with the engineer, copies of all other agreements between any parties regarding the performance of work under the contract.

108.1.2 Prime Contractor Participation

(1) Perform at least 30 percent of the original contract amount with the contractor's own organization. The contractor's own organization is defined as workers the contractor employs and pays directly as well as equipment the contractor owns or rents, either with or without operators. Submit documentation according to CMM 2-60 to indicate what work the contractor's own organization is performing and the dollar value of that work before contract execution as specified in 103.6. Include a detailed computation showing the contractor's share of work calculated as follows:

Contractor's share = P / (C - S)

Where:

P = Work the prime contractor performs. The prime may include materials the prime purchases and installs or that the prime purchases but others install, and trucking the prime pays for directly. Do not include equipment and associated operators the prime leases to others performing work.

C = Total contract amount.

S = Specialty work others perform. Work on sanitary sewer systems and water-main systems is specialty work. Specialty work also includes work performed under any bid item in the designated sections or under special provision bid items for similar work as follows:

- Contractor staking work under 650.
- Electrical work under 651 - 678.
- Landscaping and erosion control work under 626 - 632.
- Traffic control work under 643.
- Signing work under 633 - 638 and 641.
- Pavement marking work under 646 - 649.
- Fencing work under 616.

108.2 Start of the Work

(1) For the purpose of determining contract time, the contract starting date is defined as follows:

If the contract provides for starting work not later than 10 calendar days after the date of written notification from the engineer, the contract starting date will be the date construction operations are started or the tenth calendar day following the date of that notification, whichever is earlier.

108.3 Prosecution of the Work

(1) The department will issue a written notification to begin or resume work for all working day, calendar day, and completion date contracts. Do not begin or resume work before receiving the engineer's written notification. Notify the engineer at least 3 business days before starting or resuming work. Notify the engineer at least one business day before changing the schedule of work, such as working on Saturdays, Sundays, and department-specified holidays.

(2) Give the work the constant attention necessary to promote the progress of the work. Promptly supply the materials, tools, equipment, and incidental items required to perform the work. Employ an ample force of workers and provide a construction plant properly adapted to the work and of sufficient

capacity and efficiency to accomplish the work in a safe and skillful manner as provided in the contractor's progress schedule. Maintain all plants in good working order and make provisions for immediate emergency repairs.

(3) Take precautions necessary to protect the work as specified in 107.14. Include in the contract price the cost for taking precautions and protecting the work. The cost of taking precautions and protecting the work is incidental to the work as specified in 109.2 and 109.6.1.

108.4 Progress Schedules

108.4.1 General

(1) Submit a bar chart progress schedule as specified in 108.4.2. The contractor may alternatively submit one of the following:

1. A linear schedule conveying all the information specified in 108.4.2 for a bar chart.
2. A relationship bar chart (RBC) schedule as specified in 108.4.3.
3. A critical path method (CPM) schedule as specified in 108.4.4.

(2) If the contract requires, submit an RBC schedule as specified in 108.4.3 or a CPM schedule as specified in 108.4.4, and do not submit a bar chart schedule.

(3) Plan and execute the work to meet the contract-required interim completion dates and the specified contract time or completion date. The engineer will use the schedule to monitor the progress of the work. The schedule is not part of the contract.

108.4.2 Bar Chart Progress Schedule

108.4.2.1 Initial Bar Chart Progress Schedule

(1) At least 14 calendar days before the preconstruction meeting, submit to the engineer for review an initial bar chart progress schedule conforming to the following minimum requirements:

1. Include activities that describe essential features of the work and activities that might potentially delay contract completion. Identify activities that are controlling items of work.
2. Identify the contemplated start and completion dates for each activity. Provide a duration, ranging from one to 15 working days, for each activity. Break longer activities into 2 or more activities distinguished by the addition of a location or some other description. Specify the sequencing of all activities.
3. Provide the quantity and the estimated daily production rate for controlling items of work.
4. Include a narrative that lists the work days per week, department-specified holidays, number of shifts per day, and number of hours per shift. For calendar day and completion date contracts, provide the estimated number of adverse weather days for each month consistent with the monthly-anticipated adverse weather days 108.10.2.2 shows.
5. Show completing the work within interim completion dates and the specified contract time or completion date.

(2) In addition to the required activities, the contractor is encouraged to include other activities such as:

1. The procurement of materials, equipment, articles of special manufacture, concrete curing time, etc.
2. The furnishing of drawings, plans, and other data required in the contract for the engineer's review.
3. The department's inspections of structural steel fabrication, etc.
4. Third-party activities related to the contract.

(3) Hand drawn schedules are acceptable. If the contractor develops the initial schedule with scheduling software, the contractor is encouraged to provide the engineer a diskette of the schedule and the name of the scheduling software used.

(4) The engineer and contractor will review the initial schedule at the preconstruction meeting. Within 5 business days after the preconstruction meeting, the engineer will accept the contractor's initial schedule or request additional information. Make the appropriate adjustments and resubmit the revised initial schedule within 5 business days after the engineer's request. If the engineer requests justification for an activity duration, provide information that may include estimated labor, equipment, unit quantities, and production rates used to determine the activity duration.

(5) The department will only make progress payments for the value of materials, as specified in 109.6.3.2, until the engineer accepts the initial schedule. The engineer accepts the contractor's initial schedule based solely on whether that schedule is complete as specified in 108.4.2.1(1). The engineer's acceptance of the schedule does not modify the contract or validate the schedule.

108.4.2.2 Monthly Progress Meetings and Bar Chart Progress Schedule Updates

(1) The contractor and the engineer will meet monthly to assess progress and jointly add update information to the initial schedule. At a minimum, updates will include the actual start and finish of each activity, percentage complete, and remaining durations of activities started but not yet completed.

108.4.2.3 Engineer's Right to Request Bar Chart Progress Schedule Revisions

(1) The engineer will monitor the progress of the work and may request that the contractor revise the schedule if project completion or interim completion targets are delayed 14 calendar days or more for calendar day or completion date contracts, or 10 working days or more for working day contracts. Submit the revised schedule within 5 business days after the engineer's request.

108.4.2.4 Bar Chart Progress Schedule Documentation for Time Extensions

(1) Furnish documentation including schedule updates to support requests to extend interim completion dates, the specified contract time, or the completion date.

(2) If the contractor does not furnish documentation to support the additional time needed to complete work on increased quantities for an excusable delay that affects a controlling item of work, the engineer may extend contract time, rounded to the nearest 1/2 day, as follows:

$$TE = OT \times (ATC - OC)/OC$$

Where:

TE = Time extension

OT = Original time (original contract time)

OC = Original cost (total bid amount)

ATC = Adjusted total cost (actual cost of all work minus the cost of change order work where contract time was determined)

108.4.2.5 Bar Chart Progress Schedule Measurement and Payment

(1) Include the cost for the schedule in the total bid. The schedule is incidental to the contract.

108.4.3 Relationship Bar Chart Progress Schedule

108.4.3.1 General

(1) If the contract requires, submit a RBC Progress Schedule.

108.4.3.2 Initial RBC Progress Schedule

(1) At least 14 calendar days before the preconstruction meeting, submit to the engineer for review an initial RBC schedule that meets the following minimum requirements:

1. Include activities that describe essential features of the work and activities that might potentially delay contract completion. Identify activities that are controlling items of work.
2. Identify the contemplated start and completion dates for each activity. Provide a duration, ranging from one to 15 working days, for each activity. Break longer activities into 2 or more activities distinguished by the addition of a location or some other description.
3. Provide a logic diagram that shows the sequence of activities and the scheduling interrelationships among activities. Alternatively, the contractor may identify the activity interrelationships in a tabular listing. Ensure all activity interrelationships are finish to start relationships with no leads or lags. Use only contractual constraints in the schedule logic. The engineer may accept requested exceptions.
4. Provide the quantity and the estimated daily production rate for controlling items of work.
5. Include a narrative that lists the work days per week, department-specified holidays, number of shifts per day, and number of hours per shift. For calendar day and completion date contracts, provide the estimated number of adverse weather days for each month consistent with the monthly-anticipated adverse weather days 108.10.2.2 shows.
6. Show completing the work within interim completion dates and the specified contract time or completion date.
7. Develop the RBC schedule using computerized scheduling software. Provide the engineer with a paper copy of the information required in items 3 and 5 of 108.4.3.2(1). Submit a diskette of the schedule and identify the software used to prepare that schedule.

(2) In addition to the required activities, the contractor is encouraged to include other activities such as:

1. The procurement of materials, equipment, articles of special manufacture, concrete curing time, etc.
2. The furnishing of drawings, plans, and other data required in the contract for the engineer's review.
3. The department's inspections of structural steel fabrication, etc.
4. Third-party activities related to the contract.

(3) The contractor may augment the initial submittal of the RBC schedule by submitting a linear schedule. The linear schedule must be generated from the RBC schedule.

(4) The engineer and the contractor will review the initial schedule at the preconstruction meeting. Within 5 business days after the preconstruction meeting, the engineer will accept the contractor's initial schedule or request additional information. Make the appropriate adjustments and resubmit the revised initial schedule within 5 business days after the engineer's request. If the engineer requests

justification for an activity duration, provide information that may include estimated labor, equipment, unit quantities, and production rates used to determine the activity duration.

(5) The department will only make progress payments for the value of materials, as specified in 109.6.3.2, until the engineer accepts the initial schedule. The engineer accepts the contractor's initial schedule based solely on whether that schedule is complete as specified in 108.4.3.2(1). The engineer's acceptance of the schedule does not modify the contract or validate the schedule.

108.4.3.3 Monthly RBC Progress Schedule Updates and Progress Meetings

(1) Update the schedule monthly to show current progress. At a minimum, ensure that the update includes:

1. The actual start and finish of each activity, percentage complete, and remaining durations of activities started but not yet completed.
2. A narrative report that includes a listing of monthly progress, changes to the controlling items of work from the previous update, sources of delay, potential problems, work planned for the next 30 calendar days, and changes to the RBC schedule. Changes include, but are not limited to, changes in the method and manner of performing the work, changes in the contract, extra work, changes in an activity duration, and changes to relationships between activities.

(2) For each schedule update, submit a diskette and an updated paper copy meeting the requirements in 108.4.3.2(1).

(3) Within 5 business days after submitting the monthly update, hold a job-site meeting with the engineer to review the progress of the schedule. At that meeting, the department will confirm the actual start and actual finish dates of completed activities, remaining durations of uncompleted activities, and changes to the controlling items of work.

108.4.3.4 Engineer's Right to Request RBC Progress Schedule Revisions

(1) Between monthly updates, the engineer will monitor the progress of the work and may request that the contractor revise the schedule for one or more of the following reasons:

1. The project completion or interim completion targets are delayed 14 calendar days or more for calendar day or completion date contracts, or 10 working days or more for working day contracts.
2. The engineer determines the progress of the work differs significantly from the current schedule.
3. A contract change order requires the addition, deletion, or revision of activities that causes a change in the contractor's work sequence or the method and manner of performing the work.

(2) Submit the revised schedule within 5 business days after the engineer's request.

(3) Within 5 business days after submitting the revised schedule, hold a job-site meeting to review the schedule revisions. At the meeting, the engineer will accept the contractor's schedule or request additional information. Make the appropriate adjustments and resubmit the newly revised schedule.

108.4.3.5 RBC Progress Schedule Documentation for Time Extensions

(1) Furnish documentation, including schedule updates, to support requests to extend interim completion dates, the specified contract time, or completion date.

108.4.3.6 RBC Progress Schedule Measurement

(1) The department will measure one RBC Progress Schedule for the contract acceptably completed.

108.4.3.7 RBC Progress Schedule Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
108.4300	RBC Progress Schedule	EACH

(2) Payment is full compensation for all work required under this bid item. The department will pay the contract amount in 3 payments as follows:

1. The department will make the first payment, equal to 50 percent of the amount bid for this bid item, after the department accepts the initial schedule.
2. The department will make the second payment, equal to 25 percent of the amount bid for this bid item, when the contractor completes work representing 40 percent of the total contract price, excluding the price for this bid item.
3. The department will make the third payment, equal to 25 percent of the amount bid for this bid item, when the contractor completes work representing 80 percent of the total contract price, excluding the price for this bid item.

108.4.4 Critical Path Method Progress Schedule

108.4.4.1 General

(1) If the contract requires, submit a CPM Progress Schedule.

108.4.4.2 Initial Work Plan

(1) At least 14 calendar days before the preconstruction meeting, submit an initial work plan conforming to, as a minimum, the following requirements:

1. Include a detailed bar chart schedule, meeting the requirements of 108.4.2.1(1), for the first 60 calendar days of work. Ensure that all activities have durations of one to of 15 working days, unless the engineer accepts requested exceptions. Show additional activities that require department review or approval.
2. Include a summary bar chart schedule for the balance of the project. Summary activities may be greater than 15 working days.
3. Ensure the bar chart schedules show completing the work within the interim completion dates and specified contract time or completion date.

(2) The engineer and the contractor will review the initial work plan at the preconstruction meeting. Within 5 business days after the preconstruction meeting, the engineer will accept the contractor's initial work plan or request additional information. The engineer will use the detailed bar chart schedule to monitor the progress of the work until accepting the initial CPM schedule.

(3) Maintain and submit on a bi-weekly basis an updated version of the detailed bar chart schedule until the department accepts the initial CPM schedule. Ensure that each schedule update includes the actual start and finish of each activity, percentage complete, and the remaining durations of activities started but not yet completed.

108.4.4.3 Initial CPM Progress Schedule

(1) Within 30 calendar days after the notice to proceed, submit to the engineer for review an initial CPM schedule, beginning at the start of work date and conforming to the following minimum requirements:

1. Include activities that describe essential features of the work and activities that might potentially delay contract completion. Identify activities that are controlling items of work.
2. Identify the contemplated start and completion dates for each activity. Provide a duration, ranging from one to 15 working days, for each activity. Break longer activities into 2 or more activities distinguished by the addition of a location or some other description.
3. Provide a logic diagram having a maximum of 50 activities for each 11 in. by 17 in. sheet. Ensure that each sheet includes title, match data for diagram correlation, and a key to identify all components used in the diagram. Show the sequence of activities and the scheduling interrelationships among activities. Ensure all activity interrelationships are finish to start relationships with no leads or lags. Use only contractual constraints in the schedule logic. The engineer may accept requested exceptions.
4. Provide the quantity and the estimated daily production rate for controlling items of work.
5. Include a narrative that lists the work days per week, department-specified holidays, number of shifts per day, and number of hours per shift. For calendar day and completion date contracts, provide the estimated number of adverse weather days for each month consistent with the monthly-anticipated adverse weather days 108.10.2.2 shows.
6. Provide tabular sorts by:
   - Activity Identification/Early Start.
   - Total Float.
   - Predecessor/Successor.
   - Responsibility/Early Start.
   - Area/Early Start.
7. Provide 60-day look-ahead bar charts by early start.
8. Show completing the work within interim completion dates and the specified contract time or completion date.
9. Develop the CPM schedule using computerized scheduling software. Provide the engineer with a paper copy of the information required in items 3, 5, 6, and 7 of 108.4.4.3(1). Submit a diskette of the schedule and identify the software used to prepare that schedule.

(2) In addition to the required activities, the contractor is encouraged to include other activities such as:

1. The procurement of materials, equipment, articles of special manufacture, concrete curing time, etc.
2. The furnishing of drawings, plans, and other data required in the contract for the engineer's review.
3. The department’s inspections of structural steel fabrication, etc.
4. Third-party activities related to the contract.

(3) Float is defined as the time between the date when an activity can start, the early start, and the date when an activity must start, the late start. The department and the contractor agree that float is a shared commodity, and is not for the exclusive use or financial benefit of either party. Either party has the full use of the float until it is depleted.

(4) The contractor may augment the initial submittal of the CPM schedule by submitting a linear schedule. The linear schedule must be generated from the CPM schedule.

(5) Attend a meeting to review the schedule. The engineer will schedule the meeting within 10 business days after receiving the contractor's initial CPM schedule submittal. Within 5 business days after the meeting, the engineer will accept the contractor's initial CPM schedule or request additional information. Make the appropriate adjustments and resubmit the revised initial CPM schedule within 10 business days after the engineer's request. If the engineer requests justification for an activity duration, provide information that may include estimated labor, equipment, unit quantities, and production rates used to determine the activity duration.

(6) The department will only make progress payments for the value of materials, as specified in 109.6.3.2, until the contractor has submitted the initial CPM schedule. The department will retain 10 percent of each estimate until the department accepts the initial CPM schedule.

(7) The engineer accepts the contractor's initial CPM schedule based solely on whether that schedule is complete as specified in 108.4.4.3(1). The engineer's acceptance of the schedule does not modify the contract or validate the schedule.

108.4.4.4 Monthly CPM Progress Schedule Updates and Progress Meetings

(1) Update the schedule monthly to show current progress. At a minimum, ensure that the update includes:

1. The actual start and finish of each activity, percentage complete, and remaining durations of activities started but not yet completed.
2. A narrative report that includes a listing of monthly progress, changes to the controlling items of work from the previous update, sources of delay, potential problems, work planned for the next 30 calendar days, and changes to the CPM schedule. Changes include, but are not limited to, changes in the method and manner of performing the work, changes in the contract, extra work, changes in an activity duration, and changes to relationships between activities.

(2) For each schedule update, submit a diskette and an updated paper copy of the following:

1. Tabular sorts by:
   - Activity Identification/Early Start.
   - Total Float.
2. If applicable, an updated logic diagram as the engineer requires.
3. If augmenting the CPM schedule with a linear schedule, provide an update of the linear schedule.

(3) Within 5 business days after submitting the monthly update, hold a job-site meeting with the engineer to review the progress of the schedule. At that meeting, the department will confirm the actual start and actual finish dates of completed activities, remaining durations of uncompleted activities, changes to the controlling items of work, and the logic changes.

108.4.4.5 Engineer's Right to Request CPM Progress Schedule Revisions

(1) Between monthly updates, the engineer will monitor the progress of the work and may request that the contractor revise the schedule for one or more of the following reasons:

1. The project completion or interim completion targets are delayed 14 calendar days or more for calendar day or completion date contracts, or 10 working days or more for working day contracts.
2. The engineer determines the progress of the work differs significantly from the current schedule.
3. A contract change order requires the addition, deletion, or revision of activities that causes a change in the contractor's work sequence or the method and manner of performing the work.

(2) Submit the revised schedule within 10 business days after the engineer's request.

(3) Within 5 business days after submitting the revised schedule, hold a job-site meeting to review the schedule revisions. At the meeting, the engineer will accept the contractor's schedule or request additional information. Make the appropriate adjustments and resubmit the newly revised schedule.

108.4.4.6 CPM Progress Schedule Documentation for Time Extensions

(1) Furnish documentation, including schedule updates, to support requests to extend interim completion dates, the specified contract time, or completion date.

108.4.4.7 CPM Progress Schedule Measurement

(1) The department will measure one CPM Progress Schedule for the contract acceptably completed.

108.4.4.8 CPM Progress Schedule Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
108.4400	CPM Progress Schedule	EACH

(2) Payment is full compensation for all work required under this bid item. The department will pay the contract amount in 3 payments as follows:

1. The department will make the first payment, equal to 50 percent of the amount bid for this bid item, after the department accepts the initial schedule.
2. The department will make the second payment, equal to 25 percent of the amount bid for this bid item, when the contractor completes work representing 40 percent of the total contract price, excluding the price for this bid item.
3. The department will make the third payment, equal to 25 percent of the amount bid for this bid item, when the contractor completes work representing 80 percent of the total contract price, excluding the price for this bid item.

108.5 Limiting Operations

(1) Limit operations to prevent undue inconvenience to the traveling public. If the engineer concludes that the extent of the contractor's work zone unnecessarily inconveniences the public, the engineer will require the contractor to finish sections in progress before allowing the contractor to start work on additional sections.

108.6 Character of Workers

(1) Provide personnel necessary to supervise and complete all contract work as specified. Ensure workers have the experience and skills necessary to perform assigned work.

(2) Remove from the project all personnel performing in an unskilled manner or who are intemperate or disorderly. If the engineer concludes that personnel are performing in an unskilled manner or are intemperate or disorderly, the engineer may direct the contractor, in writing, to remove them from the project. Do not allow removed personnel to return to the project without the engineer's written consent.

(3) The engineer may suspend the work in writing, withhold progress payments due the contractor, or both for the following reasons:

1. The contractor does not furnish suitable and sufficient personnel to perform the work.
2. The contractor does not remove personnel from the project as specified in 108.6(2).

108.7 Methods and Equipment

108.7.1 General

(1) Use equipment of the capacity and mechanical condition necessary to perform work conforming to the contract. Ensure that the equipment does not harm the roadway, pavement, structures, adjacent property, other highways, workers, or the public. Use equipment conforming to the specific contract requirements for individual bid items or classes of work.

(2) If the contractor does not provide adequate equipment, properly maintained, the engineer may:

1. Order the contractor to remove the equipment.
2. Suspend specific operations until the contractor provides adequate equipment.
3. Determine that the contractor is in default of the contract.

(3) Equip each unit of motorized construction equipment with a muffler constructed to the equipment manufacturer’s specifications. The contractor may substitute other mufflers producing equivalent results. Maintain mufflers and exhaust systems in good operating condition, free from leaks and holes.

108.7.2 Moving Heavy Loads

(1) For all vehicles operated on completed subgrade, base, or pavement that will remain a permanent part of the project, do not exceed the legal loading defined in Wisconsin statutes for Class A highways without the engineer's written permission. For structures, do not exceed that legal loading without written permission whether or not the structure will remain a permanent part of the project. Adhering to these requirements, or allowed variations, does not relieve the contractor of liability for damage caused by those operations.

108.7.3 Loads on Structures

(1) Demonstrate that all loads on structures within the project limits throughout the duration of the contract do not exceed the structural capacity of the structure. If the engineer directs, submit stamped and signed copies of analyses and associated calculations performed by a professional engineer

registered in the state of Wisconsin to the engineer and to the department's bureau of structures. Do not begin construction operations or move a heavy load across a structure without the engineer's written authorization.

(2) If a PE's analysis is required, determine capacity at the operating load level using the same AASHTO specification the structure was rated under. Include materials, equipment, and other construction or vehicular loads in the analyses. If under public traffic, also include the Wisconsin standard permit vehicle (Wis-SPV) as shown in chapter 45 of the department's bridge manual. The structure must be capable of carrying a Wis-SPV load equal to or greater than 100,000 pounds in addition to construction loads. The engineer's written authorization must be accompanied by a copy of the analysis stamped accepted by department's bureau of structures before proceeding.

(3) Except as required to accommodate public traffic or to complete the deck pour, do not operate heavy equipment or impose vehicular live loads on lanes adjacent to freshly placed concrete decks until it develops sufficient strength to open it to service under 502.3.10.1.

108.8 Substituting Equipment, Methods, and Materials

(1) Use the equipment, methods, or materials specified in the contract unless the engineer authorizes substitutes. If the contract does not specify equipment, methods, or materials, the contractor may use those the contractor demonstrates, to the engineer's satisfaction, to produce conforming work.

(2) Obtain the engineer's authorization before substituting for equipment, methods, or materials specified in the contract. Submit a written request to the engineer describing the equipment, methods, or materials proposed and the reasons for the change. The engineer's authorization of a substitution does not relieve the contractor of the obligation to produce work conforming to the contract as specified in 105.3.1.

(3) If after use of substituted equipment, methods, or materials, the engineer finds the work nonconforming, the contractor shall complete the remaining work with the specified equipment, methods, or materials. The nonconforming work is subject to the provisions of 105.3.2.

(4) The department will pay for a substitute made under 108.8 at the contract price for the original work. The department will not extend contract time for a substitute made under 108.8, except for time resulting from a cost reduction incentive as provided in 104.10.

108.9 Contract Time for Working Day, Calendar Day, and Completion Date Contracts

108.9.1 General

(1) Complete all or any portion of the project called for in the contract within the time or times for completion of the contract. All time limits in the contract are crucial elements of the contract.

(2) The proposal will specify the time for completion as a specific number of working days, calendar days, or as a given completion date.

108.9.2 Assessing Time Charges for Working Day Contracts

(1) For working day contracts, contract time is the number of working days specified for completion. Beginning with the start of work specified in 108.2, the engineer will assess working days for all days except:

1. Days excluded in 108.9.2(4).
2. Days if one or more of the following prevent the contractor from working on the controlling item:
   - 2.1 Earthquakes and other cataclysmic phenomena of nature the contractor cannot foresee and avoid.
   - 2.2 Weather conditions.
   - 2.3 Job conditions caused by weather.
   - 2.4 Non-compensable delays as specified in Items 2 through 7 of 108.10.2.1(3).
   - 2.5 Compensable delays as specified in Items 2 through 5 of 108.10.3(2).

(2) The engineer will assess working days based on the number of hours the contractor is able to work on the controlling item with full and normal efficiency. The engineer will assess working days as follows:

1. Contractor can work less than 4 hours; no working day.
2. Contractor can work from 4 to less than 8 hours; 1/2 working day.
3. Contractor can work 8 hours or more; full working day.

(3) The engineer will assess working days if the contractor is not performing work on the controlling item of work, and that non-performance is due to delays the contractor can foresee, control, or prevent.

(4) The engineer will not assess working days on:

1. Saturdays, Sundays, and department-specified holidays.

2. Engineer-ordered suspensions for reasons other than contractor negligence or non-compliance including winter suspensions before November 16 or after March 31.
3. Contract-identified, non-work days during the construction season.
4. Days from November 16 through March 31.

(5) The engineer will continue to assess working days after November 15 if the contractor has not completed the work to the stage the contract requires to be completed by November 16.

(6) If the engineer determines the contractor shall not work during the period from November 16 through March 31, the contractor is not entitled to claim for a delay, time extension, or other related damages.

(7) The engineer will prepare a weekly statement showing days charged for the preceding week and days remaining on the contract. The engineer will make this statement available to the contractor in a mutually agreeable location within 5 business days after the week covered in the statement. If the contractor disagrees with the time assessed, the contractor may give notice as specified in 104.3.

108.9.3 Contract Time for Calendar Day Contracts

(1) For calendar day contracts, contract time is the number of calendar days specified for completion, including Saturdays, Sundays, and department-specified holidays, counted from the starting date specified in 108.2. Contract time includes contract-identified non-work days during the construction season, but excludes contract-identified winter suspension periods.

108.9.4 Contract Time for Completion Date Contracts

(1) For completion date contracts, contract time begins with the start of work as specified in 108.2 and concludes on the specified completion date. Complete the contract by that date.

108.10 Determining Contract Time Extensions and Payment for Excusable Delays

108.10.1 General

(1) The department may extend contract time by contract change order. The department will only extend contract time if an excusable delay affects the controlling item of work. Excusable delays are unforeseen and unanticipated delays not resulting from the contractor's fault or negligence. Provide documentation and schedule updates to support requested time extensions as specified:

1. In 108.4.2.4 for bar chart progress schedules.
2. In 108.4.3.5 for RBC progress schedules.
3. In 108.4.4.6 for CPM progress schedules.

(2) The department may choose not to consider time extensions for delays unless the contractor notifies the engineer as specified in 104.3 and updates the schedule. The engineer will evaluate the facts, pay adjustment, and time extension for the delay. The engineer's findings are final and conclusive.

108.10.2 Excusable, Non-Compensable Delays

108.10.2.1 General

(1) Non-compensable delays are excusable delays not the contractor's or the department's fault. The engineer will not pay for the delay costs listed in 109.4.7 for non-compensable delays.

(2) For non-compensable delays under calendar day and completion date contracts, the engineer will extend contract time if the conditions specified in 108.10.1 are met. The department will relieve the contractor from associated liquidated damages, as specified in 108.11, if the engineer extends time under 108.10.1.

(3) The following are non-compensable delays:

1. Delays due to earthquakes, other cataclysmic phenomena of nature the contractor cannot foresee and avoid, severe weather or job conditions caused by recent weather as specified in 108.10.2.2.
2. Extraordinary delays in material deliveries the contractor or their suppliers cannot foresee and forestall resulting from strikes, lockouts, freight embargoes, industry-wide shortages, governmental acts, or sudden disasters.
3. Delays due to acts of the government, a political subdivision other than the department, or the public enemy.
4. Delays from fires or epidemics.
5. Delays from strikes beyond the contractor's power to settle not caused by improper acts or omissions of the contractor, their subcontractors, or their suppliers.
6. Delays caused by non-completion of work by utilities or other third parties, if the contract does not specify a number of days or a completion date for that utility or third-party work.
7. Altered quantities as specified in 109.3.

108.10.2.2 Extension of Contract Time for Severe Weather

(1) The engineer will award a time extension for severe weather on calendar day and completion date contracts. Submit a request for severe weather days if the number of adverse weather days, as defined in 101.3, exceeds the anticipated number of adverse weather days tabulated below.

TOTAL ANTICIPATED ADVERSE WEATHER DAYS FOR EACH CALENDAR MONTH[2]

Jan: 31[1]	Feb: 28[1]	Mar: 31[1]	April: 5	May: 4	June: 4	July: 3	Aug: 3
Sep: 4	Oct: 5	Nov 1 thru 15: 2	Nov 16 thru 30: 15[1]	Dec: 31[1]			

[1] Includes an anticipated winter suspension from November 16 through March 31.

[2] The number of days will be modified in the special provisions for year-round and painting contracts.

(2) Submit the request to the engineer at the end of the month. Indicate the number of adverse weather days that occurred during that month. Provide progress schedule documentation to show that the controlling item of work was delayed. Show that the delay was beyond the control of the contractor. The engineer will assess the contractor's submittal and indicate how many adverse weather days are confirmed.

(3) For each calendar month, the engineer will grant a severe weather day for each confirmed adverse weather day that exceeds the number of anticipated adverse weather days 108.10.2.2(1) shows. When the contractor requests severe weather days, the engineer will give the contractor a monthly written statement showing the number of days credited for severe weather. At the end of the project, the engineer will extend time on calendar day and completion date contracts for the cumulative number of severe weather days credited each month.

108.10.3 Excusable Compensable Delays

(1) Compensable delays are excusable delays due to the department's actions or lack of actions, or determined by judicial proceeding to be the department's sole responsibility. The engineer will grant a time extension for a compensable delay if the conditions specified in 108.10.1 are met.

(2) The following are compensable delays:

1. A contract change for revised work as specified for extra work under 104.2.2.1, for a differing site condition under 104.2.2.2, or for significant changes in the character of the work under 104.2.2.4.
2. A contract change for an engineer-ordered suspension under 104.2.2.3.
3. The unexpected discovery of human remains, an archaeological find, or historical find consistent with 107.25.
4. The unexpected discovery of a hazardous substance consistent with 107.24.
5. The non-completion of work that utilities or other third parties perform, if the contract specifies a number of days or a completion date for that utility or third-party work. For delays covered under Trans 220 of the Wisconsin administrative code, the contractor must seek recovery of delay costs from the utility.

(3) For a compensable delay or a time extension, the department will relieve the contractor from associated liquidated damages under 108.11, and will pay the contractor for delay costs determined as follows:

1. Adjust the contract price as specified in 109.4.2 through 109.4.5 for delays under item 1 of 108.10.3(2).
2. Adjust the contract price as specified in 109.4.7 for delays under items 2 through 5 of 108.10.3(2).

108.11 Liquidated Damages

(1) If the contractor does not complete the work within the contract time or within the extra time allowed under engineer-granted time extensions, the department will assess liquidated damages. The department will deduct a specified sum from payments due the contractor for every calendar day on calendar day contracts and completion date contracts, or for every working day on working day contracts, that the work remains uncompleted.

Revise 108.11(2) & (3) to clarify that the standard liquidated damages amounts are for engineering and supervision and represent only a fraction of the costs typically assessed for interim liquidated damages. This change was implemented in ASP 6 effective with the December 2017 letting.

(2) This deducted sum is not a penalty but is a fixed, agreed, liquidated damage due the department from the contractor for the added cost of engineering and supervision resulting from the contractor's failure to complete the work within the contract time.

(3) Unless enhanced in the special provisions, the department will assess the following daily liquidated damages

LIQUIDATED DAMAGES

ORIGINAL CONTRACT AMOUNT		DAILY CHARGE	
FROM MORE THAN	TO AND INCLUDING	CALENDAR DAY	WORKING DAY
$0	$250,000	$850	$1700
$250,000	$500,000	$815	$1630
$500,000	$1,000,000	$1250	$2500
$1,000,000	$2,000,000	$1540	$3080
$2,000,000	___	$2070	$4140

(4) If the engineer allows the contractor to continue and finish the work or any part of it after the contract time expires, the department waives no rights under the contract.

108.12 Terminating the Contract for Default

(1) The engineer, after giving written notice to the contractor and the contractor's surety, may take the prosecution of the work out of the hands of the contractor or the contractor's surety, or both, for one or more breach of the contract the contractor commits, as follows:

1. Failing to begin the work under the contract within the time specified.
2. Failing to perform the work with sufficient workers, equipment, or materials to complete the work within the specified time.
3. Failing to complete the contract within the contract time specified, as extended by the engineer.
4. Performing the work unsuitably, or not obeying an engineer directive to remove and replace or otherwise correct unacceptable work.
5. Discontinuing the prosecution of the work before completion without the engineer's permission.
6. Failing to resume work that the engineer discontinued within a reasonable time after notice to do so.
7. Insolvency or bankruptcy, or committing an act of bankruptcy or insolvency.
8. Allowing a final judgment against the contractor to stand unsatisfied for a period of 48 hours.
9. Making an assignment for the benefit of creditors.
10. Failing to comply with the provisions of the contract relative to hours of labor, wages, equal opportunity, character and classification of workers employed.
11. Failing to acquire or maintain the required insurance.
12. Failing to carry on the work in an acceptable manner.

(2) The engineer will give the contractor and the contractor's surety written notice specifying the delay, neglect, or default and the action required. If the contractor or the contractor's surety, within a period of 10 calendar days after that notice, fails to proceed satisfactorily in compliance therewith, the department then has full power and authority to take the work out of the hands of the contractor or the contractor's surety, or both; to use all suitable materials and equipment on the project; or to enter into contract, or use other methods that the department requires to complete the work.

(3) If the department takes over the incomplete work under 108.12, the department will deduct all additional costs and damages and the costs and charges of completing the work under contract from payments due the contractor. If the total of those damages, costs, and charges is less than the sum that would have been payable under the contract if the contractor had completed the work, then the contractor is entitled to receive the difference subject to all claims for liens thereon that may be filed with the department. If that total exceeds the sum that would have been payable under the contract, the department will consider the contractor and the contractor's surety liable, and the contractor and the contractor's surety shall pay to the department the amount of that excess.

(4) The department will not relieve the contractor and the contractor's surety of the liability for the assessment of liquidated damages under 108.11 because of the contractor's default.

(5) The rights and remedies of the department are in addition to all other rights and remedies provided by law or under the contract and the bonds.

(6) If, after the engineer gives notice of default as specified in 108.12(1), it is determined that the contractor was not in default, the rights and obligations of the parties are the same as if the notice of termination had been issued as specified in 108.13.

(7) If a court finds the department's default of the contractor under 108.12 to be legally improper, the department will treat the contract as if the department had terminated the contractor for convenience as specified in 108.13. The department will pay the contractor as specified in 108.13.

108.13 Terminating the Contract for Convenience of the Department

(1) The department may terminate the contract or any part of the contract for reasons beyond the control of the department or contractor after determining that termination is in the department's or the public interest. Reasons for termination include, but are not limited to, one or more of the following:

1. A national emergency that creates a shortage of materials, labor, or equipment by: reason of war conditions involving the United States; reason of orders of the federal government or its duly authorized agencies; or executive orders with respect to prosecution of war or national defense.
2. Orders from duly constituted authorities relating to energy conservation.
3. An injunction or restraining order obtained by a citizen's action alleging violations of 42 U.S.C. 4331-4332, 23 U.S.C. 138, or public law 91-646.

(2) The department will deliver to the contractor a termination notice specifying the extent of termination and the effective date.

(3) Upon receipt of a termination notice, do not proceed with the affected bid items unless directed to do so in that notice. Complete all bid items specified in the termination notice. That work includes punch list items and all work necessary to ensure the safety of the public, to properly secure work already constructed or partially constructed, and to secure the project site. Perform this work, which may include bid items not in the original contract, the contract specifies. The contract is sufficiently complete upon completion and acceptance of all bid items specified in the termination notice, except punch list items. After completion of the punch list items and all contract-required documents, the department will terminate the contract by issuing a final certificate and payment. The department reserves the right to declare in default a contractor who does not carry out the conditions of a termination for convenience.

(4) If the department orders termination of the contract for convenience, the department will pay for all completed work as of that date at the contract price. The department will pay for partially completed work at agreed prices or by force account methods specified in 109.4.5 provided, however, that payment does not exceed the contract price for the bid item under which the work was performed. The department will pay for work eliminated by the termination only to the extent provided under 109.5. The department will pay for new work, if any, at agreed prices or paid for by force account methods specified in 109.4.5.

(5) The department may allow the contractor to purchase materials that the department obtained for the work but that have not been incorporated into the work at actual cost delivered to a designated location or otherwise disposed of as mutually agreed.

(6) The department may, at the department's option, purchase unused materials that the contractor has obtained and that the department has inspected, tested, and accepted, at the points of delivery as the department designates and at a cost shown by receipted bills or other proper evidence.

(7) If the engineer directs, the contractor shall promptly remove equipment and supplies from the project site or other department property. If the contractor does not remove the equipment and supplies as directed, the engineer may do so at the contractor's expense.

(8) Within 60 calendar days of the effective termination date, submit claims for additional costs actually incurred. Do not include claims for loss of anticipated profits on work not performed. The contractor may claim one or more of the following:

1. Costs for reasonable idle equipment time or mobilization efforts.
2. Bidding and project investigative costs.
3. Overhead expenses attributable to the terminated project.
4. Subcontractor costs not otherwise paid for.
5. Actual idle labor cost if work is stopped before the termination date.
6. Guaranteed payments for private land usage as part of the original contract.

(9) Make cost records available to the department to the extent necessary to determine the validity and amount of each item claimed.

(10) The department will not relieve the contractor of contractual responsibilities for the work completed. The department does not relieve the contractor's surety of its obligations for and concerning a just claim arising from work performed due to a termination of the contract.

108.14 Terminating the Contractor's Responsibility

(1) The contractor's responsibilities are terminated, except as set forth in the contract bond and specified in 107.16, when the department grants final acceptance as specified in 105.11.2.3.

Section 109 Measurement and Payment

109.1 Measurement of Quantities

109.1.1 General

109.1.1.1 Bid Items Not Designated as Pay Plan Quantity

(1) The engineer will use the US standard system to measure all work completed under the contract. The engineer will determine quantities of materials the contractor furnishes and work the contractor performs using measurement methods and computations conforming to standard engineering practice, modified to meet department requirements. The engineer will document these measurements using department procedures.

(2) The engineer will measure the work as the contract measurement subsection for individual items specifies. The department will measure the actual quantities of work the contractor acceptably completes and make final payment based on those actual measured quantities except as follows:

1. If the measurement subsection for a bid item specifically restricts the quantity measured for payment or allows for use of conversion factors.
2. If the engineer executes a contract change order modifying the method of measurement for specific bid items, the engineer will measure the quantities of applicable bid items for payment using the change order methods.
3. If the engineer, under 105.3.1(2), approves a contractor-requested plan dimension change between US standard and SI metric dimensions, the engineer will measure whichever of the following is less:
   - Actual quantities constructed.
   - Quantities derived from the original plan dimensions.
4. For substitutions made under 106.2.3 between US standard and SI metric products, the engineer will measure the actual quantities of the substitute products using the original contract measuring system.

109.1.1.2 Bid Items Designated as Pay Plan Quantity

109.1.1.2.1 General

(1) If the schedule of items designates a bid item with a **P** in the item description, the department will use the plan quantity, the approximate quantity the schedule of items shows, for payment unless one or both of the following occurs:

- Scope changes regardless of the magnitude of the revised work.
- Errors and omissions that affect the plan quantity.

109.1.1.2.2 Scope Changes

(1) For engineer-directed quantity increases, the engineer will issue a contract change order for extra work, establish the cost of the added work as specified in 109.4, and measure the revised work. For engineer-directed quantity decreases, the engineer will issue a contract change order to adjust the plan quantity under the designated bid item.

109.1.1.2.3 Errors and Omissions

(1) The engineer may issue a change order under 105.4(5) to adjust the plan quantity for an error or omission and may revise the contract unit price as specified in 109.4.

109.1.2 Area

(1) If the contract designates payment for a measured area, the engineer will measure the length and width of the area actually constructed within engineer-designated limits, or the final dimensions measured along the surface of the completed work within the neat lines the plans show or the engineer designates. The engineer will use the method or combination of methods of measurement that reflect, with reasonable accuracy, the actual surface area of the finished work as the engineer determines.

(2) If the contract allows, the engineer may weigh or determine a volume and convert to area for payment. The engineer will determine the weight-to-area or volume-to-area conversion factors. The engineer and contractor must agree on the conversion factor before the engineer converts a pay quantity.

109.1.3 Volume

(1) For material specified for measurement by volume in the vehicle, haul the material in engineer-approved vehicles. Ensure that the vehicle body type allows for ready and accurate measurement of the contents.

(2) The engineer will determine the approved capacity of vehicles to the nearest 1/10 cubic yard. Unless all department-approved vehicles on a job have the same capacity, mark each vehicle with a plainly

legible identification mark showing the approved capacity. Do not change capacity markings without the engineer's consent.

(3) The engineer will measure the material in the vehicle at the point of delivery. The engineer will make no adjustment for the settlement of material during transit. The engineer may reject loads not hauled in department-approved vehicles.

(4) If the contract allows, the engineer may weigh material and convert to a volume for payment. The engineer will determine the weight to volume conversion factors. The engineer and contractor must agree on the conversion factor before the engineer converts a pay quantity.

109.1.4 Weight

(1) For aggregates and asphaltic mixtures specified for measurement by weight, weigh the material on platform scales or other engineer-approved scales. Include the cost to furnish scales in the bid price. Furnishing scales is incidental to the work. Use scales that the engineer has tested and determined to be satisfactory, or ensure that authorized testing firms or agencies test the scales as often as the engineer deems necessary to ascertain their accuracy.

(2) If weighing materials in the hauling vehicle, check gross weights and determine the vehicle tare weight whenever the engineer directs.

(3) If the contract allows, the engineer may measure the volume of material and convert to weight for payment. The engineer will determine the volume to weight conversion factors. The engineer and contractor must agree on the conversion factor before the engineer converts a pay quantity.

109.2 Scope of Payment

(1) The department will use the US standard unit prices the schedule of items shows to pay for the work.

(2) The department will pay for the quantity of work acceptably completed and measured for payment as the measurement subsection for each bid item specifies. Within the contract provide means to furnish and install the work complete and in-place. Payment is full compensation for everything required to perform the work under the contract including, but not limited to, the work elements listed in the payment subsection. Payment also includes all of the following not specifically excluded in that payment subsection:

1. Furnishing and installing all materials as well as furnishing the labor, tools, supplies, equipment, and incidentals necessary to perform the work.
2. All losses or damages, except as specified in 107.14, arising from one or more of the following:
   - The nature of the work.
   - The action of the elements.
   - Unforeseen difficulties encountered during prosecution of the work.
3. All insurance costs, expenses, and risks connected with the prosecution of the work.
4. All expenses incurred because of an engineer-ordered suspension, except as specified in 104.2.2.3.
5. All infringements of patents, trademarks, or copyrights.
6. All other expenses incurred to complete and protect the work under the contract.

(3) The department may withhold payments due under the contract until the contractor proves to the department that the contractor has paid for all labor and materials used in the work.

109.3 Payment for Altered Quantities

(1) If the measured quantity for a bid item varies from the quantity given in the proposal, the department will pay at the original contract bid price for the quantity measured as specified in 109.1.1.1(2). The department will adjust payment for revisions in plans or quantities of work requiring contract change orders as specified in 104.2.

(2) The department will not pay the contractor for loss of expected reimbursement or anticipated profits suffered or claimed by the contractor. The department will not make revisions to the contract bid prices except as specified in 104.2.

109.4 Price Adjustments for Contract Revisions

109.4.1 General

(1) If the department revises the contract under 104.2, the department will adjust the contract price using the sequence specified in 109.4.2 through 109.4.5. This price adjustment includes payment for performing the revised work, delay costs, and all other associated costs the engineer deems reasonable and not expressly precluded in 109.4.6. The department may, at anytime, direct the contractor to perform all or part of the revised work under force account.

(2) If a contract revision includes a time adjustment for compensable delays under items 2 through 5 of 108.10.3(2), the department will adjust the contract price for delay costs as specified in 109.4.7.

109.4.2 Contract Bid Prices

(1) Before proceeding to another pricing method, the engineer will attempt to price revised work using contract bid prices.

109.4.3 (Vacant)

109.4.4 Negotiated Prices

(1) The engineer and contractor will negotiate the price of a contract revision for one or more of the following:

1. Adjustments in contract bid prices are necessary due to a significant change as specified in 104.2.2.4.
2. The engineer and contractor cannot agree on a revised price under 109.4.2.

(2) Provide an estimate of the proposed unit prices or lump sum price for the contract revision. Include the cost of performing the revised work, delay costs, all other associated costs, plus a reasonable allowance for profit and applicable overhead. The engineer may request that the contractor justify the estimate by providing one or more of the following:

1. Labor requirements by trade in hours for each task.
2. Equipment costs and time requirements.
3. Material costs.

(3) Provide the justification within 5 business days after the department's request. The department will respond to the estimate within 5 business days after receipt of the contractor's justification. The department and the contractor can mutually agree to extend these 5-day requirements.

(4) If the department negotiates with the contractor but does not agree on a price adjustment, the engineer may direct the contractor to perform all or part of the revised work under force account.

109.4.5 Force Account

109.4.5.1 General

(1) The engineer may direct the contractor to perform the revised work under force account. Submit a written proposal for the work including the planned equipment, materials, labor, and work schedule.

(2) The department will pay the contractor as specified in 109.4.5.2 through 109.4.5.6, as full compensation for performing the force account work, delay costs, and all other associated costs. At the end of each workday, the contractor's representative and the inspector shall compare records of the work done under force account. The department will make no force account payment before the contractor submits an itemized statement of the costs for that work.

Revise 109.4.5.1(3) to include accumulated wages and FUTA & SUTA multipliers for force account work.

(3) Provide the following content in itemized statements for all force account work:

1. Name, classification, date, daily hours, total hours, rate, and amount for all labor. Include accumulation of wages to date for each employee performing force account work and identify allowable federal unemployment tax (FUTA) and state unemployment tax (SUTA) multipliers.
2. Designation, dates, daily hours, total hours of actual operation and stand-by operation, rental rate, and amount for each unit of equipment, or the applicable hourly equipment expense rate for each truck or other unit of machinery and equipment. Include the manufacturer's name or trademark, model number, and year of manufacture with the designation.
3. Quantities of materials and prices.
4. Transportation charges on materials, free on board (f.o.b.) at the job site.
5. Cost of property damage, liability, and workers compensation insurance premiums; unemployment insurance contributions; and social security tax.
6. Documentation showing payment for all invoiced work.
7. If materials are taken from contractor's stock and original receipted invoices for the materials and transportation charges cannot be provided, provide an affidavit and certify the following:

- The materials were taken from the contractor's stock.
- The quantity shown was actually used for the force account work.
- The price and transportation costs represent the actual cost to the contractor.

(4) The department will pay for force account work based on the engineer's review of the actual invoice costs the contractor submits. The engineer will approve payment for costs the engineer deems reasonable based on experience or prevailing market rates. The engineer may request that the

contractor provide additional evidence to support costs the engineer questions. The department will only pay for costs the engineer approves.

109.4.5.2 Labor

(1) The department will pay the contractor's labor costs, at prevailing wage rates or at wage rates previously agreed upon with the department in writing, for personnel directly involved in producing and supervising the force account work. The department will only pay for hours that personnel are actually engaged in force account work. The department will also reimburse the contractor based on actual invoiced costs paid to, or on behalf of, workers for subsistence and travel benefits, health and welfare benefits, pension fund benefits, or other contractor-paid benefits. The department will pay an additional 35 percent markup of these wages and benefits.

(2) The department will pay no part of wages or benefits for personnel connected with the contractor's forces above the classification of foreman and having only general supervisory responsibility for the force account work.

109.4.5.3 Insurance

(1) The department will pay the contractor based on actual invoiced costs for property damage, liability, and workers compensation insurance premiums, unemployment insurance contributions, and social security taxes on force account work. The department will pay an additional 15 percent markup of these costs. The contractor shall furnish satisfactory evidence of the rates actually paid.

109.4.5.4 Materials

(1) The department will pay the contractor based on actual invoice costs, including applicable taxes and actual freight charges, for engineer-approved materials the contractor uses in force account work. The department will pay an additional 15 percent markup of these costs. If the contractor uses materials from the contractor’s stock, the department and the contractor will agree on the price. Do not incorporate materials into the work without agreement.

(2) The department reserves the right to furnish materials as it deems appropriate. Make no claims for costs, overhead, or profit on materials that the department provides.

109.4.5.5 Equipment

109.4.5.5.1 General

(1) The department will pay the contractor's costs for equipment the engineer deems necessary to perform the force account work for the time the engineer directs or until the contractor completes the force account work, whichever happens first. The department will pay the contractor for equipment only during the hours that it is operated. The department will pay for non-operating hours at the stand-by rate as specified in 109.4.5.5.3. Report equipment hours to the nearest 1/2-hour.

(2) The department will pay for use of contractor-owned equipment the engineer approves for force account work at published rates. The department will pay the contractor expense rates, as modified in 109.4.5.5, given in EquipmentWatch Cost Recovery (formerly Rental Rate Blue Book) . Base all rates on revisions effective on January 1 for all equipment used in that calendar year.

http://equipmentwatch.com/estimator/

(3) For each piece of equipment the contractor uses, whether bought or rented, the contractor shall provide the engineer with the following information:

1. Manufacturer’s name.
2. Equipment type.
3. Year of manufacture.
4. Model number.
5. Type of fuel used.
6. Horsepower rating.
7. Attachments required, together with their size or capacity.
8. All further information necessary to determine the proper rate.

(4) The contractor shall provide for the engineer's confirmation, the manufacturer's ratings, and manufacturer-approved modifications required to classify equipment for rental rate determination. For equipment with no direct power unit, use a unit of at least the minimum recommended manufacturer's rating.

(5) The department will not pay rental for tools or equipment with a replacement value of $500 or less.

(6) Use engineer-approved equipment in good working condition and providing normal output or production. The engineer may reject equipment not in good working condition or not properly sized for efficient performance of the work.

(7) For equipment not listed in the blue book, provide an expense rate and furnish cost data to support that rate. Obtain the engineer's written approval for the expense rate before using that equipment on force account work.

109.4.5.5.2 Hourly Equipment Expense Rates (Without Operators)

(1) The contractor shall determine, and the department will confirm, hourly equipment expense rates as follows:

$$HEER = [RAF \times ARA \times (R/176)] + HOC$$

Where:

HEER = Hourly equipment expense rate.

RAF = EquipmentWatch regional adjustment factor.

ARA = EquipmentWatch age rate adjustment factor.

R = Current EquipmentWatch monthly rate.

HOC = EquipmentWatch estimated hourly operating cost.

(2) The EquipmentWatch hourly operating cost represents all costs of equipment operation, including fuel and oil, lubrication, field repairs, tires, expendable parts, and supplies.

109.4.5.5.3 Hourly Equipment Stand-By Rate

(1) For equipment that is in operational condition and is standing-by with the engineer's approval, the contractor shall determine, and the department will confirm, the hourly stand-by rate as follows:

$$HSBR = RAF \times ARA \times (R/176) \times (1/2)$$

Where:

HSBR = Hourly stand-by rate.

RAF = EquipmentWatch regional adjustment factor.

ARA = EquipmentWatch age rate adjustment factor.

R = Current EquipmentWatch monthly rate.

(2) The department will limit payment for stand-by to 10 hours or less per day up to 40 hours per week. The department will not pay the contractor for equipment that is inoperable due to breakdown. The department will not pay for idle equipment if the contractor suspends work or if the contractor is maintaining or repairing the equipment.

109.4.5.5.4 Hourly Outside-Rented Equipment Rate

(1) If the contractor rents or leases equipment from a third party for force account work, the contractor shall determine, and the department will confirm, the hourly outside-rented equipment rate as follows:

$$HORER = HRI + HOC$$

Where:

HORER = Hourly outside-rented equipment rate

HRI = Hourly rental invoice costs prorated for the actual number of hours that rented equipment is operated solely on force account work

HOC = EquipmentWatch hourly operating cost.

109.4.5.5.5 Owner-Operated Equipment

(1) For rental of equipment owned and operated by persons other than the contractor or their subcontractors, the department will pay the contractor based on the actual paid invoice. Provide an invoice that includes all costs for furnishing and operating the equipment. Obtain the engineer's written approval of the rental rates before starting the force account work.

(2) The department will allow the contractor to add a markup on the invoice for owner-operated equipment. Determine the markup in the same manner as specified in 109.4.5.6 for subcontractors.

109.4.5.5.6 Moving of Equipment

(1) The department will pay the contractor at the hourly equipment expense rate, as specified in 109.4.5.5.2, for time required to move needed equipment under its own power to the location of the force account work and to return it to its original location on the project. The department will pay the contractor at the hourly equipment expense rate, as specified in 109.4.5.5.2, for the transporting vehicle only if it is transporting equipment to, from, and within the project.

(2) The department will pay the contractor for actual freight costs of equipment moved by commercial carrier.

109.4.5.6 Force Account Work by Subcontractors

(1) If a subcontractor performs force account work, the department will allow the contractor a markup on work the subcontractor performs as follows:

1. Use a markup of 10 percent for the first $10,000 of work.
2. Use a markup of 2 percent for work in excess of $10,000.

109.4.6 Non-Allowable Charges for Adjustment of Contract Prices

(1) Whether contract revision price adjustments are based on contract bid prices, agreed lump sum prices, negotiated prices, or force account, the department will not reimburse the contractor for the following:

1. Profit in excess of that specified in 109.4.2 through 109.4.5.
2. Loss of anticipated profit.
3. Home office overhead.
4. Consequential damages, including loss of bonding capacity, loss of bidding opportunities, and insolvency.
5. Indirect costs.
6. Attorneys fees, claims preparation expenses, or costs of litigation.
7. Interest.

109.4.7 Price Adjustments for Delay Costs

109.4.7.1 General

(1) For a compensable delay under items 2 through 5 of 108.10.3(2), the department will pay for the costs specified here in 109.4.7.2. The department will not pay for non-allowable charges specified in 109.4.6 nor duplicate payment made under 109.4.2 through 109.4.5.

(2) The department will only pay the contractor for costs the contractor actually incurs. The department will make no payment for delay costs before the contractor submits an itemized statement of those costs. Provide the content specified in 109.4.5.1(3), for the applicable items, in this statement.

109.4.7.2 Allowable Delay Costs

109.4.7.2.1 Extended Field Overhead

(1) The department will pay the contractor for extended field overhead costs that include costs for general field supervision, field office facilities and supplies, and for maintenance of field operations.

(2) General field supervision costs include, but are not limited to, field supervisors, assistants, watchman, and clerical and other field support staff. Compute these labor costs as specified in 109.4.5.2(1). For salaried personnel, calculate the daily wage rate actually paid by dividing the weekly salary by 5 days per week.

(3) Field office facility and supply costs include, but are not limited to, field office trailers, tool trailers, office equipment rental, temporary toilets, and other incidental facilities and supplies. Compute these costs on a calendar-day basis using actual costs incurred due to the delay to provide these services.

(4) Maintenance of field operations costs include, but are not limited to, telephone, electric, water, and other similar expenses. Compute these costs on a calendar-day basis using actual costs incurred due to the delay to maintain these services.

109.4.7.2.2 Extended Labor

(1) Compute labor costs during delays as specified in 109.4.5.2 for all non-salaried personnel remaining on the project as required under collective bargaining agreements or for other engineer-approved reasons.

109.4.7.2.3 Escalated Labor

(1) To receive payment for escalated labor, demonstrate that the department-caused delay forced the work to be performed during a period when labor costs were higher than planned at the time of bid. Provide adequate support documentation for the costs, allowances, and benefits specified in 109.4.5.2.

109.4.7.2.4 Equipment Stand-By or Equipment Demobilization

(1) The department will pay the contractor the stand-by rate calculated in 109.4.5.5.3 for equipment, other than small tools, that must remain on the project during delays. The department will pay the contractor's transportation costs to remove and return equipment not required on the project during delays.

109.4.7.2.5 Materials Escalation or Material Storage

(1) The department will pay the contractor for increased material costs or material storage costs due to the delay. Obtain the engineer's approval before storing material due to a delay.

109.5 Eliminated Work

(1) If the department partially eliminates or completely eliminates work as specified in 104.2.2.5, the department will pay contractor costs incurred due to that elimination. The department will pay a fair and equitable amount covering all costs incurred as of the date the work was deleted. Immediately submit a certified statement covering all money expended for the eliminated work.

(2) The department will execute a contract change order for the following costs related to eliminated work:

1. Preparation expenses defined as follows:
   - If preparation for the eliminated work has no value to other contract work, the department will reimburse the contractor in full for that preparation.
   - If preparation for the eliminated work is distributed over other contract work, the department will prorate reimbursement based on the value of the eliminated work compared to the total value of associated contract work.
2. All restocking and cancellation charges.
3. A markup for applicable overhead and other indirect costs paid as 7 percent of the contract price of the work actually eliminated.

(3) If the department partially eliminates or completely eliminates work, the department may pay for, and take ownership of, materials or supplies the contractor has already purchased.

109.6 Progress Payments

109.6.1 General

(1) The department will first prepare a progress payment estimate as described in 109.6.3, and then will make a progress payment based on the engineer's estimate of the quantities of work completed. Payment will be at the contract or agreed unit or lump sum prices. The department may suspend progress payments if the contractor does not comply with the engineer's directions as the contract specifies. The department will notify the contractor immediately whenever progress payments are suspended.

(2) The department will restrict progress payments, as specified in 108.4, until the engineer accepts the contractor's progress schedule. Progress payment restrictions are specified in 108.4.2.1(5) for bar chart schedules, in 108.4.3.2(5) for RBC schedules, and in 108.4.4.3(6) for CPM schedules.

(3) The department's payment of an estimate before conditional final acceptance of the work does not constitute the department's acceptance of the work, and does not relieve the contractor of responsibility for:

1. Protecting, repairing, correcting, or renewing the work.
2. Replacing all defects in the construction or in the materials used in the construction of the work under the contract, or responsibility for damage attributable to these defects.

(4) The contractor is responsible for all defects or damage that the engineer may discover on or before the engineer's conditional final acceptance of the work. The engineer is the sole judge of these defects or damage, and the contractor is liable to the department for not correcting all defects or damage.

(5) The department will take ownership of all material and work covered by progress payments. However, the contractor remains solely responsible for all materials and work covered by progress payments and for the restoration of damaged work as specified in 107.14. Also, by making the progress payment, the department waives no requirement, right, or term of the contract as specified in 107.16.

109.6.2 Frequency

(1) The department will make 2 progress payments each month, as feasible, if the contractor is due a payment of $1000 or more. The department may reduce this minimum payment due for contracts of $25,000 or less.

109.6.3 Preparation of Progress Payment Estimate

109.6.3.1 General

(1) The department will compute quantities to reflect the approximate quantity of work completed, or substantially completed, under the pertinent contract bid items to the date of the progress payment estimate. The department will adjust quantities to cover contingencies and costs for finishing or maintaining the work. If the engineer bases the progress payment estimate on contract quantities, the department will adjust quantities to cover variations between the contract and final quantities.

109.6.3.1.1 Pending Contract Change Order Work

(1) Between the times the engineer authorizes a contract change order and the department executes it, the engineer will include, in the progress payment estimate, the value of the acceptably completed change order work. The department will pay at least 90 percent of the value of the work as it is completed under an unexecuted change order. After the department executes the change order, the department will deduct payments made on the unexecuted change order work from future payments due the contractor.

109.6.3.2 Materials

109.6.3.2.1 General

(1) The engineer may include in the progress payment estimate the value of materials that:

1. Are specifically manufactured, produced, or purchased for incorporation as a permanent part of the work.
2. Are delivered to the project or stored at a location off the project as specified in 106.4.
3. Are stored separately and irrevocably assigned to the project if stockpiled at plants or fabrication sites.

(2) The engineer will require the contractor to document costs for materials included in a progress payment estimate. Provide the required invoice, billing, title, or assignment documents including a complete material description, identification, and cost data.

(3) If the contractor does not satisfy all vendor claims made against the contractor for materials within 30 calendar days after receiving the progress payment, the department may cancel the applicable materials payment in the next progress payment estimate.

(4) If making progress payments for materials, the engineer will not exceed the delivered cost or contract amount for the material complete in place. The engineer will use those amounts paid for materials to reduce future payments due the contractor for completed work incorporating those materials.

109.6.3.2.2 Structural Steel

(1) On contracts containing 250 tons or more of structural steel, the engineer may also include in the progress payment estimate the value of Structural Steel Carbon or Structural Steel HS, or both, to be used in the completed work and that has been delivered to the fabricator.

(2) In addition to the information required in 109.6.3.2.1, provide the weights, dimensions, and heat and unit numbers.

(3) Store the structural steel separately. Use stored structural steel only for fabrication of structural components to be used on the contract.

(4) Present acceptable evidence indicating satisfactory fabrication of structural steel. The engineer may include, in the estimate prepared for progress payment, the value of this fabricated material, determined by multiplying the total unit weight of the material by 80 percent of the contract unit price.

109.6.3.3 Retainage

(1) The department will withhold retainage from progress payment estimates for liquidated damages and claims including the following:

1. To provide for recovery of liquidated damages assessable against the contract under 108.11.
2. To cover claims against the contract filed with the department under chapter 779 of the Wisconsin statutes.

   http://docs.legis.wi.gov/statutes/statutes/779

3. To provide for recovery of damage and tort claims assessable against the contract under 107.12.

(2) In addition to the above retainage, the department will retain 5 percent of each estimate that exceeds 75 percent of the original contract value until the department finally accepts the work. When the contractor substantially completes the work under the contract or upon completion and acceptance of the work, and pending final payment, the engineer may choose to reduce the amount retained.

109.7 Acceptance and Final Payment

(1) After the engineer grants conditional final acceptance of the work as specified in 105.11.2.2 and reviews required document submittals and materials test reports, the engineer will issue the semi-final estimate.

(2) Within 30 calendar days after receiving the semi-final estimate, submit to the engineer a written statement of agreement or disagreement with the semi-final estimate. For an acceptable statement of disagreement, submit an item-by-item list with reasons for each disagreement. If the contractor does not submit this written statement within those 30 days, the engineer will process the final estimate for payment. The engineer and the contractor can mutually agree to extend this 30-day submission requirement.

(3) If the contractor submits an acceptable statement of disagreement, the department will withhold payment of the final estimate and determine the validity of the contractor's disagreement. After considering the contractor's statement, the department may revise the final estimate based on the engineer's judgment of the validity of the contractor's disagreement.

(4) The department will make final payment within one year after the date the contractor provides the department with written confirmation of the semi-final estimate, or within one year after expiration of the 30-day period specified in 109.7(2), whichever applies. If the department does not pay as required, the department will pay interest, compounded monthly, on the balance due at the rate specified in section 16.528(2)(a) of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/16

(5) If the department has been notified that there are multiple claims against the amount held and the department concludes that it cannot appropriately choose between or among the conflicting claims, the department may withhold payment of the amount at issue pending resolution of those conflicts. Upon resolution of all issues affecting rights to the amount held, the department will pay the claimant or claimants.

(6) The department may correct progress estimates and payments in the final estimate and payment.

(7) If approved by the division administrator, the department may set off any sums the department determines the contractor owes the department against any sums otherwise due and payable to the contractor under this contract or any previously executed or future contract with the department. The department will notify the contractor when exercising this right and identify how the department has or will make that equitable adjustment.

109.8 No Assignment of Payments

(1) The department will pay the contractor all payments due under the contract, or any part of the contract, as specified in 109. The department will recognize no contractor-executed assignment or order directing payment of all, or any portion of, the funds to any other person or persons.

Part 2 Earthwork

Section 201 Clearing and Grubbing

201.1 Description

(1) This section describes cutting and disposing of trees, brush, windfalls, logs, and other vegetation occurring within the clearing limits; and removing and disposing of roots, stumps, stubs, logs, and other timber occurring within the grubbing limits.

201.2 (Vacant)

201.3 Construction

(1) Clear and grub areas within the clearing and grubbing limits defined as follows:

1. Between lines 5 feet outside the grading limits of roadway cuts and fills, including intercepting embankments, channels, ditches, borrow pits, and marsh or waste disposal areas.
2. Other parts of the right-of-way the plans or special provisions designate.
3. Designated clear zone and clear vision areas.
4. With the engineer's approval, areas with vegetation that interferes with excavation, embankment, marsh, or waste disposal.
5. The contractor does not have to grub the following:
   - Areas designated for occupation by earth embankments 6 feet or more in height.
   - Areas used for marsh excavation disposal for which the State has obtained easements.

(2) Preserve vegetation within the clearing limits as the plans show or the engineer directs. Cut off and dispose of other trees, brush, shrubs, or other vegetation occurring within the clearing limits. Within the grubbing limits, remove debris not suitable for the roadway foundation, stumps and associated roots, logs, timber, brush, and matted roots to the following minimum depths:

1. In cut areas, one foot below final subgrade.
2. In embankment areas, one foot below the existing grade.

(3) Do not remove trees and shrubs located beyond the clearing limits unless the engineer specifically authorizes their removal. If clearing where grubbing is not required, cut shrubs and brush to within 3 inches of the ground surface. Cut trees as nearly flush with the ground surface as practicable with tools ordinarily used for these operations.

(4) Prevent the spread of oak wilt by treating cut surfaces and abrasions sustained between April 1 and September 30 by healthy oak trees and saplings with a thorough application of tree paint immediately upon discovering a wound. Between these dates, also paint the cut surfaces of the stumps of healthy oak trees and saplings immediately after cutting, whether remaining in place or grubbed.

(5) If feasible, fell trees toward the center of the area being cleared. If this is not possible due to danger to traffic or injury to other trees, structures, or property, cut them into sections from the top down.

(6) Do not injure or damage trees and shrubs left in place on the right-of-way. Symmetrically trim lower limbs or branches of trees left in place and overhanging the roadbed to at least 20 feet above the finished grade. Trim using generally accepted horticultural practices.

(7) Unless the contract specifies otherwise, the contractor owns timber salvaged from the required clearing of right-of-way acquired by the highway authority in fee simple title, or from clearing of trees acquired by and for the public in the acquisition of easement of the right-of-way. Set aside logs and timber greater than 4 inches in diameter to the extent feasible for commercial or fuel use. Do not burn or bury this material on the right-of-way or lands adjacent to the right-of-way without first making it available for commercial or fuel use. If it is not possible to dispose of this material for commercial or fuel use, dispose of the salvaged logs as specified for waste logs in 201.3(10).

(8) Private owners holding underlying title to lands acquired or reserved for highway purposes by easement or by use have a prior right to all timber from trees standing or lying, except timber required for construction of the work, and except timber from trees acquired by and for the public in the acquisition of the right-of-way. Consult with the private owners about disposing of trees cut on their land. Remove from the right-of-way and dispose of trees, or portions of trees, claimed by the owners. Ensure that timber disposal sites are neatly constructed.

(9) Dispose of stumps, roots, brush, waste logs and limbs, timber tops, and debris resulting from clearing and grubbing or occurring within the clearing and grubbing limits by burning, chipping, burying, or removing from the right-of-way.

(10) For disposal by open burning, burn within the clearing limits when and in a way that does not harm trees or shrubs left in place, create a nuisance, pose a hazard to traffic, or damage public or private property. Take care to avoid burning poison oak, poison ivy, poison sumac or other materials posing a health hazard when burned. Obtain burning permits required under local and state fire protection

regulations and provide copies to the engineer before burning. Comply with WDNR rule NR 429 regulating open burning that prohibits open burning in the Southeast Wisconsin Intrastate Air Quality Control Region (Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha counties). Do not use oily substances or other materials prohibited under NR 429 to start or maintain fires.

http://docs.legis.wisconsin.gov/code/admin_code/nr/400/429.pdf

(11) If open burning is not allowed and the engineer approves, the contractor may bury material in engineer-approved locations on the right-of-way outside the construction limits. Minimize the bulk of the material and cover it with at least one foot of earth. If the engineer approves, the contractor may dispose of the debris from open burning in this same manner.

(12) For disposal by mechanical chipping, recover all material as it leaves the chipping machine. Stockpile and use this material as specified for mulch under 627, dispose of it off the right-of-way, or bury it as specified in 201.3(11).

(13) Dispose of material off the right-of-way according to applicable solid waste disposal regulations. Obtain written permits for this disposal from the owner of the property where placing the material, unless disposing of this material at a licensed waste disposal operation. Provide copies of permits to the engineer before disposal begins.

(14) Chip, burn, or bury under not less than one foot of earth elm wood consisting of trees, logs, stumps, stubs, branches, or windfalls with adhering bark, and elm bark and debris within clearing and grubbing limits or resulting from clearing and grubbing operations.

(15) Debark elm logs salvaged, and elm wood or stumps not disposed of by chipping, burning, or burying; and chip, burn, or bury the bark. For clearing and grubbing operations performed between April 1 and September 30, perform final disposal of elm wood, bark, or debris within 30 days. For clearing and grubbing operations performed between October 1 and March 31, perform final disposal of elm wood, bark, or debris before the succeeding May 1.

(16) Dispose of clearing and grubbing debris before proceeding with grading operations. If the contractor intends to burn debris but cannot secure burning permits on schedule, do not delay removing clearing debris from areas affected by other operations. While waiting to secure burning permits, pile clearing and grubbing debris beyond the limits affected by other work. Do not leave elm debris beyond the limits specified in 201.3(15).

201.4 Measurement

201.4.1 General

(1) The department will measure Clearing and Grubbing separately, either by the station, inch of diameter, square yard, or acre as the contract indicates.

(2) The department will measure Clearing and Grubbing required for the excavation of channels and ditches, occurring outside the limits of the roadway clearing and grubbing. If measured by the station, the department will measure along the centerline of these channels and ditches.

(3) The department will measure Clearing performed on marsh disposal or waste disposal areas of the right-of-way and on easements furnished by the State. If measured by the station, the department will measure along the roadway centerline.

(4) The department will not measure incidental clearing and grubbing operations required to perform the work as follows:

1. Clearing areas of light brush, shrubs, and other vegetation that the contractor can cut with a brush scythe or mowing machine.
2. Clearing areas containing logs, tree roots, roots of brush and shrubs, and other vegetation having a woody structure that the contractor can remove with a rooter.
3. Clearing small trees of less than the minimum number and size specified for measurement.
4. Trimming overhanging limbs and branches to provide required clearance.
5. Clearing and grubbing borrow pits.

201.4.2 By the Station

(1) The department will measure Clearing and Grubbing by the full 100-foot station acceptably completed, measured along the roadway centerline or reference line with each full 100-foot station starting and ending at a +00 station. If 2 or more roadways occur, the department will measure along the centerline or reference line of each roadway. For divided highways, the department will extend measurement units for each roadway, in width, from 5 feet outside the grading limit of that roadway to a line mid-way between the reference lines or centerlines for each roadway.

(2) The department will only include stations with a total of 12 inches or more of diameter determined as specified under 201.4.5. The department will include each station conforming to this criterion as a full station.

201.4.3 By the Square Yard

(1) The department will measure Clearing and Grubbing by the square yard acceptably completed within the designated limits. The department will calculate the horizontal area bounded by the line of trunks cut or grubbed. The department will not measure outside the right-of-way limits or acquired easements. The department will include only areas containing trees or stumps with a 3-inch or greater diameter. The department will determine diameters as specified under 201.4.5.

201.4.4 By the Acre

(1) The department will measure Clearing and Grubbing by the acre acceptably completed within the designated limits. The department will calculate the horizontal area bounded by the line of trunks cut or grubbed. The department will not measure outside the right-of-way limits or acquired easements. The department will measure separate areas or isolated stands of less than 1/5 acre as 1/5 acre. The department will include only areas containing trees or stumps with a 3-inch or greater diameter. The department will determine diameters as specified under 201.4.5.

201.4.5 By the Inch of Diameter

(1) The department will measure Clearing and Grubbing by the inch of diameter acceptably completed. The department will determine tree diameter by measuring the circumference approximately 4 1/2 feet above the existing ground level, but above the ground swell, and dividing by 3. The department will determine stump diameter, for stumps not resulting from the contractor's clearing operations, by computing the average diameter of the stump top. The department will include only those in-place trees or stumps with a 3-inch or greater diameter. The department will round circumference measurements and diameters to the nearest inch.

201.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
201.0105	Clearing	STA
201.0110	Clearing	SY
201.0115	Clearing	ACRE
201.0120	Clearing	ID
201.0205	Grubbing	STA
201.0210	Grubbing	SY
201.0215	Grubbing	ACRE
201.0220	Grubbing	ID

(2) Payment for Clearing and Grubbing is full compensation for the following:

- Clearing and grubbing required under this section and performed within the clearing and grubbing limits, as defined in 201.3(1).
- Handling, hauling, piling, burning, burying, trimming, chipping, wound treatment, rehandling, and disposing of waste and debris.
- Excavations made to bury clearing and grubbing material, backfilling these excavations, and disposing of excess excavated material.

(3) The department will pay for clearing and grubbing ordered and performed beyond the clearing and grubbing limits, as defined in 201.3(1), at the contract unit price per square yard, acre, or inch of diameter. If the contract does not contain Clearing and Grubbing bid items using those units, the department will pay for this additional clearing and grubbing as extra work.

(4) The incidental clearing and grubbing described in 201.4.1(4) is incidental to the Excavation bid items of 205 or to other contract bid items.

Section 202 Roadside Clearing

202.1 Description

(1) This section describes cutting and disposing of undesirable trees, brush, shrubs, and vegetation; removing and disposing of windfalls, logs, uprooted stumps, and rubbish; and trimming of selected trees and saplings to be saved; all within the right-of-way limits but outside the clearing limits defined in 201.3.

202.2 (Vacant)

202.3 Construction

(1) Perform roadside clearing on sections of the project the plans designate and to the limits the plans or special provisions indicate. If no limits are indicated, perform roadside clearing on areas of the right-of-way outside the clearing limits.

(2) Preserve desirable and structurally sound trees, saplings, or shrubs suitable for shade or road beautification purposes unless the engineer directs otherwise. Do not injure or damage trees and saplings designated for preservation. Remove the dead material and lower branches of preserved trees as directed, to promote uniformity and proper development of shape and appearance. Trim using generally accepted horticultural practices.

(3) Cut undesirable trees, brush, shrubs, existing stumps, and vegetation as nearly flush with the ground surface as reasonably possible with tools ordinarily used for these operations. Avoid harming trees and saplings designated for preservation when felling undesirable trees. If unable to fell trees due to danger to traffic or injury to other trees, structures, or property, then cut them into sections from the top down.

(4) Treat cut surfaces, abrasions, and damaged areas of healthy oak trees and saplings, and cut surfaces of stumps of these trees as specified for preventing oak wilt under 201.3(4).

(5) Remove windfalls, logs, uprooted stumps, and rubbish from the surface of the ground within areas of the right-of-way included under roadside clearing operations.

(6) Dispose of timber, stumps, brush, waste logs and limbs, tops, and debris resulting from roadside clearing as specified in 201.3.

202.4 Measurement

202.4.1 By the Station

(1) The department will measure the Roadside Clearing by the full 100-foot station acceptably completed, measured along the roadway centerline or reference line with each full 100-foot station starting and ending at a +00 station. If 2 or more roadways occur, the department will measure along the centerline or reference line of each roadway.

(2) The department will include only stations where roadside clearing is designated and performed. The department will include each station conforming to these criteria as a full station.

202.4.2 By the Square Yard

(1) The department will measure Roadside Clearing by the square yard acceptably completed within the designated limits as calculated from horizontal measurements. The department will not measure outside the right-of-way limits or acquired easements.

202.4.3 By the Acre

(1) The department will measure Roadside Clearing by the acre acceptably completed within the designated limits as calculated from horizontal measurements. The department will not measure outside the right-of-way limits or acquired easements. The department will measure separate areas or isolated stands of less than 1/5 acre as 1/5 acre.

202.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
202.0105	Roadside Clearing	STA
202.0110	Roadside Clearing	SY
202.0115	Roadside Clearing	ACRE

(2) Payment for the Roadside Clearing bid items is full compensation for cutting, clearing, wound treatment, and disposal of waste vegetation.

Section 203 Removing Old Culverts and Bridges

203.1 Description

(1) This section describes wholly or partially removing or closing existing culverts and bridges, disposing of the resulting materials, or if required, salvaging and storing designated materials.

203.2 (Vacant)

203.3 Construction

203.3.1 General

(1) Remove or close all or parts of existing culverts and bridges within the roadway and that are replaced by or interfere with new construction. The contractor who constructs the new structure that replaces the existing facility, unless the contract specifies otherwise, shall perform this removal or closing.

(2) If specified in the contract, remove or close existing culverts, bridges, or parts of them, beyond the roadway limits, but within the highway limits.

(3) Leave existing culverts and bridges beyond the limits of the highway in place and in service unless the contract specifies otherwise.

(4) Upon removal, culverts, bridges, or parts of them, become the contractor's property, unless designated in the contract as salvageable. If the contractor removes, but does not replace entrance pipes from private property, the contractor must offer these pipes to the property owners before claiming them.

203.3.2 Breaking Down and Removing

203.3.2.1 General

(1) Remove those parts of an existing structure that interfere with new construction. Do not use equipment, facilities, or methods that might damage members, portions of the structure to be preserved, or adjacent construction. Before starting new work, complete blasting or other operations that might endanger new work. If incorporating portions of existing culverts or bridges in the new work, remove the portions not being saved in a way that leaves the remainder of the structure undamaged.

(2) Notify the engineer if the portion of a structure remaining in place is damaged. Do not conduct construction operations that would obscure that damage or cause additional damage until the department has had an opportunity to assess the structural significance of the damage. Provide the engineer with means to access the site to make this determination.

(3) Repair damage done during breaking down and removal as the engineer directs.

203.3.2.2 Removal Operations

Revise 203.3.2.2 to require department assessment of and written approval for restoration of contractor-caused damage done during deck removal. This change was implemented in ASP 6 effective with the December 2017 letting.

203.3.2.2.1 General

(1) Except as specified below for closing culverts, remove the entire top slab of box culverts and the entire superstructure of other culverts and bridges designated for removal. Completely remove existing piles, cribs, or other timber construction within the limits of new embankments, or remove these structures to an elevation at least 2 feet below finished ground line. Remove sidewalls or substructure units in water to an elevation no higher than the elevation of the natural stream or lake bed, or, if grading the channel is required under the contract or the plans, to the proposed finished grade of the stream or lake bed. Remove sidewalls or substructure units not in water down to at least 2 feet below natural or finished ground line.

(2) If extending or incorporating existing culverts and bridges in the new work, remove only those parts of the existing structure as necessary to provide a proper connection to the new work. Saw, chip, or trim the connecting edges to the required lines and grades without weakening or damaging the remaining part of the structure. During concrete removal, do not damage reinforcing bars left in place as dowels or ties incorporated into the new work.

(3) Remove pipe culverts designated for salvage in a way that prevents damage to the culverts.

(4) Dismantle steel structures or parts of steel structures designated for salvage in a way that avoids damage to the members. If the contract specifies removing the structure in a way that leaves it in a condition suitable for re-erection, matchmark members with durable white paint before dismantling. Mark pins, bolts, nuts, loose plates, etc., similarly to indicate their proper location. Paint pins, bolts, pinholes, and machined surfaces with a department-approved rust preventative. Securely wire loose parts to adjacent members, or label and pack them in boxes.

(5) Remove timber structures or parts of timber structures designated for salvage in a way that prevents damage to the members.

(6) If the engineer approves, the contractor may temporarily use materials designated for salvage in falsework used to construct new work. Do not damage or reduce the value of those materials through temporary use.

203.3.2.2.2 Deck Removal

(1) Protect the work as specified in 107.14 during deck removal. Minimize debris falling onto water surfaces and wetlands as the contract specifies in 107.18 or in the special provisions. Also, minimize debris falling on the ground and roadway.

(2) Do not damage existing bar steel reinforcement, girders, or other components that will be incorporated in new work. Remove decks on prestressed concrete girders using a hydraulic shear or other engineer-approved equipment. Thoroughly clean, realign, and retie reinforcement as necessary.

(3) After deck removal is complete, notify the engineer to request a damage survey. Point out damage to the engineer. Allow 1 business day for the engineer to complete the damage survey. If damage is identified, the department will determine if repairs or girder restoration will be allowed.

(4) If the department allows girder restoration, have a professional engineer registered in the State of Wisconsin analyze the effect of the damage to the bridge, make recommendations, and prepare signed and sealed computations and structural details required to restore girders to their previous structural capacity. Submit the restoration proposal, including analysis and structural details, to the department and design engineer of record. The department will accept or reject the restoration proposal within 3 business days. Do not begin restoration work until the department allows in writing.

(5) The engineer will not extend contract time to assess or remediate contractor caused damage.

203.3.3 Closing Culverts

(1) The contractor may close culverts instead of removing them if the following conditions exist:

1. The diameter or span of a culvert is less than 4 feet.
2. The top of the culvert does not come within 5 feet of the elevation of the finished roadway.
3. The engineer deems the structure to be in suitable condition.

(2) Remove the headwalls and those parts of the structure that would be within 2 feet of the finished ground line. Completely fill each end of the culvert with satisfactory soil for a distance from each end of at least 2 feet plus the height of the opening of the structure.

203.3.4 Incorporating or Disposing of Materials

(1) Remove materials resulting from culvert or bridge removals not designated for salvage or incorporation in the work, from the right-of-way. Ensure that disposal sites are neatly constructed.

(2) Place materials designated for salvage in neat piles outside the roadway but within the right-of-way at locations the engineer designates. Clean salvaged pipe culverts. Locate the piles far enough from the traveled way so they do not create a hazard to traffic.

(3) Incorporate broken steel-free concrete, stone, brick, and like granular material in the contract work to the extent practicable. The contractor may use these materials, if suitable, to construct riprap, tree wells, and similar structures. Unless the contract or the engineer specifies otherwise, incorporate the balance of these materials, if they have suitable engineering properties, in embankments as specified for placing rocks under 207.3.4. Do not place these materials within 8 inches of the surface of the earth grade.

(4) Incorporate excavated material in the work to the extent practicable. Use materials with suitable engineering properties to backfill areas resulting from removals and to construct embankments. Dispose of surplus or unsuitable material as specified under 205.3.12.

(5) If placing broken concrete, stone, brick, or any other waste material outside the right-of-way, conform to regulations governing solid waste disposal. Obtain written permits for this disposal from the owner of the property where placing the material, unless disposing of the material at a licensed waste disposal operation. Furnish permits, or copies of permits, to the engineer before disposal begins. Do not deposit waste in wetlands.

(6) Arrange with the owners for the disposal of private entrance pipes removed but not replaced.

(7) Unless the contract or the engineer gives more specific instructions, neatly store structural steel designated for salvage on blocking in a location suitable for loading. Store structures or portions of structures, specified in the proposal for re-erection, in separate piles.

(8) Remove nails and bolts from timber or piling from old structures, designated for salvage. Store this timber or piling in neat piles in locations suitable for loading. Dispose of waste timber and lumber by open burning, if allowed; by burning in an air curtain destructor, if allowed; by chipping, or dispose of as specified for surplus material in 205.3.12. Dispose of chipped material as specified for machine cutting or chipping in 201.3(13). Dispose of creosote treated piling as required by the WDNR.

203.3.5 Backfilling

(1) Backfill trenches resulting from removing or breaking down old culverts and bridges, and not occupied by new structures or required for waterways. Use either satisfactory soil or broken masonry and satisfactory soil. If the contract plans or special provisions specify granular backfill, use backfill material conforming to 209. Place backfill material in layers no thicker than 8 inches. If using granular backfill, the contractor may place granular backfill in layers up to 12 inches thick. Thoroughly compact each layer using engineer-approved tampers, rollers, or vibrators. If encountering water in an excavation, place backfill in a way that displaces the water and does not trap it.

(2) Do not use water to expedite settlement of backfill except with the engineer's approval. However, this provision does not require the contractor to de-water the excavation before placing backfill.

203.4 Measurement

(1) The department will measure Removing Small Pipe Culverts as each individual small culvert removal acceptably completed.

(2) The department will measure the Removing Old Structure bid items as a single lump sum unit for each structure acceptably completed.

(3) The department will not deduct the volume of these removals from the volume of the associated roadway, drainage, or structure excavation item.

203.5 Payment

203.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
203.0100	Removing Small Pipe Culverts	EACH
203.0200	Removing Old Structure (station)	LS

Revise 203.5.1(2) to clarify that all costs associated with contractor-caused damage are incidental. This change was implemented in ASP 6 effective with the December 2017 letting.

(2) Payment is full compensation for breaking down and removing; costs associated with contractor-caused damage; required salvaging, storing, and disposing of materials; and, unless the contract specifies granular backfill, for backfilling.

(3) Removing non-rectangular culverts with a cross-sectional area smaller than the area of a 12-inch diameter round pipe is incidental to associated items of work.

(4) If the contract specifies backfilling with granular backfill, the department will pay separately for that backfilling under the Backfill Granular bid items as specified in 209.5.

203.5.2 Removing Small Pipe Culverts

(1) Under the Removing Small Pipe Culverts bid item, remove non-rectangular culverts with a cross-sectional area equivalent to or larger than the area of a 12-inch diameter round pipe but smaller than a 60-inch diameter round pipe.

(2) The department will pay for each individual pipe in a multi-pipe cluster at the contract price each. Associated precast components are incidental to this bid item. The department will pay for associated cast-in-place components separately under the appropriate 204 removal item.

(3) If a culvert removal the engineer directs, or 104.7 requires, conforms to the classification criteria for the Removing Small Pipe Culverts bid item, but the contract does not show that removal, the department will pay for that removal at the contract price each or, absent the bid item, as extra work. If a removal that the plans show as a small pipe culvert conforms to the classification criteria for the Removing Old Structure bid items, the department will pay for that removal as extra work.

203.5.3 Removing Old Structure

(1) Under the Removing Old Structure bid items, remove bridge-like structures. The department classifies a removal as a bridge-like structure if the structure is one or more of the following:

1. A bridge with a span of 20 feet or greater.
2. Bridge-like with a span less than 20 feet.

3. A rectangular culvert of any size.
4. A non-rectangular culvert with a cross-sectional area equivalent to or larger than the area of a 60-inch diameter round pipe.

(2) Payment includes removing associated incidental structures, hybrid concrete box culverts with associated pipe culvert extensions, and multi-cell and multi-pipe systems. If required in 104.7 or if the engineer directs removing a structure, conforming to the classification criteria for this bid item but not included in the contract, the department will pay for that removal as extra work.

(3) The contractor will bear all expenses, including engineering costs, for restoring structurally damaged girders as specified in 203.3.2.2(2).

Section 204 Removing or Abandoning Miscellaneous Structures

204.1 Description

(1) This section describes wholly or partially removing or abandoning existing miscellaneous structures, disposing of the resulting materials, or if required, salvaging and storing designated materials.

204.2 (Vacant)

204.3 Construction

204.3.1 General

204.3.1.1 General Requirements

(1) If retaining a portion of the existing structure, avoid damaging that portion during construction operations. Do not use any equipment or devices that might damage structures, facilities, or property to be preserved and retained. Complete operations necessary to remove or abandon an existing structure and that might endanger the new construction before constructing new work.

204.3.1.2 Backfilling

(1) Backfill trenches, holes, and pits resulting from breaking down, removing, or abandoning miscellaneous structures as specified for backfilling trenches in 203.3.5.

(2) Unless the contract specifies otherwise, backfill to the elevation of the natural ground, the proposed finished earth subgrade, or finished slopes, as necessary due to the location of the removed structure.

204.3.1.3 Salvaging or Disposing of Materials

(1) Carefully remove materials designated for salvage to avoid damage. Place salvaged materials in neat piles outside construction limits but within the right-of-way, at locations the engineer approves. Stockpile materials designated for salvage at locations the engineer approves, without contaminating the material with dirt or foreign matter.

(2) Dispose of concrete, stone, brick, and other material not designated for salvage as specified for disposing of materials under 203.3.4.

204.3.2 Breaking Down and Removing

204.3.2.1 General

(1) Unless specified otherwise, remove structures that the contract designates for removal or that interfere with the new construction as follows:

- From within the roadway.
- From within the removal limits the plans show.
- From within the limits designated under the Obliterating Old Road bid item, whether specified or subsequently found necessary and required.
- If the contract specifies, also wholly or partially remove structural elements occurring outside the limits of construction and beyond the limits of Obliterating Old Road.

(2) Unless the plans show otherwise, remove entirely or break down walls, piers, surface drains, foundations, and similar masonry structures as follows:

1. Within the roadbed, to a depth at least 2 feet below the subgrade.
2. Outside the roadbed, to a depth at least 2 feet below the finished grade.
3. At any location, to the extent required to avoid interfering with the work.

(3) If removing pavement, curb, gutter, sidewalk, crosswalk, and similar structures and portions of the existing structure are to remain in the surface of the finished work, remove the structure to an existing joint, or saw and chip the structure to a true line with a face perpendicular to the surface of the existing structure. Remove enough of the structure to provide proper grades and connection to the new work. Maintain drainage as specified for drainage during construction in 205.3.3.

(4) The contractor becomes the owner of the removed asphaltic pavement or surfacing and is responsible for its disposal as specified for disposing of materials under 204.3.1.3.

204.3.2.2 Removing Items

204.3.2.2.1 General

(1) Under the Removing Pavement bid item, remove concrete pavements, concrete alleys, concrete driveways, or rigid base including all surfaces or other pavements superimposed on them.

(2) Under the Removing Pavement Butt Joints bid item, remove concrete pavements to allow the construction of butt joints. Remove existing pavement to the depth the plans show by grinding, planing, chipping, sawing, or other engineer-approved methods.

(3) Under the Removing Asphaltic Surface bid item, remove all types of asphaltic pavement or surfacing not supported on rigid bases, or underlain by proposed excavation, or overlaid by proposed embankment. Also, remove asphaltic overlays of existing concrete pavements, bases, or bridge decks designated to remain in place.

(4) Under the Removing Asphaltic Surface Butt Joints bid item, remove asphaltic pavement or surfacing to allow the construction of butt joints. Remove existing asphaltic pavements or surfacing to the depth the plans show by grinding, planing, chipping, sawing, or other engineer-approved methods.

(5) Under the Removing Concrete Sidewalk bid item, remove concrete sidewalk, crosswalk, and steps.

(6) Under the Removing Lip Curb bid item, remove lip curb to the plane of the pavement surface, +/- one inch.

(7) Under the Removing Concrete Slope Paving bid item, restore the slope in front of the abutment to a smooth, plane surface after removing the slope paving.

(8) Under the Removing Delineators and Markers bid item, remove delineators and markers.

(9) Under the Removing Railroad Track bid item, remove rails, paving, ties, track encasement, and other appurtenances. Remove concrete foundation and leave the ballast aggregate in place.

(10) Under the Removing Manholes, Removing Catch Basins, and Removing Inlets bid items, rebuild, and properly reconnect live sewers connected with them. Maintain satisfactory bypass service during these operations. Plug unused sewers as specified for abandoning pipes and structures under 204.3.3.1.

(11) Under the Removing Septic Tanks bid item, first completely remove the contents of the tank. Conform to the WDNR requirements for removal and disposal of these contents. Break down and remove the tank, to an elevation not less than 2 feet below the proposed ground surface, or 2 feet below the finished slopes or natural ground surface, as required due to the location of the tank. Before backfilling, break a hole in the bottom of any remaining portion of the tank to allow drainage. Backfill as specified for trenches, holes, and pits in 204.3.1.2. If the septic tank disposal system includes a dry well, remove the dry well to not less than 2 feet below ground surface, and backfill it in the manner specified above for the septic tank.

(12) Under the Site Clearance bid items, remove building foundations and concrete slabs, backfill exposed openings, and clear the site within the right-of-way at the locations the plans show. Materials removed from building sites under this bid item become the contractor's property. The contractor may incorporate these materials in the roadway embankment if the engineer approves. Clear the entire premises of decomposable and combustible refuse, debris, and materials resulting from the removals and leave the premises in a neat condition.

(13) Under the Removing Storm Sewer bid items, remove existing storm sewer. Backfill resulting trenches with granular backfill conforming to 209.2.

204.3.2.2.2 Removing Asphaltic Surface Milling

(1) Under the Removing Asphaltic Surface Milling bid item, remove existing asphaltic pavement or surfacing by milling at the location and to the depth the plans show. The contractor may incorporate suitable material into the work or dispose of it outside the project limits.

(2) If stockpiling material for subsequent incorporation into the work, store material at an engineer-approved location that will minimize the hauling required to place the material. Prepare the stockpile foundation to minimize contamination. Ensure that the stockpile foundation is free of clods, lumps, or stones larger than 2 inches in any dimension.

(3) Remove the existing asphaltic pavement or surfacing without incorporating or damaging underlying material that will remain in place. Provide a uniform milled surface that is reasonably plane, free of large scarification marks, and has the grade and transverse slope the plans show or the engineer directs.

(4) Use a self-propelled milling machine with depth, grade, and slope controls. Shroud the drum to prevent discharging loosened material into adjacent work areas or live traffic lanes. Provide an engineer-approved dust control system.

(5) Maintain one lane of traffic during working hours. Unless using a continuous removal and pick-up operation, do not windrow or store material on the roadway. Clear the roadway of materials and equipment during non-working hours. Grade shoulders adjacent to milled areas by the end of each work day to provide positive drainage of the pavement. Do not allow abrupt longitudinal differences of 2 inches or more between lanes during non-working hours. The engineer may waive one or more of these requirements if the highway is closed to traffic or if a particular operation does not endanger traffic.

204.3.2.3 Removing Buildings

(1) Under the Removing Building and Removing Buildings bid items, remove buildings, dispose of material and debris resulting from removing buildings, and backfill resulting holes.

(2) Buildings removed and materials resulting from building removal become the contractor's property unless the contract specifies otherwise. Dispose of unclaimed and removed material as specified for disposing of materials in 203.3.4.

(3) The department assumes no responsibility for the condition of any building at any time. The department makes or implies no guarantee that any building will remain in the condition the bidder finds it in when the bidder prepares its proposal.

(4) Obtain permits necessary for removing buildings, including those necessary if the contractor's operations obstruct streets or alleys.

(5) Remove buildings and building materials safely and according to the requirements of the Wisconsin department of workforce development, applicable ordinances of the municipality where the building is located, and the WDNR. Pay close attention to the requirements regulating the handling and disposal of asbestos, lead paint, and other hazardous substances. If creating hazardous conditions incident to the contract operations, furnish, erect, and maintain suitable barricades to safeguard the public.

(6) Notify public utility companies serving the building in sufficient time, before removal operations, to allow them to disconnect and remove their facilities from the building.

(7) Shut off municipal water service lines at the curb boxes. Tightly plug or seal sewer connections. If municipal ordinances or permits specify the manner of sealing a sewer service connection, then perform the work accordingly.

(8) Unless the contract specifies otherwise, when removing a building also remove that portion of its foundation, including any masonry floors, to an elevation not less than 2 feet below the ground surface, the proposed finished earth subgrade, or finished slope grade, as necessary due to the location of the building.

(9) Remove heating units, plumbing fixtures, and similar appurtenances to the elevation of the basement floor.

(10) Before backfilling, remove debris not suitable for backfilling. Break holes comprising at least 10 percent of the floor area in basement floors to allow drainage.

204.3.3 Abandoning Pipes and Structures

204.3.3.1 General

(1) If the contract calls for abandoning manholes, catch basins, or inlets, clean them thoroughly. Plug the existing pipe connections with brick or concrete block masonry, or with any grade of concrete specified under 501.3.1.3, or any engineer-approved commercial grade of concrete. Unless the plans show otherwise, remove the walls of the structures as follows:

1. Within the roadbed, to a depth at least 2 feet below the subgrade.
2. Outside the roadbed, to a depth at least 2 feet below the finished grade.
3. At any location, to the extent required to avoid interfering with the work.

204.3.3.2 Abandoning, Closing, and Sealing Items

(1) Under the Abandoning Culvert Pipes bid item, plug both ends of the abandoned pipe as specified in 204.3.3.1.

(2) Under the Closing Culvert Pipes bid item, close both ends of the abandoned pipe as specified for closing culverts in 203.3.3.

(3) Under the Sealing Pipes bid item, thoroughly clean the ends of the abandoned pipe, and seal them with brick, concrete block, or any grade of concrete specified under 501.3.1.3.

204.3.3.3 Abandoning Wells

(1) Under the Abandon Wells bid item, fill and seal wells conforming to the Wisconsin administrative code as follows:

For monitoring wells.....NR 141
For community wells or high capacity wells.....NR 811
For private water supply wells.....NR 812

204.4 Measurement

(1) Unless specified otherwise, the department will measure this work in the original position of the removed structures. If the contract does not include bid items for removing the listed miscellaneous

structures from within the roadway, the department will measure the excavation for those removals as common excavation. The department will determine the volume of excavation for removing concrete structures as the area of the structure times the depth removed.

(2) The department will measure Removing Pavement, Removing Pavement Butt Joints, Removing Asphaltic Surface, and Removing Asphaltic Surface Butt Joints by the square yard acceptably complete regardless of the depth or number of courses encountered. The department will measure Removing Asphaltic Surface Milling by the square yard, or by the ton acceptably completed.

(3) If removing curb, gutter, or curb & gutter is required in conjunction with removing pavement, the department will measure removing these structures by the square yard acceptably completed, under the Removing Pavement bid item. If removing a rigid base with an asphaltic surface extending beyond the lateral limits of the rigid base, as in a widened pavement, the department will measure only the area occupied by the rigid base under the Removing Pavement bid item. The department will measure the portion of the asphaltic surfacing beyond the rigid base removed under the Excavation bid items or the Obliterating Old Road bid item. The department will make no deductions for any opening in the removed pavement having an area of 3 square yards or less.

(4) The department will make no deductions from the volume measured under the Excavation bid items for pavement removed under the Removing Pavement bid item.

(5) If removing curb, gutter, or curb & gutter that is separate from and not removable in conjunction with removing pavement, the department will measure Removing Curb, Removing Gutter, and Removing Curb & Gutter by the foot acceptably completed, measured along the flow line of gutter for gutter, or curb & gutter, and along face of curb for curb.

(6) The department will measure Removing Concrete Sidewalk by the square yard acceptably completed. The department will include steps based on the area of the horizontal projection of the steps.

(7) The department will measure Removing Concrete Barrier, Removing Lip Curb, Removing Guardrail including end sections or anchorages, and Removing Fence by the linear foot acceptably completed.

(8) The department will measure Removing Concrete Slope Paving by the square yard acceptably completed, measured in the plane of the removal surface.

(9) The department will measure Removing Delineators and Markers as each individual delineator or marker acceptably completed.

(10) The department will measure Removing Masonry by the cubic yard acceptably completed.

(11) The department will measure Removing Surface Drains as each individual surface drain acceptably completed.

(12) The department will measure Removing Concrete Bases as each individual concrete base acceptably completed.

(13) The department will measure Removing Railroad Track by the linear foot acceptably completed, measured along single track lines, tracks with 2 rails.

(14) The department will measure Removing Utility Poles as each individual pole, or pole stub acceptably completed, including attached parts and connections.

(15) The department will measure Removing Manholes, Removing Catch Basins, and Removing Inlets as each individual manhole, catch basin, or inlet acceptably completed, including attached parts and connections.

(16) The department will measure Removing Septic Tanks as each individual septic tank acceptably completed, including any dry wells in the tank's disposal system.

(17) The department will measure the Removing Building bid items as a single lump sum unit for each building acceptably completed. The department will measure the Removing Building bid items as a single lump sum unit for all buildings within the specified parcel acceptably completed.

(18) The department will measure the Site Clearance bid items as a single lump sum unit for each specified parcel acceptably completed.

(19) The department will measure the Removing Storm Sewer bid items by the linear foot acceptably completed, measured along the centerline of the pipe.

(20) The department will measure the Abandoning Manholes, Abandoning Catch Basins, Abandoning Inlets, and Abandoning Wells bid items as each individual unit acceptably completed.

(21) The department will measure Abandoning Culvert Pipes, Closing Culvert Pipes, and Sealing Pipes as each individual pipe acceptably completed, having both ends plugged.

204.5 Payment

204.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
204.0100	Removing Pavement	SY
204.0105	Removing Pavement Butt Joints	SY
204.0110	Removing Asphaltic Surface	SY
204.0115	Removing Asphaltic Surface Butt Joints	SY
204.0120	Removing Asphaltic Surface Milling	SY
204.0125	Removing Asphaltic Surface Milling	TON
204.0130	Removing Curb	LF
204.0140	Removing Gutter	LF
204.0150	Removing Curb & Gutter	LF
204.0155	Removing Concrete Sidewalk	SY
204.0157	Removing Concrete Barrier	LF
204.0160	Removing Lip Curb	LF
204.0165	Removing Guardrail	LF
204.0170	Removing Fence	LF
204.0175	Removing Concrete Slope Paving	SY
204.0180	Removing Delineators and Markers	EACH
204.0185	Removing Masonry	CY
204.0190	Removing Surface Drains	EACH
204.0195	Removing Concrete Bases	EACH
204.0200	Removing Railroad Track	LF
204.0205	Removing Utility Poles	EACH
204.0210	Removing Manholes	EACH
204.0215	Removing Catch Basins	EACH
204.0220	Removing Inlets	EACH
204.0225	Removing Septic Tanks	EACH
204.0230	Removing Building (station)	LS
204.0235	Removing Building (parcel)	LS
204.0240	Site Clearance (parcel)	LS
204.0245	Removing Storm Sewer (size)	LF
204.0250	Abandoning Manholes	EACH
204.0255	Abandoning Catch Basins	EACH
204.0260	Abandoning Inlets	EACH
204.0265	Abandoning Wells	EACH
204.0270	Abandoning Culvert Pipes	EACH
204.0275	Closing Culvert Pipes	EACH
204.0280	Sealing Pipes	EACH

(2) Payment for removing or abandoning miscellaneous structures is full compensation for breaking down, removing, closing, plugging, or sealing; for removing and disposing of headwalls; for obtaining any required work permits; for hauling and disposing of materials; for providing any required bentonite, soil, brick, concrete block, or concrete; for restoring the roadway cross-section; and, unless the contract specifies granular backfill, for backfilling.

(3) If the contract specifies or the engineer directs backfilling with granular backfill, the department will pay separately for that backfilling under the Backfill Granular bid items as specified in 209.5.

(4) Except for storm sewer, if the contract does not include bid items for removing the listed miscellaneous structures from within the roadway, the department will pay for excavating these removals under the Excavation Common bid item. The department will pay for excavation for removing concrete structures exceeding one cubic yard, that were not specified for removal in the contract, at 5 times the unit price bid for Excavation Common under the Removing Miscellaneous Concrete Structures administrative

item. Other work involved in removing or abandoning miscellaneous structures within the roadway is incidental to the work.

(5) Except for storm sewer, if the contract does not include a separate bid item for removing any of the miscellaneous structures listed above from within the limits of Obliterating Old Road, all work involved in the removal thereof, whether specified or subsequently found necessary and required, is incidental to Obliterating Old Road.

(6) Except for storm sewer, if the contract does not include a separate bid item for removing any of the miscellaneous structures listed above from beyond the roadway and outside the limits of Obliterating Old Road, all work involved in the removal, if the removal is specified in the contract, is incidental to other bid items of work. If this removal is not specified but later found necessary and required, the department will pay for all work involved in this removal as extra work.

204.5.2 Storm Sewer

(1) If the contract or the engineer requires storm sewer removal and the contract does not include the Removing Storm Sewer bid item, the department will pay for that removal as extra work.

Section 205 Roadway and Drainage Excavation

205.1 Description

(1) This section describes excavating and disposing of material taken from within the right-of-way for project construction.

(2) This section does not include material obtained from borrow pits outside the right-of-way limits, excavation for structures, or other excavation that separate bid items and specific measurement and payment are specified elsewhere in the specifications and contract.

205.2 Materials

205.2.1 Classification

(1) The department classifies excavation as common, rock, stone piles and stone fences, or marsh excavation. If the contract contains the Excavation Common and Excavation Rock bid items, the engineer will classify that excavation as either common or rock, based on unfrozen material, as the contractor performs the work.

(2) The department classifies EBS outside of marshes as common or rock.

205.2.2 Common Excavation

(1) Under the Excavation Common bid item, excavate materials not classified as rock, stone piles and stone fences, or marsh excavation. For contracts without the Excavation Rock bid item, remove boulders having volumes of one cubic yard or more under the Excavation Common bid item.

205.2.3 Rock Excavation

(1) Under the Excavation Rock bid item, excavate hard, solid rock in ledges, bedded deposits, and unstratified masses, and conglomerate deposits or any other material so firmly cemented they present the characteristics of solid rock, and the engineer determines it is impracticable to excavate this material without blasting or using rippers. Rock excavation also includes removing rock boulders having a volume of one cubic yard or more.

(2) The classification of rock excavation does not apply to crushed aggregate or asphaltic base or surface courses, or to concrete base or surface courses.

205.2.4 Stone Piles and Stone Fences

(1) Under the Excavation Stone Piles and Stone Fences bid item, remove and dispose of stones, boulders, and rock fragments found assembled on the right-of-way in piles so that the engineer can make collective measurements by volume of the weight. If the contract includes a bid for this bid item, the classification applies to portions of the piles or assembled stone masses found on the right-of-way that are removed and disposed of as specified. This applies regardless of whether this material occurs entirely above or partially below the ground surface. Do not classify stones in groups or piles of less than one cubic yard in volume under stone piles and stone fences.

205.2.5 Marsh Excavation

(1) Under the Excavation Marsh bid item, perform required excavation below the original ground level of marshes and swamps underlying proposed embankments, within the limits indicated on the plans or as the engineer determines, and necessary or desirable to ensure a stable foundation for embankment or to accelerate the subsidence of unstable material under embankment load. If old road embankment cores are encountered in areas involving marsh excavation, salvage the portions of old road cores as designated on the plans and use them in the construction of embankments. This bid item also includes material of whatever nature encountered below the original ground elevations in areas designated for this work, exclusive of portions of old road cores designated for salvage and used in construction of embankments.

(2) On contracts containing the Excavation Marsh bid item, excavate any marsh areas not indicated on the plans but encountered during construction as marsh excavation if the engineer orders removing these areas.

205.3 Construction

205.3.1 General

(1) Excavate materials as the plans show or the engineer allows from within the right-of-way. Use excavated material in the work to the extent practicable. Use excavated material with suitable engineering properties to construct the roadway, roadbed, embankments, earth subgrade and shoulders, intersections, side ditches and dikes, channels, and waterways. Dispose of surplus or unsuitable material as specified in 205.3.12.

(2) Grade entrances, approaches, ditches, and channels beyond the right-of-way.

(3) Replace unsuitable material with satisfactory material. Trim and finish the roadway. Maintain the work done under 205 in a finished condition until acceptance.

205.3.2 Preparing Roadway Foundation

(1) Remove vegetation taller than one foot before excavating or placing embankment. Remove heavy sod, perishable material, unstable topsoil, muck, peat, and other undesirable material from the roadway foundation as defined in 101.3. Also remove frozen material from the roadway foundation unless the engineer approves otherwise. Dispose of removed material as specified in 205.3.12 unless the contract or the engineer directs otherwise.

(2) Salvage topsoil, as specified in 625.3.2, from excavation areas and the roadway foundation. Remove excess unstable topsoil from the roadway foundation as EBS as specified in 205.3.4.

(3) Compact, or prepare otherwise as required, the existing ground within the roadway foundation as necessary to support the embankment and attain the specified embankment density.

(4) If placing embankment on side slopes 10 feet high or higher and steeper than one vertical to 3 horizontal, provide vertically faced horizontal steps or benches in the slopes to support the embankment. The contractor may cut or form the steps or benches while placing the embankment.

(5) Completely remove pavement, asphaltic surface, and rigid base from within the roadbed slopes and underlying proposed embankments to a depth of 2 feet or more below the finished grade line, or to the depth the plans show.

205.3.3 Drainage During Construction

(1) During construction, maintain roadway, ditches, and channels in a well-drained condition at all times by keeping the excavation areas and embankments sloped to the approximate section of the ultimate earth grade. Perform blading or leveling operations when placing embankments and during the process of excavation except if the excavation is in ledge rock or areas where leveling is impracticable or necessary. If it is necessary in the prosecution of the work to interrupt existing surface drainage, sewers, or under drainage, provide temporary drainage until completing permanent drainage work.

(2) If storing salvaged topsoil on the right-of-way during construction operations, stockpile it to preclude interference with or obstruction of surface drainage.

(3) Seal subgrade surfaces as specified for subgrade intermediate consolidation and trimming in 207.3.9.

(4) Preserve, protect, and maintain existing tile drains, sewers, and other subsurface drains, or parts thereof, that the engineer judges should continue in service without change. Repair, at no expense to the department, damage to these facilities resulting from negligence or carelessness of the contractor's operations.

205.3.4 Excavation Below Subgrade

(1) Remove deposits of frost-heave material, unstable silty soils, wet and unstable soil, material salvaged from old road cores in marshes, topsoil containing considerable humus or vegetable matter, rocks, or other undesirable foundation material to the depth below finished grade as the plans show or the engineer directs. If possible, slope and drain the excavation bottoms to prevent water accumulation.

(2) Dispose of humus bearing soils and other excavated materials not suitable for embankment construction as specified for disposal of surplus or unsuitable material in 205.3.12.

(3) Use selected materials from roadway and drainage excavation having suitable engineering properties, borrow, or granular backfill, as the plans or special provisions show or as the engineer directs, to backfill excavated areas.

205.3.5 Grading the Roadway, Intersections, and Entrances

(1) Use material with suitable engineering properties removed from excavation, to the extent practicable, to construct the roadway. Use excess excavated material in other locations the plans show.

(2) Undercut or under fill to the necessary depth, excavated slopes or areas and embankment slopes or areas designated to receive topsoil or salvaged topsoil in order to provide for placement and finish of the specified quantity of topsoil or salvaged topsoil to the required grade lines and section.

(3) Perform excavation to avoid removing or loosening any material outside the required slopes. Replace and thoroughly compact any material removed or loosened to the required cross-section.

(4) Grade intersecting roads, approaches, entrances, and driveways as the plans show or as the engineer lays out. Construct intersections and private entrances, trim shoulders and slopes, finish and blade the earth subgrade, and complete the ditches to the proper alignment, grade, and cross-section closely following the rough grading.

205.3.6 Constructing Ditches, Dikes, and Channels

(1) Construct inlets, outlets, swamp, berm and intercepting ditches, dikes, or intercepting embankments and channels where and as the plans show or where and as the engineer directs. Maintain inlets, outlets, swamp, berm, and intercepting ditches, dikes, or intercepting embankments and channels to the required section until acceptance. Perform the work in proper sequence with other work to provide adequate drainage and to minimize erosion and siltation.

(2) The department will include excavation from ditches and channels with the pertinent bid items classified under roadway and drainage excavation.

(3) Use material with suitable engineering properties excavated from ditches and channels, to the extent practicable, to construct the roadway and backfill abandoned ditches and channels. Dispose of unused excavated material as the plans show or as the engineer directs.

(4) Do not deposit waste or surplus excavation within 3 feet of the edge of ditches or channels or within a greater distance as required to ensure stability of the side slopes. Spread waste or surplus material in thin, neatly shaped, uniform layers. Remove roots, stumps, logs, and other objectionable material in the slopes and bottoms of ditches and channels. Backfill the holes with suitable material, or cut the holes to conform to the cross-section the plans show. If necessary, provide sufficient openings in spoil banks to allow surface drainage of adjacent lands.

(5) Provide suitable outlets or flumes from intercepting ditches to roadway ditches where necessary as the plans show.

205.3.7 Excavating Rock

205.3.7.1 General

(1) Remove rock, if encountered in excavation, to a depth of approximately 6 inches below the earth subgrade between limits of the shoulder slopes. If the plans show design details covering the depth of rock excavation, perform the work according to the details. If the plans or special provisions do not require specific materials, then use selected material obtained from roadway and drainage excavation to backfill areas of EBS in rock excavation. If excavation methods leave undrained pockets in the rock surface, drain the depressions properly. If the engineer allows, the contractor may fill the depressions with engineer-approved impermeable material, at no expense to the department.

(2) Excavate rock cuts using methods and equipment so that the resulting backslopes substantially conform to the slopes the plans show or to the slopes established from the stakes set for excavation. Avoid creating depressions in or substantial displacement of material outside the lines, limits, or slope planes defined by the stakes. Scale the backslopes in rock cuts to dislodge loose rock. Dispose of removed material in the manner specified for other excavation.

(3) Undercut the slopes of rock cuts if designated to receive topsoil, or salvaged topsoil to the depth necessary to allow placing the specified quantity of topsoil or salvaged topsoil, and finish to the required section.

205.3.7.2 Presplitting Rock

(1) If the plans show or the engineer authorizes, employ the presplitting technique to split the face of the rock cut in a relatively smooth plane along the designated backslope, before removing the interior portion of the cut by blasting.

(2) Remove soil and loose or decomposed rock overlying the surface of the rock to be split to the elevation the engineer designates or approves before drilling the presplitting holes.

(3) At the beginning of the presplitting operation or if encountering material of different geologic characteristics, drill, blast, and excavate short test sections, up to 100 feet in length, to determine the optimum spacing, size, and loading of the holes. Do not perform testing until the engineer approves a contractor-prepared plan of the test section. After presplitting the test section, expose the presplit face to allow the engineer to examine and evaluate the results. If the results are unsatisfactory, make adjustments in hole size and spacing, size and spacing of charges, and other aspects of the plan to produce an acceptable split face.

(4) Drill holes not larger than 3 1/2 inches in diameter at a spacing determined from the test section, but not less than 24 inches and not more than 42 inches.

(5) Drill holes on the required slope line and at the required slope inclination to the full depth of the cut or to a predetermined stage elevation. If the depth of cut is greater than is practicable to maintain the required alignment of the drilled holes, drill, blast, and excavate the cut in 2 or more lifts. If the cut is too deep for presplitting to the full-required depth in one operation, the engineer will allow a maximum offset of 12 inches at the bottom of each lift for use in drilling the next lower presplitting pattern. Plan

the offset benches so the toe of the completed rock slope coincides with the toe of slope the plans show.

(6) Carefully charge drill holes for presplitting with manufactured cartridge-type explosives, fully stem each hole, and detonate the charges simultaneously.

(7) Before blasting the interior portion of the excavation area, presplit rock slopes, either by separate operations or by time delay fuses that fracture the slope line before the charges detonate in the interior portion.

(8) Position drill holes for production blasting to avoid damage to the presplit face. Do not place the bottom of the production holes below the bottom of the presplit holes. Do not drill portions of production drill holes within 4 feet of a presplit plane except as the engineer approves.

(9) Use explosive charges, detonating cord, spacing, and other items necessary for the blasting operation conforming to the explosive manufacturer's recommendations and instructions.

205.3.8 Marsh Excavation and Disposal

(1) If encountering muck or peat marshes, complete excavation of the marshes as soon as practicable to obtain maximum settlement before proposed base and surface construction.

(2) Begin excavation of wet marshes with relatively unstable side slopes at one end and proceed in one direction to the full width across the entire marsh immediately ahead of backfilling. Ensure the method and sequence of excavating and backfilling result in the complete removal or displacement of peat or muck from within lateral limits the plans show or as the engineer staked, and to the bottom of the marsh or to firm support. Excavate displaced peat or muck accumulating ahead of the advancing embankment toe. Construct embankments as specified for placing in marsh in 207.3.3.

(3) Completely excavate, to the extent practicable, dry marshes having relatively stable side slopes and firm bottoms to the width the plans show or as the engineer staked, and to the bottom of the marsh. Backfill the area in layers as specified for placing layers in 207.3.2.

(4) Unless the contract specifies otherwise, the contractor may temporarily deposit the excavated material outside the toe of the slope of the proposed embankment but not over marsh or wetlands. After completing the embankment, place the excavated material against the fill slopes, and spread the material between the fill and marsh ditch if not placing over marsh or wetlands. Dispose of left over material as unsuitable material, or use it as the plans show. If disposing of excavated material by hauling to other locations, complete hauling before construction of any subbase, base, or surface course.

205.3.9 Removing Embankment Surcharge

(1) Remove and dispose of excess fill placed above the elevation for earth grade over deposits of unstable material to secure displacement or settlement. Remove surcharge only after the engineer determines the fill has reached stability or the required settlement.

205.3.10 Removing Masonry Walls, Foundations of Buildings, or Other Structures

(1) Unless the plans show otherwise, remove masonry walls or foundations of buildings or other structures as follows:

1. Within the roadbed, to a depth at least 2 feet below the subgrade.
2. Outside the roadbed, to a depth at least 2 feet below the finished grade.
3. At any location, to the extent required to avoid interfering with the work.

(2) Break holes in basement floors to allow drainage. Backfill those portions of basements or other openings resulting from removing buildings or other structures, or openings resulting from removing walls or foundations of buildings or structures, lying within the shoulder lines of the new roadway, subgrade elevation with suitable material from roadway excavation, unless the contract specifies granular backfill. Backfill similar openings lying outside the ditch lines of the new roadway with material secured from roadway excavation.

205.3.11 Incorporating or Disposing of Stones, Broken Rock, and Boulders

(1) Incorporate stones, broken rock, and boulders not required for other construction included in the contract, to the extent practicable, in embankments outside the limits of any proposed structure or structure piling. Completely fill the voids between them with satisfactory soil. Dispose of material not incorporated in the work at no expense to the department, either by burying in the ground within the right-of-way in an engineer-approved manner or by placing off the right-of-way and out of sight from a public highway. If placing material outside the right-of-way, comply with all regulations relating to disposal of solid waste. Obtain written permits for disposal from the owner of the property where

placing the material, unless disposing of the material at a licensed waste disposal operation. Furnish permits, or copies of permits, to the engineer before disposal. Do not deposit waste in wetlands.

205.3.12 Incorporating or Disposing of Surplus or Unsuitable Material

(1) Dispose of vegetation as specified for clearing and grubbing under 201.3. Save material containing humus or of a nature suitable to support vegetation but unsatisfactory for constructing embankments. Use this material in salvaged topsoil operations. The contractor may, if the engineer approves, use surplus humus-bearing soils, and other excavated materials not suitable for embankment construction but suitable to uniformly widen embankments, to flatten slopes, and to fill low places in the right-of-way for these purposes, unless specified otherwise.

(2) Do not deposit excavated material along the roadsides above the elevation of the adjacent roadbed, unless the plans show or the engineer allows.

(3) Dispose of surplus excavation that is not, or cannot be, disposed of by flattening slopes or filling in low places on the right-of-way, at no expense to the department. Locate disposal sites outside the right-of-way, and comply with all regulations relating to disposal of solid waste. Ensure that disposal sites are neatly constructed. In performing these operations, do not create a nuisance or cause pollution or siltation of natural watercourses, streams, lakes, wetlands, or reservoirs. Furnish written permits to the engineer as required from the owner of the property under 205.3.11 before disposal. Do not deposit waste in wetlands.

205.3.13 Approving Cuts and Shallow Fills

(1) The department may approve areas of subgrade in cuts and shallow fills for subsequent operations. The department defines shallow fills as areas requiring 2 feet or less of fill material. The contractor is responsible for the subgrade in the embankment.

(2) After rough grading, on all or a portion of the subgrade in cuts and shallow fills, identify yielding areas for engineer evaluation as follows:

- When the grade is ready for placing subgrade improvement material.
- When the subgrade is complete and ready for blue tops.

(3) The engineer will evaluate cuts and shallow fills to determine if corrective work or EBS is required. If the engineer requests, provide loaded trucks and run the grade as the engineer directs to confirm yielding areas. Perform EBS in yielding areas and backfill as the engineer directs.

(4) If satisfied that a cut or shallow fill area requires no EBS, the engineer will approve that area for subsequent operations.

205.3.14 Finish Grading

(1) Complete the grading, trimming, and finishing before constructing the subbase, base, or surface courses.

(2) Make gradual adjustment in slopes to avoid injury to standing trees or to harmonize with existing landscape features, especially at the intersection of cuts and fills.

(3) Round the crests of earth cut banks as the plans show or as the engineer directs.

(4) Merge constructed earth slopes with adjacent terrain and substantially conform to the plan cross-sections. Use blading or other operations, to partially smooth the horizontal serrated condition of slopes ordinarily left by excavating equipment. Produce slopes that are slightly rough and irregular and have a general contour of the required slope.

(5) Flatten, round, or modify the slopes and banks of existing ditches, channels, berms, and dikes within the clear zone to the extent necessary to remove obstacles or obstructions encountered by vehicles leaving the adjacent traveled way.

(6) During grading operations and pending acceptance of grading or placement of subbase, base, or surface course, provide continuous maintenance of the entire roadbed and perform blading and repair work necessary to keep the grade smooth and to the required grade and cross-section specified. The contractor is not required to maintain or restore the minimum required density in the graded roadway after completing shaping, trimming, and finishing operations, except as specified for preparing the foundation in 211 before placing subbase or base under the contract.

(7) Refill and compact washouts caused by erosion.

205.3.15 Preserving Trees and Shrubs

(1) Protect trees and shrubs designated for preservation from scarring or other injury during grading operations.

(2) If excavating around trees to be preserved, do not disturb the original ground around the trees within a minimum distance of one foot or twice the diameter of the tree, whichever is the greater distance. Cleanly cut exposed roots resulting from excavation, and cover them with humus-bearing soil.

(3) If the plans, special provisions, or the engineer requires, construct tree wells to protect trees or shrubs surrounded by excavation or embankment.

205.3.16 Dust Control

(1) Minimize dust dispersion from the subgrade during grading and maintenance operations, until the work is accepted, by applying water or other engineer-approved dust control materials as the contract specifies or the engineer requires.

205.4 Measurement

205.4.1 Excavation

(1) The department will measure all classes of roadway and drainage excavation by the cubic yard acceptably completed as computed using the method of average end areas, with no correction for curvature, except as follows:

1. The engineer and contractor mutually agree to an alternate volume calculation method.
2. The method of average end areas is not feasible.
3. Other methods are specified here in 205.4.1.

(2) For minor quantities, the engineer may elect to measure Excavation Common by the cubic yard in the vehicle. The engineer will determine the capacity of each haul vehicle to the nearest 0.1 cubic yard.

(3) The department will measure Excavation Rock in ledges and solid masses by the cubic yard acceptably completed. The department will perform this measurement by making vertical measurements for determining end areas within the limits of the roadbed as defined by the shoulder slopes. These vertical measurements will extend from the surface of the rock to an elevation 6 inches below the subgrade or ground surface, or to the depth indicated on the plans, or to the bottom of the solid ledge or mass if the rock does not extend downward to the elevation specified, or indicated below the established grade.

(4) The department will measure boulders and surface stone with a volume of one cubic yard or more individually and compute the volume from average dimensions taken in 3 directions, except as specified below for Excavation Stone Piles and Stone Fences.

(5) If the contract includes a separate bid item for Excavation Stone Piles and Stone Fences, the department will measure the stone piles or portions of stone piles removed in cubic yards in their original position, computed by the method of average end areas, with no correction for curvature, or, if the engineer elects, by the method of truncated prisms. Measurement under Excavation Stone Piles and Stone Fences includes stones, regardless of size; located in the stone piles and stone fences, and the department will make no classification of stone size for material measured under this bid item.

(6) If undercutting designated slopes to provide for placing topsoil or salvaged topsoil, the undercut is incidental to the Topsoil or Salvaged Topsoil bid items.

(7) The department will measure Excavation Marsh in its original position, by the average end area method, within the limits of excavation. The department will use this method if the contractor excavated and formed a reasonably well defined trench of required cross-section, with relatively stable side slopes, and a bottom that is the bottom of the marsh or a satisfactory support for the backfill and embankment. In cases that the excavation does not result in a reasonably well defined measurable trench with relatively stable side slopes, the department will measure the cross-section area based on the lateral limits of the excavation shown in the plan cross-sections or as staked in the field. The department will determine the depth between the original marsh surface and the bottom of the placed fill by taking soundings during the marsh excavation or by taking borings through the completed fill. The department will not measure marsh material from outside the lateral limits defined above that is excavated or is displaced by the fill.

(8) If it is not possible to compute volumes of the various classes of roadway and drainage excavation by the method of average end areas due to erratic location of isolated deposits, the department may compute the volumes by alternate methods involving 3-dimensional measurements.

(9) The department will not measure for payment materials excavated in forming benches or steps in preparing the foundation for embankments placed on slopes.

(10) The department will not measure excavated material used for purposes the contract does not designate, except as specified for use of materials found on the project in 104.8. The department will not measure material excavated beyond the limits of the required slopes unless the engineer allows

overbreak in rock cuts and that overbreak was beyond the contractor's control. In this case the department may measure this overbreak.

(11) The department will measure erosion control, fertilizing, and seeding for material disposal sites as specified for material disposal sites in 628.4.1.1.

205.4.2 Presplitting Rock

(1) The department will measure Presplitting Rock by the linear foot of drill holes, including test section holes, drilled along the face of acceptable presplit rock slopes. The department will take the measurement from the top of the drill hole at the rock surface to the elevation of the roadway ditch, to a predetermined bench elevation or to the bottom of the rock ledge or mass where the rock does not extend to the roadway ditch or predetermined bench elevation. The department will not include overbreak quantities in the measurement of Excavation Rock where presplitting is used.

205.5 Payment

205.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
205.0100	Excavation Common	CY
205.0200	Excavation Rock	CY
205.0300	Excavation Stone Piles and Stone Fences	CY
205.0400	Excavation Marsh	CY
205.1300	Presplitting Rock	LF

205.5.2 Excavation

(1) Payment for the Excavation bid items under this section is full compensation for all work specified for those excavation classes under 205 for which no separate unit prices are included in the contract, except as specified otherwise in 203 and 204 for removing concrete structures, and below for performing EBS after the engineer approves the subgrade in cut areas. The cost of removing walls, foundations, etc., the satisfactory disposal of resulting material, and the backfilling of basements or openings resulting from removing walls, foundations, etc., for which no separate unit prices are included in the contract, is included in the contract unit price for the Excavation bid items, except for removing concrete structures. The department will not pay extra for this work, except the department will pay separately for providing the required granular backfill under the Backfill Granular bid items, and, except as specified above for removing concrete structures and EBS performed after the engineer approves the subgrade in cut areas. Payment also includes hauling.

(2) The department will only pay for engineer-approved EBS to correct problems beyond the contractor's control. Work performed under 105.3 to correct unacceptable work is the contractor's responsibility. For EBS work performed where the engineer did not approve the subgrade for subsequent operations, the department will pay for EBS at the contract price under the pertinent excavation and backfill bid items, or absent those bid items as extra work. For EBS work performed where the engineer approved the underlying layers for subsequent operations, the department will pay for EBS as follows:

1. Up to a maximum of $25,000 per contract, the department will pay as follows:
   - 1.1 For excavation: 3 times the contract unit price for the Excavation Common bid item under the EBS Post Grading administrative item.
   - 1.2 For backfill with the materials the engineer directs: at the contract unit price for the bid items of each material used to fill the excavation.
   - 1.3 For excavation or backfill without contract bid items: as extra work.
2. After exceeding $25,000 per contract, the department will pay for additional EBS in engineer-approved areas as determined under 109.4.

(3) If the contract does not include the Excavation Rock bid item, the department will pay 5 times the contract bid price of the Excavation Common bid item to remove boulders having volumes of one cubic yard or more. The department will pay for these boulder removals under the Removing Large Boulders administrative item.

(4) Constructing and removing temporary drainage installations as specified under 205.3.3 is incidental to the work under this section.

(5) The department will pay for erosion control, fertilizing, and seeding of material disposal sites as specified for material disposal sites in 628.5.1.

(6) The department will pay for refilling and compacting washouts caused by erosion under the contract bid item for the additional volume of material used, or as extra work according to 107.14, except that if the erosion is caused by the contractor's negligence then the contractor performs refilling and compaction at no expense to the department.

205.5.3 Presplitting Rock

(1) Payment for Presplitting Rock is full compensation for drilling, charging, stemming, and blasting; and for providing materials, including explosives.

Section 206 Excavation for Structures

206.1 Description

(1) This section describes excavating for culverts, structural plate pipe, and structural plate pipe arches, bridges, and retaining walls. It also describes removing old substructure units within the space occupied by the new structure.

206.2 Materials

(1) Furnish backfill material of a quality acceptable to the engineer and free from frozen lumps, wood, or other extraneous or perishable material. The contractor may use engineer-approved material obtained from excavation.

(2) If the contract specifies structure backfill, furnish material conforming to 210. The contractor may use material conforming to the requirements for structure backfill obtained from excavation as specified under 104.8.

206.3 Construction

206.3.1 General

(1) Under the Excavation for Structures bid items, excavate material of whatever nature encountered. The department will not classify this excavation as common, rock, or marsh excavation under 205 or as dry or wet excavation.

(2) Remove logs, stumps, and other materials and obstructions necessary to place the foundations and structure. Dispose of material obtained from excavation. Backfill, compact, shape, slope, and clean the site.

(3) Construct, and subsequently remove, necessary cofferdams and cribs or well-point systems, and the necessary sheeting, shoring, bracing, draining, and pumping to allow constructing the substructure, above the seal, in the dry. Do not use stream diversions and earth dikes instead of specified cofferdams or well-point systems, unless the engineer authorizes in writing.

206.3.2 Excavation Depth

(1) The elevation of the bottoms of footings, as the plans show, is approximate only. The engineer may order, in writing, changes in dimensions or elevation of footings necessary to secure a satisfactory foundation.

206.3.3 Cofferdams and Cribs

(1) If providing cofferdams and cribs for foundation construction, ensure that they are safely designed and constructed, carried to adequate depths and heights, and are made watertight as necessary for the proper performance of the work. Construct cofferdams and cribs so that interior dimensions give sufficient clearance for the construction of forms and the inspection of their exteriors, and to allow pumping from sumps outside the forms. If cofferdams or cribs tilt or move laterally during the process of sinking, right, reset, or enlarge them to provide the necessary clearance. The contractor is responsible for any claims for damages resulting from the use of a well-point system.

206.3.4 Protecting Concrete

(1) Construct cofferdams and cribs to protect fresh concrete against damage from a sudden rising of the stream and to prevent damage to the foundation by erosion. Place wales and cross braces at locations that allow construction of the substructure unit without construction joints other than those the plans show. If required to leave wales or braces in place, use only pipe, precast concrete or rolled steel sections. Do not box out with timber braces.

206.3.5 Plans Required

(1) If the engineer requests, submit one copy of signed and sealed plans as specified for cofferdams and cribs under 105.2, showing the proposed method of cofferdam or crib construction for the file. At the engineer's request, submit 2 additional copies of these plans for review. If the engineer does not find the plans submitted for review satisfactory, make the required changes. Whether or not the engineer requests submittal of the plans or concurs in the use of the plans as submitted or corrected, the department will not relieve the contractor of the responsibility to secure a safe and satisfactory cofferdam or crib.

206.3.6 Removal

(1) Unless specified otherwise, remove cofferdams or cribs, including sheeting and bracing, after the completion and curing of the substructure unit. Exercise care not to disturb or otherwise injure the finished masonry.

206.3.7 Excavation

(1) Notify the engineer sufficiently before beginning excavation for structures so the engineer may take elevations and measurements of the existing ground and substructure units before disturbance and removal.

(2) Excavate as specified in 29 CFR Part 1926 OSHA subpart P for excavations. Slope the sides of the excavation as required by soil conditions to stabilize the sides for safe working conditions. Limit excavation to the quantity considered necessary for safety. If the plans require, shore the excavation instead of sloping the sides. If the plans do not require shoring, the contractor may elect to use, at no expense to the department, shoring rather than excavating to a slope.

http://www.dol.gov/dol/cfr/title_29/

206.3.8 Preparing Foundation for Footings

(1) Free rock or other hard foundation material of loose material. Clean and cut this material to a firm surface, either level, or stepped, or serrated. Clean out and fill seams with cement mortar or grout.

(2) If masonry is to rest on an excavated surface other than rock, exercise special care not to disturb the bottom of the excavation. Do not make the final removal of the foundation material to grade until just before placing the masonry. Protect surfaces from freezing after excavation and before placing concrete for the footing. Do not place concrete on frozen subgrade.

(3) If using foundation piles, substantially complete the excavation of each pit before beginning pile-driving operations in the pit. After completing pile-driving operations in a given pit, remove loose and displaced material in the pit to the elevation of the bottom of the footings.

(4) If the contractor can place footings in dry foundation pits, it may omit footing forms, with the engineer's approval. In this case, fill the entire excavation with concrete to the elevation of the top of the footing.

(5) For footings founded on sound rock, key them into the rock as the plans require. If required, conform the keyway to plan dimensions. For footing excavations in sound rock, fill the footing with concrete to the elevation of the top of the rock or the top of the footing, whichever is lower.

206.3.9 Dewatering

(1) If possible, dewater foundation excavations before depositing masonry within.

(2) Pump from the interior of foundation enclosures in a manner to preclude, if practicable, removing foundation material or concrete ingredients.

(3) Do not pump from the interior of a foundation enclosure while placing concrete in the enclosure or for at least 24 hours afterwards, unless done from a suitable sump outside the forms. Do not pump from within any foundation enclosure while depositing concrete under water in the enclosure. Do not begin pumping to dewater a sealed cofferdam until the seal has set sufficiently to withstand the hydrostatic pressure, or until at least 3 days have elapsed since placing the seal.

206.3.10 Subfoundation Course

206.3.10.1 Bridges and Retaining Walls

(1) If placing masonry on a soft, muddy, or muck-covered surface that will not dry out and harden if the excavation is kept dewatered for a reasonable length of time, furnish and place a subfoundation course if the engineer directs. Construct a subfoundation course of structure backfill conforming to 210, or other engineer-approved materials. Place the subfoundation course directly below the elevation of the bottom of the footings to the depth the engineer designates.

206.3.10.2 Culverts

(1) Place a 6-inch subfoundation course of structure backfill conforming to 210, or other engineer-approved materials, directly below the elevation of the bottom of the slab between the cutoff walls of culverts.

206.3.10.3 Structural Plate Pipe and Pipe Arches

(1) Place subfoundation courses, including bedding courses, for structural plate pipe and pipe arches as specified for erection in 527.3.2.

206.3.11 Foundation Seal

(1) If the contractor encounters conditions that make it impracticable to dewater the foundation excavation before placing the masonry, the engineer may require construction of a concrete foundation seal of necessary dimensions. After the seal sets, dewater the foundation excavation and place the balance of the masonry in the dry. Place foundation seals the plans do not show below the bottom of the footing unless authorized otherwise. Place concrete in foundation seals as specified for depositing concrete underwater in 502.3.5.3.

206.3.12 Inspection

(1) Do not place any masonry or erect any form or structural plate pipe or pipe arch in any excavation until the engineer approves the depth of the excavation and the character of the foundation material.

206.3.13 Backfilling

206.3.13.1 General

(1) Backfill spaces excavated and not occupied by the new structure to the elevation and section existing before excavation. Do not place backfill above the required section for the finished work. If placing backfill, provide allowance for settlement.

(2) Do not backfill substructure units, except as required for the safety of workers, until clearing the area involved of falsework, sheet piling, cribbing, shoring, bracing, forms, and rubbish. Backfill the cofferdams before removing the sheeting, unless the engineer allows otherwise.

(3) If required for the safety of workers, and with the engineer's approval, the contractor may remove sheet piling, cribbing, shoring, and bracing as backfilling progresses.

(4) Perform backfilling to prevent wedging action against the structure. Step, terrace, or treat existing slopes as necessary to prevent slipping and wedging of the backfill.

(5) Unless specified otherwise, place backfill in continuous horizontal layers no more than 8 inches thick. If practicable, uniformly raise layers on all sides of each substructure unit or culvert. Surround the stone used in backfilling by finer material. Compact each layer, before placing the next layer, by using engineer-approved rollers or portable mechanical or pneumatic tampers or vibrators.

(6) If there is water in an excavation, backfill to displace the water but not trap it within the excavation. Do not use water to expedite backfill settlement except with the engineer's written approval. However, the engineer will not require the contractor to dewater the excavation before placing backfill. If allowed to use water, keep the entire excavation inundated while placing backfill, except if jetting.

(7) Conduct backfilling operations to avoid damage or deflecting any portion of the structure out of alignment. Gradually deposit the backfilling material transported in trucks or other vehicles instead of dumping the entire contents as one mass. Lower clams, dippers, and similar backfill containers to within 5 feet of previously deposited backfill, or of the water surface, before dumping.

(8) The contractor may end dump backfill from the structure or approach embankment if it intends to spread and place the end-dumped material in the above-described 8-inch horizontal layers. Do not place backfill in or from narrow ramps or driveways up to or from the structure.

(9) Perform backfilling around structural plate pipe and pipe arches as specified for backfilling around pipe and pipe arches under 527.3.3.

(10) Extend the backfill along the front face of abutments, retaining walls, and wing walls to within 6 inches of the weep holes, unless designated otherwise.

(11) If weep holes are designated on the plans for culverts, abutments, and retaining walls, deposit coarse gravel or crushed stone behind the culvert, abutment, or retaining wall at the level of the weep holes according to dimensions the plans show.

(12) Do not place backfill against any portion of any substructure unit until completing the required curing, surface preparation, dampproofing, and waterproofing of the work to be backfilled.

206.3.13.2 Self-Supported Abutments and Retaining Walls

206.3.13.2.1 General

(1) Allow self supported structures to develop sufficient strength before backfilling.

206.3.13.2.2 Backfill on One Side of the Structure

(1) The contractor may backfill structures that have attained the specified compressive strength or upon expiration of the minimum time periods tabulated below:

STRUCTURE TYPE[1]	GENERAL PURPOSE CONCRETE in days[2]	HIGH EARLY STRENGTH CONCRETE in days[2]	COMPRESSIVE STRENGTH in psi
Abutment type A1, A2, A5[4]	2	1	2000
Abutment type A3[3]	2	1	2000
Abutment type A4	14	7	3000
Full retaining abutments	14	7	3000
Box culverts[5]	14	7	3000
Retaining walls and end walls	14	7	3000

[1] Abutment types:

A1: Body about 5 feet tall with one row of piles.
A2: Body about 5 feet tall with 2 rows of piles.
A3: Body about 5 feet tall with backwall and 2 rows of piles
A4: Body about 13 feet tall with backwall and 2 or more rows of piles.
A5: Body about 10 feet tall with one row of piles extending to within 2 feet of abutment top.

Full retaining: Body extending from lower roadway/river elevation to beam seats.

[2] Only count days where the concrete temperature did not fall below 40 F.

[3] Upon obtaining the required compressive strength, the contractor may backfill the body of A3 abutments before placing the backwall.

[4] Place and cure the superstructure before backfilling A5 abutments as specified in 206.3.13.3.

[5] Place and cure the top before backfilling except as allowed under 206.3.13.3.

206.3.13.2.3 Backfill on Both Sides of the Structure

(1) The contractor may backfill footings to the top of the footings; sill abutments to the berm elevation; and retaining walls and piers uniformly and simultaneously on both sides to the elevation of the front ground surface immediately upon removing the forms.

206.3.13.3 Rigid Frame Structures

(1) Do not place backfill against an abutment or wall designed to gain support from a superstructure until placing and curing that superstructure.

(2) The contractor may backfill 1/4 of the total wall height of a box culvert after attaining a wall compressive strength of 2000 psi. Do not complete the backfill until the top is placed and conforms to 206.3.13.2.2.

206.3.14 Incorporating or Disposing of Excavated Material

(1) Incorporate excavated material in the work to the extent practicable. Use materials with suitable engineering properties for riprap or backfill. If the contract contains the Excavation Common or Borrow bid items and embankment material is needed at the time of disposal, use the balance of the excavated material, with suitable engineering properties, in the embankment.

(2) Dispose of surplus or unsuitable material as specified in 205.3.12.

206.3.15 Preserving Channels and Waterways

(1) Unless otherwise allowed, do not excavate outside caissons, cribs, cofferdams, or sheet piling, and do not disturb the natural streambed next to the structure. If performing any excavation or dredging at the site of the structure before caissons, cribs, or cofferdams are sunk in place, backfill these excavations to the original ground surface or stream bed with material satisfactory to the engineer after placing the foundation.

(2) After completing work within cofferdams, cribs, or sheet piling, backfill excavated areas within the cofferdams to the stream bed elevation, unless specified otherwise.

(3) Remove excavated material and debris resulting from the contractor's operations from stream channels, ditch lines, or waterways to the level of the finished streambed or ground line at no expense to the department.

206.4 Measurement

(1) The department will measure the Excavation for Structures bid items as a single lump sum unit for each structure acceptably completed.

(2) The department will measure the Cofferdams bid items as a single lump sum unit for each structure acceptably completed.

206.5 Payment

206.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
206.1000	Excavation for Structures Bridges (structure)	LS
206.2000	Excavation for Structures Culverts (structure)	LS
206.3000	Excavation for Structures Retaining Walls (structure)	LS
206.4000	Excavation for Structures Structural Plate Pipe or Pipe Arches (station)	LS
206.5000	Cofferdams (structure)	LS

(2) The department will pay for material excavated under this section and used in embankments at the contract unit price for Borrow, or absent the Borrow bid item, at the contract unit price for Excavation Common. The department will measure material as specified for excavation in 205.4.1.

(3) The department will pay separately for foundation seals, the plans show or the engineer directs, under the Concrete Masonry Seal bid item as specified in 502.5.

(4) The department will pay separately for excavating unforeseen structures found within the limits of the Excavation for Structures bid items. Unforeseen structures are man-made structures not visible when visiting the construction site and that the plans do not list or show. The department will pay for removing all or part of a culvert or bridge as specified in 203.5. The department will pay for excavating other unforeseen structures as extra work. Other removals visible when visiting the construction site or that the plans list or show are incidental to the work.

206.5.2 Excavation for Structures

(1) Payment for the Excavation for Structures bid items is full compensation for removing and disposing of excavation, including excavating for seals, girders, projections, and subfoundation courses; for preparing foundation; and for backfilling and compacting space excavated and not occupied by the new structure, including subfoundation course.

(2) Payment also includes providing cofferdams, cribs, sheeting, shoring, bracing, pumping, and dewatering except, if the contract contains the applicable bid items, the department will pay separately for this work.

(3) Payment is full compensation for excavation, removed to an elevation between planes one foot above and below the plan elevation of the bottom of the footings or floor of culverts, or the invert of structural plate pipe or pipe arches as the plans show for the specific units.

(4) If the footing is stepped, or on a slope, payment is full compensation for excavation to an elevation between planes lying one foot above and below the plan elevation of the bottom of the footing, for each stepped section; or excavation between planes lying one foot above, below, and parallel to the slope established by the plan elevations for the bottom of the footing.

(5) If the engineer orders any excavation be performed to elevations in excess of one foot above or below the elevation of the bottom of the footings or floor or invert as indicated on the plans, the department will pay for this excavation as extra work.

(6) The department will pay separately for necessary clearing and grubbing under the Clearing and Grubbing bid items as specified in 201.5.

(7) The department will pay separately for structure backfill, if specified, under the Backfill Structure bid item as specified in 210.5.

206.5.3 Cofferdams

(1) Payment for the Cofferdams bid items is full compensation for providing cofferdams and cribs, including well-point systems, sheeting, shoring, and bracing; for constructing, maintaining, backfilling, and removing cofferdams and cribs; and for pumping and dewatering.

Section 207 Embankment

207.1 Description

(1) This section describes placing in embankments and in miscellaneous backfills, material obtained under the bid items in the roadway and drainage excavation, borrow, or excavation for structures sections.

207.2 Materials

(1) For embankment, use engineer-approved material containing no logs, stumps, brush, or other perishable material. The contractor may place excess unstable topsoil and other unstable soil in embankments outside the roadway foundation as defined in 101.3. Do not place frozen soil in embankments within the roadway foundation.

(2) For the top 8 inches of earth embankments, use materials free from large stone, rock, and broken concrete or other materials that significantly affect scarifying, compacting, and finishing the subgrade.

(3) For those portions of embankments that the contractor proposes to bore holes for piling, or to drive piling through, use materials that do not contain stone or broken concrete retained on a 3-inch sieve and free from quantities of gravel, stone, or broken concrete passing a 3-inch sieve or other material that significantly affects boring the holes or driving the piling.

207.3 Construction

207.3.1 General

(1) Before placing embankment materials, complete any required clearing and grubbing of the site and prepare the roadway foundation as specified in 205.3.2, unless the contract specifies otherwise.

(2) Remove ice and snow from the ground surface before placing embankment on the ground. Do not place embankment on frozen subgrade.

(3) Unless the contract specifies otherwise, discontinue constructing embankments in the fall or early winter if weather conditions prevail that cause substantial freezing of the materials during placement, except if using materials from rock excavation, or of a granular nature and that contain only minor quantities of silt, clay, loam, or similar materials.

207.3.2 Placing Layers

(1) Construct an embankment starting at the lowest point of the fill, below the grade at the bottom of ravines. Construct the embankment in layers by spreading and leveling the material during placement. Spread individual layers evenly to uniform thickness throughout and approximately parallel with the finished grade for the full width of the embankment, unless directed otherwise. Place the material in layers generally no thicker than 8 inches, to secure the required compaction. On side hills too steep to operate hauling equipment, over low wet ground, in marshes, or if filling in water, provide a single layer, just thick enough to support the hauling equipment while placing subsequent layers.

207.3.3 Placing in Marsh

(1) If constructing embankments in trenches excavated across wet marshes or swamps, end dump the fill material. Begin filling at one end of the marsh and proceed across the marsh, close enough to the excavating operations to allow the equipment to remove any displaced peat or muck as it accumulates ahead of the advancing embankment toe. Place fill material in a way that, and to a height that, effectively displaces unstable material from within the area of the proposed embankment. Build temporary surcharges, as required, to the height and horizontal dimensions the plans show. Progressively move temporary surcharges ahead as the embankment advances.

(2) If excavating marsh areas in a dry condition, construct the embankment in the excavation area in layers and compact it to the extent practicable.

207.3.4 Placing Rock

(1) If the material for embankment consists of rock, broken stone, or fragmented material of a size that makes placing in 8-inch layers impracticable, then place the embankment material in layers no thicker than the approximate average size of the larger rocks. Avoid nesting and fill the voids with smaller stones and satisfactory soil or rock fines.

207.3.5 Hydraulic Fills

(1) If constructing embankments by the hydraulic method, obtain the engineer's written approval as specified in 208.3 and construct as the engineer directs.

207.3.6 Compaction

207.3.6.1 General

(1) Except as specified otherwise for backfilling wet marshes, constructing rock fills, and hydraulic fills, compact embankments using standard compaction methods unless the contract specifies special compaction.

(2) Do not compact embankment material if the moisture content causes excessive rutting by the hauling equipment, or excessive displacement or distortion under the compacting equipment. If these conditions exist, allow the materials to dry before compacting. If necessary, accelerate drying the materials by aerating or by using blade graders, harrows, discs, or other appropriate equipment to manipulate the material.

(3) If the embankment material does not contain sufficient moisture to compact properly, add water in quantities the engineer deems necessary to aid, accelerate, and secure effective compaction.

(4) Compact embankments, outside the roadway foundation, to the degree contemplated for standard compaction. The engineer may allow less compaction outside the roadway foundation if the contractor uses unstable soil.

207.3.6.2 Standard Compaction

(1) Deposit, spread, and level, as specified above, the embankment material in layers generally no thicker than 8 inches before compaction. Compact each layer of the embankment until the compaction equipment achieves no further significant consolidation. Provide the required compaction for each layer before placing any material for a succeeding layer.

(2) Route hauling and leveling equipment over the entire area of each layer of fill to compact to the extent practicable during placement. The engineer may require specialized compaction equipment to provide additional compaction if, in the engineer's opinion, adequate compaction is not achieved without it.

(3) Specialized compaction equipment includes pad foot rollers, pneumatic-tire rollers, vibratory rollers, or other alternate compaction equipment that produces the required results. Obtain the engineer's approval before using alternate compaction equipment.

207.3.6.3 Special Compaction

(1) Deposit, spread, and level the embankment material, as specified above, on the properly prepared ground surface in layers generally not exceeding 8 inches thick before compaction. If compacting granular material with equipment adaptable for this purpose, the contractor may increase layer thickness to 12 inches if obtaining the required dry density. Except as specified for construction methods in 207.3.2, 207.3.3, 207.3.4, and 207.3.5, compact each layer of spread and leveled material by suitable compaction equipment, to not less than the specified dry density before placing the succeeding layer.

(2) Compact the roadway foundation to at least the dry density specified in 207.3.6.3(3). Compact embankment areas outside the roadway foundation as specified in 207.3.6.1(4).

(3) For embankments of 6 feet or less high or for portions occurring within 200 feet of a bridge abutment, compact the full depth of the embankment to at least 95 percent of maximum dry density. For embankments over 6 feet in height, compact the material placed 6 feet below the finished subgrade to at least 90 percent of maximum dry density and backfill material placed within 6 feet of the finished subgrade to at least 95 percent of maximum dry density.

(4) The engineer will determine the maximum dry density according to AASHTO T99, Method C except, replace the fraction of material retained on the 3/4-inch sieve with No. 4 to 3/4-inch material. The engineer will determine the in-place dry density of compacted embankment material according to AASHTO T310 or by other engineer-approved methods.

(5) If the material in the in-place density sample differs in percentage of aggregate retained on a No. 4 sieve from the sample that the maximum dry density was determined from, the engineer will adjust the maximum dry density according to approved department procedure.

(6) The engineer will not apply the foregoing density requirements to portions of embankments constructed of materials that, because of numerous large stones or high percentages of material retained on the No. 4 sieve, the engineer cannot accurately test according to the above procedures for determining maximum dry density or in-place dry density.

207.3.6.4 Subgrade Compaction in Cuts

(1) Compact the finished earth subgrade in cut sections for a width equal to the width of the proposed pavement plus shoulders as specified for standard compaction in 207.3.6.2, unless the contract specifies using special compaction.

(2) On grading projects that require special compaction, compact the finished earth subgrade in cut sections to the width described in 207.3.6.4(1) and to a depth of at least 6 inches to at least 95 percent of maximum density. The engineer will determine the maximum density and attained density in the subgrade as specified for special compaction under 207.3.6.3.

207.3.7 Shrinkage and Surcharge

(1) If the engineer considers it necessary, build embankments to an elevation above required grade to allow for settlement; or place sufficient surcharge above the required elevation of earth grade over deposits of unstable material to secure displacement or settlement.

207.3.8 Slopes

(1) Build embankment slopes to the lines and section the plans show or as the engineer directs. For slopes of rock fill embankments, completely fill voids with rock fines or soils, and trim slopes to a smooth uniform appearance.

(2) Construct embankments, whose slopes are receiving topsoil or salvaged topsoil, so that after placing the topsoil the finished embankment conforms to the required section.

207.3.9 Subgrade Intermediate Consolidation and Trimming

(1) In addition to maintaining drainage during construction as specified in 205.3.3, at the end of each work day consolidate and trim the subgrade to aid drainage and to protect against erosion. Consolidate and trim those portions of the subgrade surface disturbed, operated over, or constructed during that workday. Consolidate and trim until float material is pressed firmly against the subgrade and produces a tight, smooth, well-drained surface. If rain is imminent during the workday, consolidate and trim the subgrade before the rain falls to avoid ponding and erosion.

207.3.10 Backfilling Structures

(1) Place and compact required embankments over and adjacent to culverts, bridges, retaining walls, and other structures. This includes backfilling not performed incidental to the excavation of these structures.

(2) Use materials and construction methods specified for backfill in 206.3.13.

(3) If special compaction is specified, compact backfill material placed 6 feet or more below the finished subgrade to at least 90 percent of maximum density and backfill material placed within 6 feet of the finished subgrade to at least 95 percent of maximum density. For bridge approaches, compact as specified in 207.3.6.3.

207.3.11 Finish Grading

(1) Trim, finish, and maintain earth grade as specified for finish grading under 205.3.14.

(2) The engineer may require the removal and disposal of rock, stone, and boulders excavated by plowing and scarifying.

207.4 Measurement

(1) The department will not directly measure work under this section.

207.5 Payment

(1) The department will not pay directly for work specified under this section. This work is incidental to the roadway and drainage excavation, borrow, excavation for structures, granular backfill, structure backfill sections, and other contract bid items. The work includes forming, compacting, shaping, sloping, trimming, finishing, maintaining embankments, and other incidental work required under this section.

(2) The department will not pay separately for removing and disposing of rock, stone, and boulders that the engineer rejects under 207.3.11.

Section 208 Borrow

208.1 Description

(1) This section describes constructing embankments and other portions of the work consistent with the earthwork summary the plans show for borrow. If the contract specifies moving material from one division to another, that material is not borrow.

208.2 Materials

208.2.1 Quality

(1) Under the Borrow bid item, furnish material consisting of satisfactory soil or a mixture of satisfactory soil, stone, gravel, or other acceptable materials, of a character and quality satisfactory for the purpose intended. Use material free from sod, stumps, logs, and other perishable and deleterious matter.

(2) For select borrow excavation furnish material conforming to the quality requirements specified in the contract.

208.2.2 Source

(1) Obtain suitable borrow material from one or more of the following sources:

1. Contractor-furnished sources the engineer approves.
2. State-furnished sources outside the project right-of-way limits.
3. Surplus or waste materials from divisions consistent with the earthwork summary the plans show.
4. If the engineer authorizes in writing, from one or more of the following sources:
   - 4.1 Material from within the right-of-way limits but outside excavation limits that the contract does not already designate as excavation.
   - 4.2 Surplus excavation from other contracts.
   - 4.3 Material from old road fills, removed as specified in 214.

(2) Use material with suitable engineering properties obtained from work done under other contract bid items to reduce the quantity of borrow required in that division.

(3) Unless the contract specifies otherwise, the contractor shall negotiate with property owners or others from whom the contractor proposes to obtain borrow material.

(4) The department may approve non-commercial borrow sources where the contractor proposes to create or enlarge an area of open water if the contractor submits a written request. Include with that request written evidence that the following conditions are met:

1. The owner of the property has a valid and practicable plan for creating or enlarging a body of impounded water and that plan complies with all applicable ordinances or regulations.
2. If the proposed site is within 5 miles of a public-use airport, the airport manager or airport owner and the department's bureau of aeronautics have been contacted and confirm receipt of the following:
   - Contractor and landowner names and contact information including phone numbers.
   - Scale map showing the location of the proposed site in relation to the airport.
   - Detailed reclamation plans showing the location, size, and outline of proposed new open water; slopes of the impoundment area; proposed re-vegetation plan; and other requested information.
3. WDNR and other federal and state agencies with jurisdiction have approved the plan.
4. The proposed plan is not contrary to the public interest and will not create a public nuisance or hazard.

(5) Provide the final condition of the borrow site as specified for final cleanup in 104.9.

208.3 Construction

(1) Clear and grub the area for the borrow site in the same manner specified for roadway and drainage excavation. Remove sod or other perishable or unsuitable material from the proposed borrow source area. Excavate borrow sites in a way that allows the engineer to accurately measure the material excavated and incorporated in the work.

(2) Dispose of stone, broken rock, boulders, and other materials unsuitable for use in the work as specified in 205.3.12.

(3) Dispose of stumps, trees, logs, brush, tops, and other debris resulting from clearing and grubbing work in borrow site areas as specified in 201.3.

(4) Except for commercial sites, strip off the available topsoil, or other soil favorable to plant growth, overlying the borrow site. Stockpile the topsoil in sufficient quantities to cover all surfaces of excavated areas from 4 to 6 inches deep. If the topsoil overlying the borrow site is less than 4 inches deep, replace the topsoil to the original depth. After trimming and finishing the site, spread the salvaged

material uniformly over excavated areas of the borrow site, unless the engineer authorizes otherwise in writing.

(5) Restore the excavated areas of the borrow site, adjacent disturbed areas, and associated haul roads as follows:

1. Fertilize as specified in 629 and seed as specified in 630 unless the landowner elects otherwise under 630.3.3.4.
2. Install erosion control devices conforming to the ECIP developed under 107.20.

(6) The contractor may place borrow, or select borrow, by hydraulic methods. If the contractor elects to do this, it shall obtain the engineer's written approval covering the quality and sources of the proposed material and the proposed construction methods before proceeding.

208.4 Measurement

208.4.1 General

(1) The department will measure Borrow or Select Borrow by the cubic yard acceptably completed. Except when the contract specifies otherwise, the department will not measure material obtained under other contract bid items as borrow. Borrow measurement excludes material from sources that include but are not limited to the following:

1. Marsh excavation.
2. Excavation below subgrade not designated in the contract.
3. Excavation from storm sewers or pipe culverts.

208.4.2 Measurement in Original Position

(1) If feasible, the department will measure the borrow quantity in its original position in the source location. The department will compute this volume by the method of average end areas, with no correction for curvature, or if the engineer elects, by the method of truncated prisms. The engineer and contractor may agree to an alternate calculation method.

(2) The contractor shall give the engineer sufficient notice before performing excavation operations so the engineer has time to accurately measure the borrow source. The department will not measure sod or other unsuitable material removed, or material salvaged from borrow sources and used for covering surfaces of the excavated areas within the borrow source. The engineer may require the contractor to remove topsoil or other unsuitable materials from the surface of the borrow area before taking original cross-sections of the source area and, upon completing the excavation, to smooth or trim the site, as required, to allow taking accurate final measurements of the area before replacing the topsoil. The department will not measure any material excavated before the engineer staked out and cross-sectioned the borrow source, and material excavated in excess of that required for, or not incorporated in the work.

208.4.3 Measurement in Vehicles

(1) If in the engineer's judgment measurement in the original position is impracticable, the engineer will measure all or part of the Borrow or Select Borrow bid item by the cubic yard in the vehicle. The engineer will determine the capacity of each vehicle used for hauling the material to the nearest 1/10 cubic yard and adjust for material expansion in the vehicle.

208.4.4 Measurement in Final Position

(1) If the contractor elects, or the contract requires to use hydraulic methods for placing embankments, the department will measure Borrow or Select Borrow by the cubic yard of compacted embankment acceptably completed, measured by the method of average end areas, with no correction for curvature. The department will determine the end areas from preconstruction cross-sections of the area being covered by the proposed embankment and from cross-sections of the completed work. The department will not make allowances for shrinkage, subsidence, lateral movement of the material, or for material in excess of that required for work the plans show or the engineer orders.

208.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
208.0100	Borrow	CY
208.1100	Select Borrow	CY

(2) Payment for Borrow and Select Borrow is full compensation for providing borrow material; for clearing, grubbing, excavating, sloping, shaping, trimming, loading, hauling, placing; compacting; disposing of

surplus and unsuitable material; and for salvaging, stockpiling, rehandling, and spreading salvaged material for covering the surfaces of excavated areas within borrow sites.

(3) The department will pay for material obtained from within the project right-of-way limits but outside project excavation limits, furnished under 208.2.2, at a price determined under 109.4.

(4) Payment also includes water for compaction and dust control except, if the contract contains the Water bid item, the department will pay separately for compaction and dust control water under 624.5.

(5) The department will pay for erosion control, fertilizing, and seeding of borrow sites and associated areas separately as specified for borrow sites and material disposal sites under 628.5.1.

Section 209 Granular Backfill

209.1 Description

(1) This section describes furnishing processed or selected granular materials, where the plans designate, as follows:

1. Backfilling excavations for frost heave or other unstable materials.
2. Backfilling storm sewers removals under 204.
3. Filling marsh areas associated with marsh excavation.
4. Placing material for subgrade improvement.

209.2 Materials

209.2.1 General

(1) Conform to the definitions under 301.2. Furnish virgin materials consisting of either sand-sized particles or sand-sized particles mixed with gravel, crushed gravel, or crushed stone. Do not use crushed concrete or reclaimed asphalt.

(2) Ensure that the material provided has a liquid limit less than or equal to 25 and a plasticity index less than or equal to 6. The contractor may substitute grade 1 for grade 2 material.

209.2.2 Gradation

(1) Furnish granular backfill material with a gradation conforming to the following:

- For the entire sample, conform to the following gradation limits:

	PERCENT PASSING BY WEIGHT	
SIEVE	GRADE 1	GRADE 2
6-inch	100	100
3-inch	85 - 100	85 - 100
No. 4	25 - 100	25 - 100

- For the portion of the sample passing the No. 4 sieve, conform to the following gradation limits:

	PERCENT PASSING BY WEIGHT	
SIEVE	GRADE 1	GRADE 2
No. 4	100	100
No. 40	0 - 75	___
No. 100	0 - 15	0 - 30
No. 200	0 - 8.0	0 - 15.0

209.2.3 Sampling and Testing

(1) The department will sample and test material according to the following:

Sampling[1] ..... AASHTO T2
Percent passing the 200 sieve ..... AASHTO T11
Gradation[1] ..... AASHTO T27
Liquid limit ..... AASHTO T89
Plasticity index and plastic limit ..... AASHTO T90

[1] As modified in CMM 8-60.

209.2.4 Source

(1) Except as specified for materials used from roadway excavation under 104.8, the contractor is responsible for negotiating with property owners to obtain granular material.

(2) Remove the granular material and restore the pit to a final condition as specified for final cleanup and material disposal under 104.9 and 208.3.

(3) In addition to removing the topsoil, substantially remove any overburden of soil, or earthy materials passing the No. 200 sieve before excavating the granular material.

(4) If the department measures granular material for payment in its original position, trim and shape pits after removing overburden and before removing granular material to allow taking accurate measurements. After removing the required quantity of granular material, repeat trimming and shaping of the areas to allow taking accurate measurements.

(5) Restore the site by replacing or disposing of the removed overburden and ensure that disposal sites are neatly constructed.

209.3 Construction

(1) If backfilling subgrade excavations or placing embankment, place and compact as specified for embankment construction in 207. If granular backfill is specified for other applications, place and compact as specified for those applications.

209.4 Measurement

209.4.1 General

(1) The department will measure the Backfill Granular bid items by the ton or cubic yard acceptably completed. For minor quantities, the engineer may measure by the cubic yard in the vehicle. The department may convert the measurement between weight and volume as specified in 109.1.

(2) For measurement by the cubic yard, the department will measure material in its original position when backfilling marsh excavation and in its final position for other applications.

(3) For measurement by the ton, the department will determine weight based on contractor-provided tickets submitted daily. Submit a ticket for each load showing the material, net weight, date, and project ID. For material with more than 7 percent moisture, the department will reduce the ticket weight by the weight of water exceeding 7 percent. The department will determine moisture content as a percent of dry weight.

(4) The department will only include material within the limits and in the places the plans show, the contract designates, or the engineer directs.

209.4.2 Measured in Original Position

(1) If measured in its original position, the department will calculate the quantity as specified for borrow in 208.4.2. Prepare the pit for measurement as specified in 209.2.4.

209.4.3 Measured in Final Position

(1) If measured in its final position, the department will calculate the quantity by the average end area or truncated prism method. The department will measure material in its final position and compacted condition.

(2) For areas where the contractor excavates and removes frost heave or unstable materials from the subgrade, the department will compute volume using the dimensions of the plane of the earth subgrade, the depth of the excavation, and the limits of the area that the engineer requires excavated and backfilled.

209.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
209.1100	Backfill Granular Grade 1	CY
209.1500	Backfill Granular Grade 1	TON
209.2100	Backfill Granular Grade 2	CY
209.2500	Backfill Granular Grade 2	TON

(2) Payment for the Backfill Granular bid items is full compensation for providing granular backfill; for stripping, clearing, grubbing, excavating, shaping, trimming, and cleaning up the pits; for salvaging, stockpiling, rehandling, and spreading salvaged material over excavated pit areas; and for disposing of surplus materials.

(3) Payment also includes water for compaction and dust control except, if the contract contains the Water bid item, the department will pay separately for compaction and dust control water under 624.5.

(4) If the contractor substitutes grade 1 for grade 2 material as allowed under 209.2, the department will pay at the contract unit price for grade 2 material.

(5) The department will pay for erosion control, fertilizing and seeding of pits and associated areas separately as specified for borrow sites and material disposal sites under 628.5.1.

Section 210 Structure Backfill

210.1 Description

(1) This section describes furnishing backfill materials and backfilling excavations for bridges, box culverts, retaining walls, and structural plate pipes and pipe arches.

210.2 Materials

210.2.1 General Requirements

(1) Conform to the definitions under 301.2. Furnish virgin materials consisting of either sand-sized particles or sand-sized particles mixed with gravel, crushed gravel, or crushed stone. Do not use crushed concrete or reclaimed asphalt.

(2) Ensure that the material provided has a liquid limit less than or equal to 25 and a plasticity index less than or equal to 6. The contractor may substitute type A for type B material.

210.2.2 Gradation

(1) Furnish granular backfill material with a gradation conforming to the following:

- For the entire sample, conform to the following gradation limits:

	PERCENT PASSING BY WEIGHT	
SIEVE	TYPE A	TYPE B
3-inch	100	100
No. 4	25 - 100	25 - 100

- For the portion of the sample passing the No. 4 sieve, conform to the following gradation limits:

	PERCENT PASSING BY WEIGHT	
SIEVE	TYPE A	TYPE B
No. 4	100	100
No. 40	0 - 75	___
No. 100	0 - 15	___
No. 200	0 - 8.0	0 - 15.0

210.2.3 Sampling and Testing

(1) The department will sample and test material according to the following:

Sampling[1] ..... AASHTO T2
Percent passing the 200 sieve ..... AASHTO T11
Gradation[1] ..... AASHTO T27
Liquid limit ..... AASHTO T89
Plasticity index and plastic limit ..... AASHTO T90

[1] As modified in CMM 8-60.

210.2.4 Source

(1) Except as specified for materials used from roadway excavation under 104.8, the contractor is responsible for negotiating with property owners to obtain granular material.

(2) Remove the granular material and restore the pit to a final condition as specified for final cleanup and material disposal under 104.9 and 208.3.

(3) In addition to removing the topsoil, substantially remove any overburden of soil, or earthy materials passing the No. 200 sieve before excavating the granular material.

(4) Restore the site by replacing or disposing of the removed overburden and ensure that disposal sites are neatly constructed.

210.3 Construction

(1) Place and compact as specified in 206.3.13. If structure backfill is specified for other applications, place and compact as specified for those applications.

210.4 Measurement

(1) The department will measure the Backfill Structure bid items by the ton or cubic yard acceptably completed. The department will only include material placed within the limits and in the places the plans show, the contract designates, or the engineer directs. For minor quantities, the engineer may measure by the cubic yard in the vehicle. The department may convert the measurement between weight and volume as specified in 109.1.

(2) For measurement by the cubic yard, the department will determine volume in its final position.

(3) For measurement by the ton, the department will determine weight based on contractor-provided tickets submitted daily. Submit a ticket for each load showing the material, net weight, date, and project ID. For material with more than 7 percent moisture, the department will reduce the ticket weight by the weight of water exceeding 7 percent. The department will determine moisture content as a percent of dry weight.

210.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
210.1100	Backfill Structure Type A	CY
210.1500	Backfill Structure Type A	TON
210.2100	Backfill Structure Type B	CY
210.2500	Backfill Structure Type B	TON

(2) Payment for the Backfill Structure bid items is full compensation for providing structure backfill. The department will pay for the Backfill Structure bid items as specified in 209.5 for Backfill Granular except; if the contractor substitutes type A for type B material as allowed under 210.2, the department will pay at the contract unit price for Backfill Structure Type B.

Section 211 Preparing the Foundation

211.1 Description

(1) This section describes restoring, correcting, strengthening, or otherwise preparing the pavement foundation to a condition suitable for constructing and supporting a subbase, base, or surface course. Perform the work described in this section whether or not the contract contains the applicable Prepare Foundation bid items.

(2) The department defines the pavement foundation as the finished earth subgrade, subbase, or base supporting subbase, base, or surface course.

211.2 (Vacant)

211.3 Construction

211.3.1 General

(1) Prepare and construct the foundation to uniform density throughout. Construct the foundation to the required alignment and cross-section with equipment and methods adapted for the purpose. After shaping and compacting, provide a smooth foundation, at required density, and at the proper elevation and contour, to receive the next course.

(2) If necessary to properly accomplish blading or to eliminate or prevent conditions of non-uniform stability or density, scarify the area forming the foundation to a uniform depth.

(3) Unless specified otherwise, fill holes, ruts, and other depressions in the foundation with materials similar to those existing in the foundation. Excavate and remove high places to the required lines, grade, and section.

(4) Do not place materials on frozen earth subgrades unless the engineer approves otherwise.

(5) Excavate and backfill areas of yielding or unstable materials with the material the engineer directs.

(6) The engineer may make minor adjustments in the plan finished grade line necessary to maintain the characteristics of a stabilized foundation by minimizing cutting into, or filling over the stabilized foundation, provided these adjustments do not impair the riding qualities, drainage, or appearance of the finished pavement or cause, in effect, a deviation from a grade established by appropriate municipal ordinance.

(7) Prepare the foundation to conform to the specifications for the specific subbase, base, or surface course constructed.

211.3.2 Earth Subgrade

(1) If the foundation is an earth subgrade, constructed under this contract or under a previous contract, prepare or restore the foundation by removing vegetation; excavating and removing materials of any nature encountered above the required elevations; filling depressions occurring below the required elevations; and smoothing, shaping, and compacting the subgrade to the required grade, section, and density.

(2) Scarify the subgrade to a depth necessary for the type of material encountered. Shape and compact the subgrade to the required lines, grade, cross-section, and uniform density. Remove stones over 6 inches in greatest dimension encountered during the operations.

(3) If the earth subgrade construction was substantially completed under a previous contract, do not presume that the previously completed work conforms to the requirements under this section.

211.3.3 Foundation for Non-Rigid Base

(1) Prepare the foundation by scarifying, blading, leveling, and rolling as required to bring the foundation to the required grade, cross-section, and density. Shape and compact the foundation for the full width of the roadbed, to the required lines, grade, cross-section, and density for at least 1000 feet in advance of base laying operations. Unless specified otherwise, uniformly compact the foundation to not less than the density for standard compaction of the particular material existing in the foundation. Maintain the prepared foundation ahead of the base laying operations in a smooth condition and at not less than specified density. Remove any ruts or surface irregularities produced by hauling or other equipment or other traffic. Correct soft or yielding areas, holes, or other defects that occur due to traffic, hauling, poor drainage, unstable materials, or from any other cause before placing the base. Remove snow or ice, if any, from the foundation before placing the base.

(2) Bring the foundation for open-graded base to the required grade and cross-section using a machine designed specifically for trimming foundations. The machine shall utilize automatic sensors to trim to the required grade and cross-section. If trimmed material consists of crushed aggregate, salvage and use this material in the aggregate base for shoulder construction.

211.3.4 Foundation for Concrete Pavement and Concrete Base

211.3.4.1 General

(1) Prepare the foundation for concrete pavement or concrete base by restoring, preparing, and conditioning unstabilized base courses. For areas of the foundation impracticable to prepare by machine methods, prepare these areas by hand methods satisfactory to the engineer.

(2) Ensure that the base course in all cases is in a moist but not saturated condition during concrete placement. Water the base course, if required, not less than 6 hours before placing the concrete. If the base course subsequently dries, moisten it by sprinkling water just before placing the concrete. Sprinkle the water to avoid forming pools.

(3) Trim and shape the base course for a concrete base or pavement for a width equal to the width of the intended base or pavement plus at least one foot on each side to approximately the required lines, grade, and cross-section; and then uniformly compact to the required density. Perform compaction with suitable rolling or other types of consolidating equipment. Unless specified otherwise, uniformly compact the foundation to not less than the density for standard compaction of earth subgrade, subbase, or base.

(4) Complete preparing the base course for at least 300 feet in advance of depositing concrete, unless the engineer allows otherwise.

(5) Trim and smooth ruts and irregularities in the base course surface caused by trucks or other equipment. Compact these ruts and irregularities ahead of concrete placing operations. Excavate, fill with suitable material, and compact soft and yielding spots.

211.3.4.2 Slip-Form Methods

(1) If using slip-form methods, after satisfactorily compacting the base course, trim the area supporting the slip-form paver and where pavement will be placed to the required grade and cross-section using a machine equipped with automatic sensors and designed for trimming base course. If placing overlays on existing pavements, compact and bring shoulder areas supporting the slip-form paver to grade by similar means. Test these areas for compliance with the required grades and cross-section using engineer-approved methods.

211.3.4.3 Form Methods

(1) After preparing the base course, set the forms and bring the base course to true section and elevation. Fill depressions and remove excess material. Dispose of excess material beyond the forms in a way that does not interfere with concrete placing and finishing operations. After trimming, compact loose areas and keep the base course smooth and at the specified density until concrete placement.

(2) If the engineer allows hauling or other equipment on the prepared base course, repair the foundation, as necessary, by methods and equipment the engineer approves.

211.3.5 Foundation for Asphaltic Surfacing

211.3.5.1 General

(1) Prepare aggregate base, existing asphaltic pavement or surfacing, or concrete base and pavement foundations for asphaltic surfacing sufficiently ahead of prime-coating or surfacing to allow uninterrupted placement. Remove material that may adversely affect bond before surfacing.

(2) Prepare the foundation for asphaltic shoulders by excavating and shaping existing aggregate shoulders. Use excavated material to shape remaining aggregate shoulders or to widen the roadbed.

211.3.5.2 Aggregate Base

(1) Scarify, shape, trim, and compact, where and as necessary, the surface of the aggregate base to produce the required cross-sectional contour; a profile free from abrupt changes in elevation; and a surface without pits, hollows, depressions, or projections.

(2) Perform shaping and trimming with long-wheel-base motor graders or subgrade finishers designed for the purpose.

211.3.5.3 Asphaltic Treated Surfaces and Pavements

(1) Remove areas that will cause raveling, shoving, or bleeding of the overlying pavement. If the engineer directs, remove other areas the engineer deems unsuitable. Remove protruding joint filler from cracks to at least the surface of the old pavement and remove excess joint filler and joint sealant materials from the pavement surface.

(2) Clean loose material from holes in the existing asphaltic pavement or surfacing. Fill the holes with asphaltic surface mixture and consolidate the mixture over its full depth.

211.3.5.4 Concrete Pavements and Bases

(1) Remove surplus crack and joint sealing material from the pavement surface. Remove protruding joint materials, including fillers and sealers, from joints and cracks to at least the surface of the old concrete.

(2) Completely remove unstable patches of asphaltic surface used to fill localized pits, depressions, or badly spalled, or disintegrated areas of the old pavement to the underlying concrete. Remove loose concrete or concrete with developing spalling within or adjacent to these areas.

211.3.6 Incorporating or Disposing of Surplus or Unsuitable Material

(1) Dispose of surplus or unsuitable material as specified in 205.3.12. The contractor may use aggregates with suitable engineering properties for building shoulders. The contractor may process and incorporate material resulting from removing old asphaltic pavement or surfacing in aggregate base or shoulders as allowed under 305.

211.3.7 Other Work

(1) Perform other preparatory work the plans show, the contract requires, or as the engineer directs. This preparatory work may consist of removing and replacing base or subbase material; correcting the subgrade; removing existing asphaltic surface courses, curbs, gutters, or lip curbs; widening or patching base or existing pavement; furnishing and placing additional base; and similar work or operations.

(2) If the engineer revises the profile grade, beyond the minor adjustments designated in 211.3.1, at the time of preparing the foundation for the construction of a base or surface course, perform the work as revised.

211.4 Measurement

(1) The department will only measure work under the Prepare Foundation bid items within the limits the plan designates. Work outside the limits the plan designates is incidental to the contract.

(2) The department will measure the LS Prepare Foundation bid items under this section as a single lump sum unit for each project acceptably completed.

(3) The department will measure Prepare Foundation for Asphaltic Shoulders by the station, measured along each side of the traveled way.

(4) The department will measure Prepare Foundation for Base Aggregate by the station, measured along the centerline or reference line of each roadway.

211.5 Payment

211.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
211.0100	Prepare Foundation for Asphaltic Paving (project)	LS
211.0200	Prepare Foundation for Concrete Pavement (project)	LS
211.0300	Prepare Foundation for Concrete Base (project)	LS
211.0400	Prepare Foundation for Asphaltic Shoulders	STA
211.0500	Prepare Foundation for Base Aggregate	STA

(2) Payment is full compensation for the work required under this section, within the limits the plan designates for the Prepare Foundation bid items, except as specified otherwise here in 211.5. Required work performed outside the limits the plan designates for the Prepare Foundation bid items is incidental to the contract. If the contract does not contain a specific Prepare Foundation bid item, the work required under this section is incidental to the contract.

(3) Payment also includes water for compaction and dust control except, if the contract contains the Water bid item, the department will pay separately for compaction and dust control water under 624.5.

(4) The department will pay separately for the following work under the pertinent contract bid items, or absent the pertinent items, as extra work:

- Excavating and backfilling areas of yielding or unstable materials.
- Performing engineer-ordered alterations of work previously completed.
- Patching base or furnishing asphaltic surface mixtures for repair of asphaltic treated foundations.
- Furnishing and placing required filling from beyond the roadbed limits to restore or adjust to required elevation a foundation constructed under a previous contract.

211.5.2 Other Work

(1) The department will pay separately for the preparatory work required in 211.3.7(1) under the pertinent contract bid items, or absent the pertinent items, as extra work.

(2) The department will pay for the additional work required in 211.3.7(2) at the contract unit prices, subject to provisions for increased or decreased quantities under 104.2.2.4, for the pertinent bid items, or absent the pertinent items, as extra work.

Section 213 Finishing Roadway

213.1 Description

(1) This section describes destroying noxious weeds, cleaning out drainage structures installed under the contract, cleaning out material deposited in existing structures as a result of construction operations, removing and disposing of litter and debris, and final trimming and dressing required to neatly and satisfactorily restore and complete the entire roadway for any project or portion of a project where grading and drainage or structures are a part of the contract.

(2) This section also describes destroying noxious weeds; removing and disposing of litter and debris; and the final shaping, finishing, trimming and dressing of shoulders, shoulder slopes and other portions of the roadway disturbed by contractor operations, on contracts for constructing base, or surface course, on any project or portions of a project where grading and roadway construction was or will be substantially completed under other contracts.

213.2 (Vacant)

213.3 Construction

(1) On contracts where seeding was completed under a previous contract, the contractor is responsible for damage caused by its operations to the seeded areas or the vegetative covering within the right-of-way. Replace topsoil that was lost or contaminated with other materials, and reseed or restore areas damaged by the contractor's operations.

(2) Trim, shape, and restore the shoulders to the finished cross-section using graders and other equipment, supplemented by hand work, if necessary, to produce smooth surfaces and slopes and uniform cross-sections. For graded roadbed without surfacing, trim and dress the entire roadbed in the same manner.

(3) Remove loose and waste stones not used in construction that fail to pass a 3-inch ring from the roadway and ground surface within areas of the clearing and grubbing limits.

(4) In urban or other areas that require a lawn-type turf, remove loose or waste stones that fail to pass a one-inch sieve from topsoiled areas.

(5) Do not drag, push, or scrape material across or along the finished pavement or surface course.

(6) During the life of the contract, destroy noxious weeds within the limits of the right-of-way by cutting or by other means and prevent the weed plants from maturing to the bloom or flower stage. The term "noxious weeds" as defined here consists of Canada thistle, leafy spurge, field bindweed, and other weeds that the governing body of the county or municipality where the project is located declares noxious, according to section 66.0407, Noxious Weeds, of the Wisconsin statutes.

http://docs.legis.wi.gov/statutes/statutes/66

(7) Before requesting acceptance of the work, if grading or structures are a part of the contract, clean out soil, silt, or debris, and fully restore the waterways of drainage installations and structures constructed under the contract. Remove materials deposited or lodged in the waterways of other drainage installations or structures due to contractor's operations.

(8) Trim and dress the slopes of the roadway embankments and excavations to restore them to the established or specified lines and grades. Clear ditches and channels of debris and obstructions, and trim slopes and beds to true line and grade. Remove, shape, trim, and leave in a neat condition excess earth, debris, spoil banks, or other waste material next to culverts, bridges, ditches, channels, poles, posts, trees, or other objects. Remove stones, roots, or other waste materials exposed on embankment or excavation slopes that may become loosened and dislodged. Dispose of slash and debris from clearing and grubbing operations, and leave the entire roadway in a neat condition. Fill holes and depressions that appear on the surface within the grubbing limits, caused by grubbing operations, with suitable material.

213.4 Measurement

(1) The department will measure Finishing Roadway as each individual project acceptably completed.

213.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
213.0100	Finishing Roadway (project)	EACH

(2) Payment for the Finishing Roadway bid items is full compensation for the work under this section. Payment includes restoring areas, seeded under a previous contract, damaged by the contractor's operations.

(3) The department will pay separately for additional material from excavation required and furnished incidental to the repair of washouts under pertinent contract bid items or as extra work.

(4) If the contract does not include a separate bid item for Finishing Roadway, then work under this section is incidental to the grading, subbase, base, structures, or surface course bid items.

Section 214 Obliterating Old Road

214.1 Description

(1) This section describes grading portions of the old road required to be abandoned, and includes scarifying or plowing areas of the old roadway. The work under this section applies only to those portions of the old roadway, designated for obliteration, located outside the slope limits of the grading for the new roadway.

214.2 (Vacant)

214.3 Construction

(1) Grade and trim areas of the old roadway contiguous to and lying partly within the lateral grading limits of the new construction as required, to obliterate the old roadway.

(2) Clear and grub areas outside the clearing and grubbing limits of the new project, necessary to properly obliterate the old road. Remove and dispose of or salvage miscellaneous structures from within the limits designated for obliteration. Topsoil, fertilize, and seed the area within the limits designated for obliteration.

(3) After the road is no longer needed for traffic, fill the old ditches and grade the roadway, either to approximately restore the original contour of the ground or to produce a contour that merges with the contour of the adjoining land. If possible, place waste material from the new construction in cuts on the old road. If the engineer allows, in writing, the contractor may obtain borrow or select borrow required for the new construction from fills on the old road.

(4) Break-down and bury, or remove old bridges and culverts to be removed, for which no separate provision for disposal is included in the contract, as specified for their removal under 203, except, leave no parts of the structures within 2 feet of the finished surface.

(5) Break pavements, curb, gutter, and similar rigid structures, that have no separate provision for disposal in the contract, and that occur within 2 feet of the proposed finished surface into pieces no larger than one square foot before covering. Break down and remove pavements, curb, gutter, and similar rigid structures if occurring within one foot of the proposed finished surface as specified for removing or abandoning miscellaneous structures under 204.

(6) Scarify or plow old road aggregate or asphaltic surfacing underlying the proposed finished surface by less than one foot, that have no separate contract provision for salvage or disposal, , to effectively mix the material with soil. If possible, blade the surfacing material into the old ditches and cover with suitable soil.

(7) Remove rocks, boulders, and surface stone encountered in the work and dispose of as specified for roadway and drainage excavation under 205. Place stones larger than 6 inches at least 6 inches below the proposed finished surface. If the obliterated area is suitable for cultivation keep stone to a reasonable minimum in the upper 18 inches of completed embankment and place no structure or pavement concrete or other debris within 2 feet of the finished grade.

(8) After completing rough grading, place topsoil as specified in 625 in the areas of the obliterated old road the plans designate, the contract specifies, or the engineer directs. After completing necessary topsoiling, harrow, smooth, fertilize, and seed the entire area of the obliterated old roadway as specified for fertilizer and seeding in 629 and 630, unless the engineer approves otherwise.

(9) Remove material from culverts or bridges and other material, designated for salvage, to avoid damage, and place in neat piles on the right-of-way at locations the engineer designates.

214.4 Measurement

(1) The department will measure Obliterating Old Road, by the station acceptably completed, measured to the nearest 1/10 station along the old road centerline or reference line of those portions of the old roadway, designated for obliteration, located outside the slope limits of the grading for the new roadway. The department will exclude areas of the old road from which the contractor has obtained material under the Borrow or Select Borrow bid items.

214.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
214.0100	Obliterating Old Road	STA

(2) Payment for Obliterating Old Road is full compensation for grading, scarifying, and plowing; for removing non-rigid pavement surfacing; and for the other work required under this section except as follows:

1. The department will pay separately for clearing and grubbing under the Clearing and Grubbing bid items as specified in 201.5.
2. The department will pay separately for grading and trimming areas of the old roadway contiguous to and lying partly within the lateral grading limits of the new construction under the Excavation bid items as specified in 205.5.
3. The department will pay separately for borrow or select borrow required for the construction of the new roadway, if obtained from the old road, under the Borrow or Select Borrow bid items as specified in 208.5.
4. The department will pay for asphaltic surfacing, gravel, crushed stone or other materials salvaged from the old road and used in the construction of the new road, as called for on the plans or ordered, separately.
5. If the contract contains the Removing Pavement bid item, the department will pay separately for removing concrete pavement, brick pavement, and rigid base, from within the limits designated for obliteration, under the Removing Pavement bid item as specified in 204.5.
6. If the contract includes separate bid items for removing specific miscellaneous structures from within the limits designated for obliteration, the department will pay separately for these removals under the 204 bid items specified under 204.5.
7. The department will pay separately for removing old culverts and bridges under the 203 bid items specified in 203.5.
8. The department will pay for separately for topsoiling under the Topsoil or Salvaged Topsoil bid items as specified in 625.5.
9. The department will pay separately for fertilizing under the Fertilizer bid items as specified in 629.5.
10. The department will pay separately for seeding under the Seeding bid items as specified in 630.5.

Part 3 Bases, Subbases, and Subgrade Aggregates

Section 301 Base, Subbase, and Subgrade Aggregate

301.1 Description

(1) This section describes requirements common to sections 305 through 313 and 350. Exceptions and additional requirements are specified in those sections.

301.2 Materials

301.2.1 General

(1) Provide coarse aggregates from a department-approved source as specified under 106.3.4.2.

301.2.2 Definitions

(1) Interpret these terms, used throughout part 3, as follows:

Aggregate	A composite mixture of hard, durable mineral materials that have been mechanically processed.
Breaker run	Aggregate resulting from the mechanical crushing of quarried stone or concrete not screened or processed after primary crushing.
Crushed gravel	Crushed angular particles of gravel retained on a No. 10 sieve.
Crushed stone	Crushed angular particles of quarried rock retained on a No. 10 sieve.
Fractured face	An angular, rough, or broken particle surface with sharp edges.
Gravel	Naturally occurring rounded particles of rock that will be retained on a No. 10 sieve.
Pit run	Unprocessed aggregate, with predominately 1 1/2-inch or larger sized particles, obtained from a gravel pit.
Natural material	Material that is excavated, mined, quarried, or originates from a pit or quarry; reclaimed asphalt or crushed concrete are not natural materials within part 3.
Reclaimed asphalt	Crushed or processed asphaltic pavement or surfacing
Reprocessed material	Waste material for which a commercially demonstrated process uses the material as a raw material.
Sand	Granular material having at least 90 percent passing the No. 4 sieve and predominantly retained on the No. 200 sieve.
Select crushed material	Crushed and screened aggregate with particles predominately larger than 1 1/2 inches.
Virgin materials	Mineral materials in a native or raw form, not previously-used.

301.2.3 Sampling and Testing

(1) Department and contractor testing shall conform to the following:

Sampling[1]	AASHTO T2
Percent passing the 200 sieve	AASHTO T11
Gradation[1]	AASHTO T27
Gradation of extracted aggregate	AASHTO T30
Moisture content[1]	AASHTO T255
Liquid limit	AASHTO T89
Plasticity index	AASHTO T90
Wear	AASHTO T96
Sodium sulfate soundness (R-4, 5 cycles)	AASHTO T104
Freeze/thaw soundness	AASHTO T103
Deleterious materials	AASHTO T113
Fracture	ASTM D5821 as modified in CMM 8-60
Moisture/density[1]	AASHTO T99 and AASHTO T180
In-place density[1]	AASHTO T191
Asphaltic material extraction	CMM 8-36 WisDOT Test Method 1560

[1] As modified in CMM chapter 8.

(2) Contact the engineer to collect sample aggregates proposed for the project. The engineer and contractor will jointly obtain the sample. The sampler must be HTCP certified to sample aggregates. Do not place base until the engineer tests and approves the material, except as allowed in 106.1.

301.2.4 Aggregate Requirements

301.2.4.1 General

(1) Obtain material from department-approved sources as specified under 106.3.4.2 and furnish material substantially free of deleterious materials that include: shale, chert, phyllite or other altered rock formed from clay materials, soft or porous rock fragments, clay lumps, coal, and other non-durable or organic particles.

301.2.4.2 Aggregate Classifications

(1) Provide aggregate conforming to one of the following classifications based on weight percentages.

Crushed stone or crushed gravel >= 85 percent virgin aggregates

Crushed concrete >= 90 percent crushed concrete that is substantially free of steel reinforcement and includes < 10 percent asphaltic pavement or surfacing, base, or a combination of asphaltic pavement, surfacing, and base, incorporated during the removal operation.

Reclaimed asphalt >= 75 percent asphaltic pavement or surfacing.

Reprocessed material Consists of crushed concrete, reclaimed asphalt, crushed stone, crushed gravel, or other construction materials that are thoroughly mixed and meet the following:

1. >= 80 percent is a combination of crushed concrete and reclaimed asphalt; where:
   - < 90 percent is crushed concrete, or else the material is classified as crushed concrete.
   - < 75 percent is reclaimed asphalt, or else the material is classified as reclaimed asphalt.
2. < 20 percent is crushed stone, crushed gravel, concrete block, brick, cinder, or slag particles; where:
   - < 10 percent of the final mixture is concrete block particles.
   - < 5 percent of the final mixture is brick, cinder, or slag particles.

Blended material Consists of a blend of crushed stone, crushed gravel, crushed concrete, reclaimed asphalt, or reprocessed material that are thoroughly mixed and meet the following:

1. Each individual component material, incorporated into the blend must meet the requirements of table 301-2 except for gradation. The final blend must conform to the specified gradation.
2. < 75 percent is reclaimed asphalt, or else the material is classified as reclaimed asphalt.
3. < 90 percent is crushed concrete, or else the material is classified as crushed concrete.
4. < 80 percent is a combination of crushed concrete and reclaimed asphalt, or else the material is classified as reprocessed material.
5. < 85 percent is virgin aggregate, or else the material is classified as crushed stone or crushed gravel.

301.2.4.3 Uses For Aggregate Classifications

(1) The contractor may furnish the aggregate classifications, at the contractor's option, for the specified base types as allowed in table 301-1.

TABLE 301-1 USES FOR VARIOUS AGGREGATE BASE CLASSIFICATIONS

BASE TYPE	CRUSHED STONE	CRUSHED GRAVEL	CRUSHED CONCRETE	RECLAIMED ASPHALT	REPROCESSED MATERIAL	BLENDED MATERIAL
Dense 3/4-inch	Yes	Yes	Yes	No	Yes[1]	Yes[1]
Dense 1 1/4-inch	Yes	Yes	Yes	Yes	Yes	Yes
Dense 3-inch	Yes	Yes	Yes	No	Yes[2]	Yes[2]
Open-graded	Yes	Yes	No	No	No	No

[1] The contractor may provide reprocessed material or blended material as 3/4-inch base only if the material contains 50 percent or less reclaimed asphalt, by weight.

[2] Ensure that material is substantially free of reclaimed asphalt.

301.2.4.4 By-Product Materials

(1) The contractor may provide an aggregate with one of the following by-product materials mixed with crushed gravel, crushed concrete, or crushed stone up to the listed maximum percentage, by weight.

Glass 12%
Foundry slag 7%
Steel mill slag 75%
Bottom ash 8%
Pottery cull 7%

(2) Furnish by-product materials substantially free of deleterious material.

(3) Crush, screen, and combine materials to create a uniform mixture conforming to the predominant material specifications.

(4) If the aggregate contains a by-product material, the department will test the final product for gradation, wear, soundness, liquid limit, plasticity, and fracture as required for the predominant material.

(5) Do not use aggregate containing a by-product material in the top 3 inches of a temporary or permanent aggregate wearing surface.

301.2.4.5 Aggregate Base Physical Properties

(1) Furnish aggregates conforming to the following:

TABLE 301-2 AGGREGATE BASE PHYSICAL PROPERTIES

PROPERTY	CRUSHED STONE	CRUSHED GRAVEL	CRUSHED CONCRETE	RECLAIMED ASPHALT	REPROCESSED MATERIAL	BLENDED MATERIAL
Gradation AASHTO T27						
dense	305.2.2.1	305.2.2.1	305.2.2.1	305.2.2.2	305.2.2.1	305.2.2.1[1]
open-graded	310.2	310.2	not allowed	not allowed	not allowed	not allowed
Wear AASHTO T96 loss by weight	<=50%	<=50%	note[2]	___	note[2]	note[3]
Sodium sulfate soundness AASHTO T104 loss by weight						
dense	<=18%	<=18%	___	___	___	note[3]
open-graded	<=12%	<=12%	not allowed	not allowed	not allowed	not allowed
Freeze/thaw soundness AASHTO T103 loss by weight						
dense	<=18%	<=18%	___	___	___	note[3]
open-graded	<=18%	<=18%	not allowed	not allowed	not allowed	not allowed
Liquid limit AASHTO T89	<=25	<=25	<=25	___	___	note[3]
Plasticity AASHTO T90	<=6[4]	<=6[4]	<=6[4]	___	___	note[3]
Fracture ASTM D5821[6] min one face by count						
dense	58%	58%	58%	___	note[5]	note[3]
open-graded	90%	90%	not allowed	not allowed	not allowed	not allowed

[1] The final aggregate blend must conform to the specified gradation.

[2] No requirement for material taken from within the project limits. Maximum of 50 percent loss, by weight, for material supplied from a source outside the project limits.

[3] Required as specified for the individual component materials defined in columns 2 - 6 of the table before blending.

[4] For base placed between old and new pavements, use crushed stone, crushed gravel, or crushed concrete with a plasticity index of 3 or less.

[5] >=75 percent by count of non-asphalt coated particles.

[6] as modified in CMM 8-60.

301.3 Construction

301.3.1 Equipment

(1) Use specialized pneumatic or vibratory compaction equipment or a combination of both types of machines. Do not use tamping rollers. Use pneumatic compaction equipment conforming to 207.3.6.2. The engineer may allow the contractor to compact the shoulder foreslopes with other equipment.

301.3.2 Preparing the Foundation

(1) Prepare the subgrade, or resurface the previously placed base layer, as specified in 211.3.3 before placing base. Do not place base on foundations that are soft, spongy, or covered by ice or snow. Do not place base on frozen foundations unless the engineer approves otherwise. Water and rework or re-compact dry foundations as necessary to ensure proper compaction, or as the engineer directs.

(2) Before placing material, identify areas of yielding subgrade and perform corrective work as specified in 205.3.13.

301.3.3 Stockpiling

(1) If continuous compliance with material specifications is questionable, the engineer may require the contractor to supply material from a stockpile of previously tested material. Maintain a sufficiently large stockpile to preclude the use of material not previously approved.

(2) Build and maintain stockpiles using methods that minimize segregation and prevent contamination. If the contract specifies location, place stockpiles where specified. Clear and prepare stockpile areas to facilitate the recovery of the maximum quantity of stockpiled material.

301.3.4 Constructing Base

301.3.4.1 General

(1) Place aggregate in a way that minimizes hauling on the subgrade. Do not use vehicles or operations that damage the subgrade or in-place base. Deposit material in a way that minimizes segregation.

(2) Construct the base to the width and section the plans show. Shape, and compact the base surface to within 0.04 feet of the plan elevation.

(3) Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

(4) Maintain the base until paving over it, or until the engineer accepts the work, if paving is not part of the contract. The contractor is not responsible for maintaining material placed on detours, unless the special provisions specify otherwise.

301.3.4.2 Standard Compaction

(1) Compact the base until there is no appreciable displacement, either laterally or longitudinally, under the compaction equipment. Route hauling equipment uniformly over previously placed base. Compact each layer before placing a subsequent layer. If the material is too dry to readily attain the required compaction, add water as necessary to achieve compaction.

301.3.4.3 Special Compaction

(1) If the contract requires special compaction, compact each layer to 95 percent of maximum density, or more, before placing the subsequent layer. The engineer will determine the maximum density according to AASHTO T99 method C or D and in-place density according to AASHTO T191.

301.3.5 Excavation Below Subgrade

(1) The engineer may request EBS in areas of placed base or subbase. Restore the surface in EBS areas to the plan grade and cross-section or as the engineer directs.

301.3.6 Controlling Dust

(1) Apply water or other engineer-approved dust control materials to control dust during construction and maintenance of the base and shoulders.

301.4 Measurement

(1) For measurement by the ton, the department will determine weight based on contractor-provided tickets submitted daily. Submit a ticket for each load showing the material, net weight, date, and project ID. For material with more than 7 percent moisture, the department will reduce the ticket weight by the weight of water exceeding 7 percent. The department will determine moisture content as a percent of dry weight.

(2) For measurement by the cubic yard, the department will determine the volume in the vehicle.

(3) The department may convert the measurement between weight and volume as specified in 109.1.

301.5 Payment

(1) Contractor testing for department-approved aggregate sources is incidental to the work.

(2) The department will only pay for engineer-approved EBS to correct problems beyond the contractor's control. Work performed under 105.3 to correct unacceptable work is the contractor's responsibility. For EBS performed after placing subbase or base in the EBS area, and where the engineer approved that area for subsequent operations under 205.3.13, the department will pay for EBS as follows:

1. For excavation, the department will pay 3 times the contract unit price for the Excavation Common bid item under the EBS Post Placing Subbase or EBS Post Placing Base administrative item.
2. For backfill and restoration with the materials the engineer directs, the department will pay 3 times the contract unit price for the bid items of each material used to fill the excavation and restore the subbase or base under the Restoration Post Completion (item) administrative item.
3. For excavation, backfill, or restoration work without contract bid items, as extra work.

(3) Payment also includes water for compaction and dust control except, if the contract contains the Water bid item, the department will pay separately for compaction and dust control water under 624.5.

Section 305 Dense-Graded Base

305.1 Description

(1) This section describes constructing a dense-graded base using one or more of the following aggregates at the contractor's option:

Crushed stone	Reclaimed asphalt
Crushed gravel	Reprocessed material
Crushed concrete	Blended material

305.2 Materials

305.2.1 General

(1) Provide aggregate conforming to 301.2 for crushed stone, crushed gravel, crushed concrete, reclaimed asphalt, reprocessed material, or blended material. Provide QMP for dense-graded base as specified in 730.

(2) Where the contract specifies or allows 1 1/4-inch base, do not place reclaimed asphalt, reprocessed material, or blended materials below virgin aggregate materials unless the contract specifies or the engineer allows in writing.

305.2.2 Gradations

305.2.2.1 General

(1) Except for reclaimed asphalt, conform to the following gradation requirements:

	PERCENT PASSING BY WEIGHT		
SIEVE	3-INCH	1 1/4-INCH	3/4-INCH
3-inch	90 - 100	___	___
1 1/2-inch	60 - 85	___	___
1 1/4-inch	___	95 - 100	___
1-inch	___	___	100
3/4-inch	40 - 65	70 - 93	95 - 100
3/8-inch	___	42 - 80	50 - 90
No. 4	15 - 40	25 - 63	35 - 70
No. 10	10 - 30	16 - 48	15 - 55
No. 40	5 - 20	8 - 28	10 - 35
No. 200	2.0 - 12.0	2.0 - 12.0[1][3]	5.0 - 15.0[2]

[1] Limited to a maximum of 8.0 percent for base placed between old and new pavement.

[2] 8.0 - 15.0 percent if base is >= 50 percent crushed gravel.

[3] 4.0 - 10.0 percent if base is >= 50 percent crushed gravel.

(2) Unless the plans or special provisions specify otherwise, do the following:

1. Use 1 1/4-inch in base course layers. Always use 1 1/4-inch in the top 4 inches of base. The contractor may substitute 3-inch for 1 1/4-inch in lower base zones including material underlying the shoulder.
2. Use 3/4-inch in shoulders. Always use 3/4-inch to match the thickness of the paved shoulder in the unpaved portion of the shoulder and on exposed shoulder foreslopes. The contractor may substitute 1 1/4-inch for 3/4-inch elsewhere in shoulders and shoulder foreslopes. If using 1 1/4-inch, limit the allowable reclaimed asphalt content to 50 percent or less.

305.2.2.2 Reclaimed Asphalt

(1) The contractor may use reclaimed asphalt with 100 percent passing a 1 1/4-inch sieve as 1 1/4-inch base. The engineer will assess gradation primarily by visual inspection but may test questionable material.

305.3 Construction

305.3.1 General

(1) Construct dense-graded base conforming to 301.3.

305.3.2 Compaction

305.3.2.1 General

(1) Compact each base layer, including shoulder foreslopes, with equipment specified in 301.3.1. Use standard compaction conforming to 301.3.4.2. Final shaping of shoulder foreslopes does not require compaction.

305.3.2.2 Compacting 1 1/4-Inch Base and 3/4-Inch Base

(1) If using a pneumatic roller, do not exceed a compacted thickness of 6 inches per layer. For the first layer placed over a loose sandy subgrade, the contractor may, with the engineer's approval, increase the compacted layer thickness to 8 inches.

(2) If using a vibratory roller, do not exceed a compacted thickness of 8 inches per layer.

305.3.2.3 Compacting 3-Inch Base

(1) Compact with a vibratory or pneumatic roller. Do not exceed a compacted thickness of 9 inches per layer.

305.3.3 Constructing Aggregate Shoulders

305.3.3.1 General

(1) Construct aggregate shoulders to the elevations and typical sections the plans show, except for minor modifications needed to conform to other work.

(2) Use equipment that does not damage or mar the pavement surface, curbs, or appurtenances.

(3) Place aggregate directly on the shoulder area between the pavement edge and the outer shoulder limits. Recover uncontaminated material deposited outside the limits and place within the limits.

(4) Do not deposit aggregate on the pavement during placement, unless the engineer specifically allows. Do not leave aggregate on the pavement overnight. After placing the shoulder aggregate, keep the pavement surface free of lose aggregate.

(5) Spread and compact the aggregate in compacted layers of 6 inches or less. Use standard compaction conforming to 301.3.4.2.

(6) After final compaction, shape the shoulders to remove longitudinal ridges to ensure proper drainage.

305.3.3.2 Shoulders Adjacent to Concrete Pavement or Base

(1) Construct shoulders along concrete pavement or concrete base so the completed shoulder is at the approximate grade and cross-section before opening the pavement to public traffic.

305.3.3.3 Shoulders Adjacent to Asphaltic Pavement or Surfacing

(1) If the roadway is closed to through traffic during construction, construct the aggregate shoulders before opening the road.

(2) If the roadway remains open to through traffic during construction and a 2-inch or more drop-off occurs within 3 feet or less from the edge of the traveled way, eliminate the drop-off within 48 hours after completing that days paving. Unless the special provisions specify otherwise, provide aggregate shoulder material compacted to a temporary 3:1 or flatter cross slope from the surface of the pavement edge.

(3) Provide and maintain signing and other traffic protection and control devices, as specified in 643, until completing shoulder construction to the required cross-section and flush with the asphaltic pavement or surfacing.

305.3.4 Shaping Shoulders

(1) Under the Shaping Shoulders bid item, blade, shape, and compact the existing shoulder aggregate, before the end of the day's work, to ensure proper drainage while salvaging existing pavement and constructing new pavement. Do not contaminate the shoulder aggregate with deleterious material. Incorporate material obtained from shaping shoulders in the new shoulder, in widening the roadbed, or as the plans show.

305.3.5 Constructing Detours

(1) Under the Aggregate Detours bid item, provide aggregate on the designated detour at the locations the plans show or the engineer directs. Use 3/4-inch base unless the plans or special provisions specify otherwise.

305.4 Measurement

(1) The department will measure the Base Aggregate Dense and Aggregate Detours bid items under this section by the ton or cubic yard acceptably completed. The department will determine weight or volume, adjust for moisture, and convert between weight and volume as specified in 301.4. The department may deduct for contaminated aggregate or unrecovered aggregate deposited outside the outer shoulder limits.

(2) The department will measure Shaping Shoulders by the station acceptably completed, measured along the centerline for each shoulder separately.

305.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
305.0110	Base Aggregate Dense 3/4-Inch	TON
305.0115	Base Aggregate Dense 3/4-Inch	CY
305.0120	Base Aggregate Dense 1 1/4-Inch	TON
305.0125	Base Aggregate Dense 1 1/4-Inch	CY
305.0130	Base Aggregate Dense 3-Inch	TON
305.0135	Base Aggregate Dense 3-Inch	CY
305.0410	Aggregate Detours	TON
305.0415	Aggregate Detours	CY
305.0500	Shaping Shoulders	STA

(2) Payment for the Base Aggregate Dense and the Aggregate Detours bid items is full compensation for preparing the foundation; and for placing, shaping, compacting, and maintaining the base.

(3) Payment for Shaping Shoulders is full compensation for blading, shaping, compacting, and maintaining the existing aggregate shoulders.

(4) If the contractor substitutes 3-inch in base course or 1 1/4-inch in shoulders as allowed under 305.2.2.1, the department will pay for the substitute material as follows:

- At the Base Aggregate Dense 1 1/4-Inch unit price if substituting 3-inch in base course.
- At the Base Aggregate Dense 3/4-Inch unit price if substituting 1 1/4-inch in shoulders.

Section 310 Open-Graded Base

310.1 Description

(1) This section describes constructing open-graded base course using crushed stone, crushed gravel, or both.

310.2 Materials

(1) Furnish crushed stone or crushed gravel conforming to 301.2, except for gradation. Provide QMP for open-graded base as specified in 730. For gradation conform to the following:

SIEVE	PERCENT PASSING (by weight)
1-inch	90 - 100
3/8-inch	45 - 65
No. 4	15 - 45
No. 10	0 - 20
No. 40	0 - 10
No. 200	0 - 5.0

(2) The contractor may substitute material conforming to the gradation requirements specified for size No. 1 coarse aggregate in 501.2.5.4.4 if that material conforms to the fracture requirements for open-graded crushed gravel specified in 301.2.4.5.

(3) Do not place reclaimed asphalt, reprocessed material, or blended materials below open-graded base unless the contract specifies or the engineer allows in writing.

310.3 Construction

(1) Construct open-graded base conforming to 301.3. Use standard compaction conforming to 301.3.4.2.

(2) Compact in layers using the equipment specified in 301.3.1. If using a pneumatic roller, do not exceed a compacted thickness of 6 inches per layer. If using a vibratory roller, do not exceed a compacted thickness of 8 inches per layer.

(3) Load and carry forward, or otherwise remove, excess material produced during trimming operations to prevent contamination of the dense-graded material in the shoulder area.

310.4 Measurement

(1) The department will measure Base Aggregate Open-Graded by the ton or cubic yard acceptably completed. The department may deduct for contaminated aggregate or unrecovered aggregate deposited outside the outer shoulder limits.

310.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
310.0110	Base Aggregate Open-Graded	TON
310.0115	Base Aggregate Open-Graded	CY

(2) Payment for Base Aggregate Open-Graded is full compensation for preparing the foundation; and for stockpiling, placing, shaping, compacting, and maintaining the base.

Section 311 Breaker Run

311.1 Description

(1) This section describes providing breaker run used primarily for subgrade correction and improvement.

311.2 Materials

(1) Furnish stone or concrete processed through a primary crusher set to produce material predominantly 6 inches or less in at least one dimension, and which is not further screened or crushed. Obtain material from a department-approved source substantially free of unconsolidated overburden materials, topsoil, organic materials, steel, and other deleterious materials.

(2) A department-approved source is a quarry with acceptable department test results for wear and soundness on record. The engineer may also approve other sources as follows:

1. Mined or quarried waste rock that, in the engineer's opinion, is hard, durable, and when processed through a primary crusher, will produce a material similar in size and texture to that produced from a quarry face.
2. Concrete that the engineer judges substantially free of steel, building materials or other deleterious material; and when processed through a primary crusher, produces a material similar in size and texture to that produced from a quarry face.

(3) The department will assess breaker run acceptability based primarily on the engineer's visual inspection. The engineer may reject material produced from deteriorated concrete or from non-durable rock such as sandstone, shale, slate, disintegrated granite, or heavily weathered rock.

(4) The contractor may substitute select crushed material conforming to 312.2 for breaker run.

311.3 Construction

(1) Place breaker run where the plans show or as the engineer directs. Ensure that there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

(2) Spread and compact breaker run in compacted layers of 16-inches or less. The engineer may allow thicker layers to address soft foundation conditions. Compact breaker run using standard compaction conforming to 301.3.4.2.

311.4 Measurement

(1) The department will measure the Breaker Run bid items by the ton or cubic yard acceptably completed.

311.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
311.0110	Breaker Run	TON
311.0115	Breaker Run	CY

(2) Payment for Breaker Run is full compensation for providing breaker run. If the contractor substitutes select crushed material for breaker run as allowed under 311.2, the department will pay for that material at the Breaker Run unit price.

Section 312 Select Crushed Material

312.1 Description

(1) This section describes providing select crushed material used primarily for subgrade correction and improvement.

312.2 Materials

(1) Furnish crushed stone or crushed concrete from a department-approved source substantially free of unconsolidated overburden materials, topsoil, organic materials, steel, and other deleterious materials.

(2) A department-approved source is a source with acceptable department test results for wear and soundness on record. The engineer may also approve other sources as follows:

1. Mined or quarried waste rock that, in the engineer's opinion, is hard, durable, and when processed through a primary crusher, will produce a material similar in size and texture to that produced from a quarry face.
2. Crushed concrete that the engineer judges substantially free of steel, building materials or other deleterious material; and when processed through a primary crusher produces a material similar in size and texture to that produced from a quarry face.

(3) The engineer may reject material produced from deteriorated concrete or from non-durable rock such as sandstone, shale, slate, disintegrated granite, or heavily weathered rock.

(4) Conform to the following gradation:

SIEVE	PERCENT PASSING (by weight)
5-inch	90 - 100
1 1/2-inch	20 - 50
No. 10	0 - 10

(5) Furnish material that has a minimum of 50 percent, by count, of the number of particles retained on the 1 1/2-inch sieve with at least 2 fractured faces.

(6) The department will assess select crushed material acceptability based primarily on the engineer's visual inspection. The department may also test for gradation or fracture.

312.3 Construction

(1) Place select crushed material where the plans show or as the engineer directs. Ensure that there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

(2) Spread and compact select crushed material in compacted layers of 16-inches or less. The engineer may allow thicker layers to address soft foundation conditions. Compact select crushed material using standard compaction conforming to 301.3.4.2.

312.4 Measurement

(1) The department will measure the Select Crushed Material bid items by the ton or cubic yard acceptably completed.

312.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
312.0110	Select Crushed Material	TON
312.0115	Select Crushed Material	CY

(2) Payment for Select Crushed Material is full compensation for providing select crushed material.

Section 313 Pit Run

313.1 Description

(1) This section describes providing pit run material used primarily for subgrade correction and improvement.

313.2 Materials

(1) Furnish a homogenous mixture of naturally occurring material that has at least 50 percent by weight retained on the 1 1/2 sieve, with the remaining material composed of sand with a nominal quantity of silt/clay. The maximum size of an individual piece cannot be more that 2/3 of the specified individual layer thickness. Obtain material from a department-approved source substantially free of topsoil, organic materials, and other deleterious materials.

(2) A department-approved source is a pit with acceptable department test results for wear and soundness on record. The engineer may also approve other sources conforming to the following criteria:

1. The deposit is of suitable texture and composition to produce crushed and graded aggregates that, in the engineer's judgement, conform to 313.2(1).
2. The material in the deposit, in the engineer's judgement, is sound, hard, and durable.

(3) The department will assess pit run acceptability based primarily on the engineer's visual inspection. The engineer may reject material produced from any pit with excessive non-durable rock such as sandstone, shale, slate, disintegrated granite, or heavily weathered rock.

(4) The contractor may substitute 3-inch dense-graded base conforming to 305.2, breaker run conforming to 311.2, or select crushed material conforming to 312.2 for pit run material.

313.3 Construction

(1) Place pit run where the plans show or as the engineer directs. Ensure that there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

(2) Spread and compact pit run in compacted layers of 16-inches or less. The engineer may allow thicker layers to address soft foundation conditions. Compact pit run using standard compaction conforming to 301.3.4.2.

313.4 Measurement

(1) The department will measure the Pit Run bid items by the ton or cubic yard acceptably completed.

313.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
313.0110	Pit Run	TON
313.0115	Pit Run	CY

(2) Payment for Pit Run is full compensation for providing pit run material. If the contractor substitutes 3-inch base, breaker run, or select crushed material for pit run as allowed under 313.2, the department will pay for that material at the Pit Run unit price.

Section 315 Asphaltic Base

315.1 Description

(1) This section describes constructing a plant mixed asphaltic base for overlaying with new pavement.

315.2 Materials

(1) Furnish one-inch nominal size aggregate graded as specified in 460.2.2.3 and conform to the other material and mixture requirements specified for asphaltic surface in 465.

315.3 Construction

315.3.1 General

(1) Conform to the general requirements for asphaltic pavements specified in 450, except as modified here in 315.3. Place the mixture in 4-inch or thinner compacted layers unless the engineer directs otherwise.

315.3.2 Asphaltic Base Widening

(1) Excavate and widen the existing shoulder to accommodate the base widening. After placing the asphaltic base, reconstruct the shoulder and slope to the grade and cross-section the plans show. Unless the engineer directs otherwise, reconstruct using the previously excavated material. Dispose of unused material as specified in 205.3.12.

(2) Prepare the foundation for the asphaltic base mixture as specified in 211. If the width of the base widening precludes using trench rollers and other conventional equipment, prepare and compact the foundation using engineer-approved hand methods.

(3) Place the mixture to the thickness of the existing abutting pavement, including the existing asphaltic surfacing, unless the contract specifies otherwise. Construct in successive layers until the top surface is flush with the adjacent pavement surface. Before allowing the asphaltic mixture to cool; place, spread, strike off, and compact the material.

(4) The engineer may allow other spreading and compacting methods and equipment if the width of the base widening precludes using the equipment specified in 450.

315.4 Measurement

(1) The department will measure Asphaltic Base and Asphaltic Base Widening by the ton acceptably completed as specified for asphaltic pavement in 450.4.

(2) The department will not measure asphaltic materials, required for and incorporated in the mixture, separately.

315.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
315.0100	Asphaltic Base	TON
315.0200	Asphaltic Base Widening	TON

(2) Payment is full compensation for preparing the foundation; for providing an asphaltic base mixture design, when required; for providing and placing the mixture, including reclaimed asphalt; and for compacting the mixture.

(3) Payment for Asphaltic Base Widening also includes excavating, reconstructing earth shoulders, and disposing of surplus or unsuitable excavated material.

Section 320 Concrete Base

320.1 Description

(1) This section describes constructing a concrete base for overlaying with new pavement.

320.2 Materials

(1) Furnish materials as specified for concrete pavement under 415 except use grade B, B-FA, B-S, B-IS, B-IP, or B-IT concrete as specified in 501. Provide QMP for class II ancillary concrete as specified in 716.

320.3 Construction

320.3.1 General

(1) Construct as specified for concrete pavement under 415 except as modified here in 320.3.

320.3.1.1 Consolidating, Finishing, and Curing

(1) Consolidate and finish as specified for concrete pavement under 415.3, except the engineer will not require tining under 415.3.8.3, or surface testing and correction under 415.3.10.

(2) Cure concrete base as specified for concrete pavement in 415.3.12. Use wax-based curing compound conforming to 501.2.9.

320.3.1.2 Opening Concrete to Traffic

(1) Conform to the procedures and opening criteria specified for grade A concrete used in concrete pavement under 415.3.15. If the contractor prevents loading within 6 inches of a free edge or an edge abutting aggregate:

1. The engineer will allow the contractor to open to traffic when the concrete reaches 2000 psi.
2. In the absence of compressive strength information, the engineer may allow the contractor to open to traffic after 3 equivalent curing days expire.

320.3.1.3 Thickness Tolerance

(1) The engineer will not require the contractor to conform to the tolerance in pavement thickness provisions specified for concrete pavement under 415.3.16.

320.3.2 Concrete Base

320.3.2.1 General

(1) Construct as a single layer on a prepared foundation to the thickness the plans show. Prepare the foundation as specified in 211.

320.3.2.2 Joints

(1) Provide transverse joints as the plans show or the engineer directs.

(2) Locate longitudinal joints as the plans show. If the plans do not show the joint locations, provide longitudinal joints on the centerline for 2-lane concrete base or at the edges of the traffic lanes parallel to the centerline of the roadway for multilane concrete base.

(3) Construct longitudinal joints as the plans show. If the plans do not show construction details, install 1/2-inch diameter or larger tie bars, 24 inches long or longer, at 3 foot spacing.

(4) Saw, form, or tool contraction joints as specified for transverse joints in concrete pavement under 415.3.7.

320.4 Measurement

(1) The department will measure the bid items under this section by the square yard acceptably completed. The department will measure fillets for widened sections or fillets at drain basins and similar locations if placed monolithic with the concrete base. The department will not deduct for fixtures located within the limits of the concrete base.

320.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
320.0100 - 0199	Concrete Base (inch)	SY
320.0300 - 0399	Concrete Base HES (inch)	SY

(2) Payment for bid items under this section is full compensation for providing curing, and protecting concrete; and for providing tie bars and dowel bars in unhardened concrete. For tie bars and dowel bars provided in concrete not placed under the contract, the department will pay separately under the Drilled Tie Bars and Drilled Dowel Bars bid items as specified in 416.5.

(3) Payment for the Concrete Base and Concrete Base HES bid items also includes preparing the foundation except, if the contract contains the Prepare Foundation for Concrete Base bid item, the department will pay separately for preparing the foundation under 211.5.

Section 325 Pulverized and Re-laid Pavement

325.1 Description

(1) This section describes full depth in-place pulverizing of the existing asphaltic pavement along with a portion of the underlying base and relaying the pulverized material to construct a new base.

325.2 (Vacant)

325.3 Construction

(1) Pulverize the full depth of the existing asphaltic pavement until 97 percent or more will pass the 2-inch sieve. Also pulverize the existing base to the depth the plans show and mix with the pulverized asphaltic pavement. Windrow material as construction operations dictate.

(2) Immediately after pulverizing, relay the material with a paver, grader, or both a paver and grader.

(3) If sufficient material is available at a given location, match the lines, grades, and cross slopes the plans show. If there is insufficient material at a given location, shape the available material to create a smooth profile and cross slope for a good ride. Eliminate localized bumps, depressions, and ruts. Unless the engineer specifically directs, the contractor is not required to haul material from one location on the project to another.

(4) Immediately after relaying, compact the re-laid material first with either a rubber tired roller or vibratory padfoot roller and second with a vibratory steel roller. Add water, as required, both before and during compaction. Compact each layer to the extent required for standard compaction under 301.3. Use compaction equipment as follows:

1. For a compacted lift of 6 inches or less, use equipment as specified in 301.3.1.
2. For a compacted lift from 6 to 8 inches, use a 12.5-ton or heavier vibratory padfoot roller and an 8-ton or heavier vibratory steel roller.
3. For a compacted lift greater than 8 inches, split into lifts less than 8 inches and use the equipment specified for those lift thicknesses.

(5) Perform each day's pulverize and relay operations to avoid leaving abrupt longitudinal differences between adjacent lanes. Repair surface damage caused by intervening construction or public traffic immediately before paving as necessary to provide a good riding pavement.

325.4 Measurement

(1) The department will measure Pulverize and Relay by the square yard acceptably completed, measured using the centerline length and the width from outside to outside of completed base, but limited to the width the plans show or the engineer directs.

325.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
325.0100	Pulverize and Relay	SY

(2) Payment is full compensation for pulverizing, windrowing, relaying, adding water, shaping, and compacting. If the engineer requires hauling material from one location on the project to another, the department will pay for that hauling as extra work.

(3) Payment also includes water for compaction and dust control except, if the contract contains the Water bid item, the department will pay separately for compaction and dust control water under 624.5.

Section 330 Milled and Re-laid Pavement

330.1 Description

(1) This section describes partial depth in-place milling of the existing asphaltic pavement and relaying the milled material to construct a new base.

330.2 (Vacant)

330.3 Construction

(1) Mill the existing asphaltic pavement to the depth the plans show and until 100 percent will pass the 1 1/2-inch sieve. Windrow material as construction operations dictate.

(2) Immediately after milling, relay the material with a paver, grader, or both a paver and grader.

(3) Match the lines, grades, and cross slopes the plans show. Eliminate localized bumps, depressions, and ruts. Unless the engineer specifically directs, the contractor is not required to haul material from one location on the project to another.

(4) Immediately after relaying, compact the re-laid material first with either a rubber tired roller or vibratory padfoot roller and second with a vibratory steel roller. Add water, as required, both before and during compaction. Compact each layer to the extent required for standard compaction under 301.3. Use compaction equipment as follows:

1. For a compacted lift of 6 inches or less, use equipment as specified in 301.3.1.
2. For a compacted lift from 6 to 8 inches, use a 12.5-ton or heavier vibratory padfoot roller and an 8 ton or heavier vibratory steel roller.
3. For a compacted lift greater than 8 inches, split into lifts less than 8 inches and use the equipment specified for those lift thicknesses.

(5) Perform each day's mill and relay operations to avoid leaving abrupt longitudinal differences between adjacent lanes. Repair surface damage, caused by intervening construction or public traffic, immediately before paving as necessary to provide a good riding pavement.

330.4 Measurement

(1) The department will measure Mill and Relay by the square yard acceptably completed, measured using the centerline length and the width from outside to outside of completed base, but limited to the width the plans show or the engineer directs.

330.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
330.0100	Mill and Relay	SY

(2) Payment is full compensation for milling, windrowing, relaying, furnishing and adding water, shaping, compacting, and removing and disposing of excess material. If the engineer requires hauling material from one location on the project to another, the department will pay for that hauling as extra work.

(3) Payment also includes water for compaction and dust control except, if the contract contains the Water bid item, the department will pay separately for compaction and dust control water under 624.5.

Section 335 Rubblized Pavement

335.1 Description

(1) This section describes rubblizing and compacting existing concrete pavement to create a stable construction platform for a pavement overlay either with or without an intermediate base layer.

335.2 Materials

(1) Furnish filler aggregate conforming to 305.2. Use either 1 1/4-inch or 3/4-inch base material.

335.3 Construction

335.3.1 General

(1) Use self-contained, self-propelled breakers. Use 10-ton or heavier rollers and roll at 6 feet per second or slower. Run vibratory rollers at an engineer-approved frequency and amplitude. A roller pass is defined as down and back in the same path.

(2) Before rubblizing, saw full depth joints and completely sever load transfer devices to isolate the rubblizing area. Saw jointed pavements at an existing joint. Do not damage adjacent pavement during rubblization. Repair damage to the adjacent pavement caused by contractor operations as the engineer directs.

(3) Use water to control dust until overlaying the rubblized pavement.

335.3.2 Rubblizing

(1) Break concrete uniformly across the pavement width into particles that have a maximum dimension less than or equal to 12 inches. Also, 75 percent of the particles, as the engineer determines visually, must have a maximum dimension less than or equal to the following:

- In the bottom half of the slab; 9 inches.
- In the top half of the slab; 3 inches.
- At the surface of the slab; 2 inches.

(2) The engineer may direct or allow larger maximum particle dimensions.

(3) Determine particle size by excavating 2 test holes, of about 9 square feet each, during the first half day. Excavate at least one test hole per lane mile thereafter unless the engineer directs or allows otherwise. Backfill and restore the stability of each test hole.

(4) Do not damage pipes, valve boxes, manholes, and other fixtures. The contractor may prevent damage by doing one or more of the following:

1. Use engineer-approved, modified methods around fixtures and above pipes.
2. Remove pavement around fixtures and above pipes, backfill with aggregate, and compact.

(5) Repair damage to pipes, valve boxes, manholes, and other fixtures as the engineer directs.

(6) Remove reinforcing steel exposed at the surface by cutting below the surface and disposing of the steel as specified in 203.3.4. Do not remove unexposed reinforcing steel.

335.3.3 Compacting

(1) Compact the rubblized area using 2 passes with a vibratory steel roller. The engineer may adjust the number of passes to achieve the desired compaction and stability.

(2) Remove loose asphaltic patching material, joint fillers, expansion material, or other similar materials from the compacted surface. Also remove pavement or patches that have a maximum dimension greater than or equal to 6 inches that are either not well seated or projecting more than one inch. Dispose of removed material as specified in 203.3.4.

(3) Fill holes and localized depressions, deeper than 2 inches, with filler aggregate and compact as the engineer directs.

(4) If paving with no intermediate base layer, roll the entire surface additionally, unless the engineer directs or allows otherwise, as follows:

1. One pass with a pneumatic-tired roller.
2. One pass with a vibratory steel roller immediately before paving.

335.4 Measurement

(1) The department will measure Rubblizing by the square yard acceptably completed.

335.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT

335.0100	Rubblizing	SY

(2) Payment is full compensation for rubblizing; removing pavement adjacent to fixtures or above pipes; removing exposed steel; compacting; disposing of removed material; excavating, backfilling, and restoring the stability of test holes; and repairing damage to pipes, fixtures, and the adjacent pavement.

(3) Payment also includes water for dust control except, if the contract contains the Water bid item, the department will pay separately for dust control under 624.5.

(4) The department will pay separately for sawing under the Sawing Concrete bid item as specified in 690.5.

(5) The department will pay separately for filler aggregate under the Base Aggregate Dense bid items. This payment includes furnishing, placing, and compacting aggregate used to fill holes and depressions.

Section 340 Cracked and Seated Pavement

340.1 Description

(1) This section describes cracking and seating existing concrete pavement to create a stable construction platform for a pavement overlay.

340.2 (Vacant)

340.3 Construction

340.3.1 Equipment

(1) Use a spade or guillotine type breaker mounted on a vehicle and capable of controlled forward and transverse movement. The breaker must be capable of exerting a minimum of 12,000 foot-pounds of energy.

(2) Use 10-ton or heavier vibratory rollers operated at an engineer-approved frequency and amplitude.

340.3.2 Cracking and Seating

(1) Crack the pavement full depth while maintaining aggregate interlock between the pieces. Do not unduly displace the concrete; damage drainage facilities, utilities, or other property; or destabilize the base or subgrade.

(2) Crack concrete uniformly across the pavement width into pieces approximately 4 to 8 square feet in area and having their maximum dimension transverse to the pavement centerline. Do not crack concrete within 2 feet of transverse joints, or at other locations designated by the contract or engineer.

(3) Roll the cracked surface to firmly seat the cracked pieces and produce an even surface. Clean the surface of the cracked and seated pavement before opening to traffic and again just before placing the asphaltic leveling course. Remove dust, dirt, debris, or other foreign or loose material.

340.4 Measurement

(1) The department will measure Cracking and Seating by the square yard acceptably completed.

340.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
340.0100	Cracking and Seating	SY

(2) Payment is full compensation for cracking, rolling, and cleaning the concrete pavement.

Section 350 Subbase

350.1 Description

(1) This section describes constructing a granular subbase on the prepared subgrade.

350.2 Materials

(1) Conform to 209.2 for granular backfill, except ensure that the maximum dimension of a particle does not exceed 3/4 of the compacted thickness of any individual layer being placed.

(2) Procure material as specified in 209.2.4 from one or both of the following sources:

- Within the right-of-way as the plans show or as allowed in 104.8.
- Beyond the right-of-way as specified for borrow in 208.3.

350.3 Construction

350.3.1 General

(1) Do not place loam, clay, silt, or similar soil materials on the subbase surface or incorporate into the subbase. With the engineer's approval, the contractor may use cement, fly ash, lime, or similar engineer-approved materials to stabilize the subbase.

(2) If the contract specifies both a subbase and a flexible base, and constructing the subbase in multiple layers, construct successive layers in the sequence and at the times the engineer directs. The engineer will phase that construction to provide a usable surface for traffic.

350.3.2 Preparing Subgrade

(1) Prepare and maintain the subgrade as specified for preparing the foundation for non-rigid base under 211. Excavate and backfill areas of soft, yielding, or spongy subgrade or otherwise treat unstable areas as the engineer directs.

350.3.3 Constructing Subbase

(1) Place granular subbase on the prepared subgrade in a way that minimizes contamination with the subgrade material. Do not place subbase material on a frozen subgrade, subgrade covered by ice or snow, or on a wet or soft subgrade unless the engineer specifically directs.

(2) Compact the material as specified in 207.3.6 except conform to 301.3.1 for compaction equipment. Follow the standard compaction methods specified in 207.3.6.2 unless the contract requires the special compaction methods specified in 207.3.6.3.

(3) Place, shape, and compact the subbase to the lines, grades, and section the contract specifies. Maintain the finished subbase until it is covered, or until the engineer accepts the work if the contract does not require covering the subbase.

350.4 Measurement

350.4.1 General

(1) The department will measure the Subbase bid items by the cubic yard, the ton, or the square yard acceptably completed.

350.4.2 By Volume

(1) For material measured by the cubic yard, the department will compute the volume of material in its original source position using one of the following methods:

- Average end areas, with no correction for curvature.
- Truncated prisms.

(2) The department will measure the original volume after the contractor strips or otherwise prepares the deposit. Notify the engineer before removing subbase material. The department will not measure material removed before the engineer measures the original volume.

(3) For small quantities, the department may elect to determine the volume in the vehicle. The engineer will determine the capacity of each vehicle used to the nearest 1/10 cubic yard.

350.4.3 By Weight

(1) For measurement by the ton, the department will determine weight based on contractor-provided tickets submitted daily. Submit a ticket for each load showing the material, net weight, date, and project ID. For material with more than 7 percent moisture, the department will reduce the ticket weight by the weight of water exceeding 7 percent. The department will determine moisture content as a percent of dry weight.

350.4.4 By Area

(1) For material measured by the square yard, the department will only measure areas placed to the thickness the contract specifies or the engineer directs. For subbase with sloping sides, the department will compute area based on the mean width of the top and bottom of the layer. The department will measure additions ordered to correct for settlement of the earth subgrade based on the in place volume converted to an equivalent area.

350.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
350.0102	Subbase	CY
350.0104	Subbase	TON
350.0110 - 0199	Subbase (inch)	SY

(2) Payment for the Subbase bid items is full compensation for preparing the subgrade; for excavating, loading, and hauling material from within the right-of-way or furnishing material as required from beyond the right-of-way; and for providing and maintaining the subbase.

(3) The department will pay separately for the items specified for borrow pits under 628.5.1. Other costs associated with the procurement of material from beyond the right-of-way are incidental to the Subbase bid items.

Section 390 Base Patching

390.1 Description

(1) This section describes patching areas of existing concrete pavement with either concrete or asphaltic mixtures for overlaying with new pavement.

390.2 Materials

(1) The contractor may use either concrete or asphaltic mixture.

(2) Furnish concrete conforming to the requirements specified for air-entrained high early strength concrete, grade B, B-FA, B-S, B-IS, B-IP, or B-IT, under 501, except that under the Base Patching Concrete SHES bid item, furnish concrete as specified for SHES concrete repair and replacement in 416.2. Provide QMP for class II ancillary concrete as specified in 716.

(3) Furnish asphaltic mixture as specified for asphaltic base under 315.2.

(4) Furnish dowel bars and tie bars as the plans show and conforming to 505.2.6.

390.3 Construction

390.3.1 General

(1) Unless the contract provides otherwise, keep the road open to traffic during construction. If possible, restrict operations to one lane at a time. Perform work to cause the least possible inconvenience to traffic.

(2) Remove areas of existing concrete pavement, including existing patching or surfacing materials, at locations the plans show or the engineer directs in the field. Saw the connecting edges as true and perpendicular as possible as specified for sawing pavement in 690. Remove the pavement without injury to the remaining pavement. Dispose of removed material as specified in 204.3.1.3.

(3) Prepare the foundation as specified in 211 using engineer-approved hand methods. Place the patch to the thickness of the contiguous pavement, including the existing asphaltic pavement or surfacing.

390.3.2 Concrete Patching

(1) Deposit concrete to require as little rehandling as possible, place and consolidate by hand, and strike off and finish flush with adjoining surfaces. The engineer will not require forms unless necessary to provide the required edge, grade, or alignment.

(2) Cure exposed patches as specified for concrete pavement in 415.3.12. Use wax-based curing compound conforming to 501.2.9. Protect as specified for concrete pavement in 415.3.14. Open to traffic as specified for concrete base in 320.3.

390.3.3 Asphaltic Patching

(1) Construct as specified for asphaltic base under 315 except as modified here in 390.3.3.

(2) Dump material outside the patch area, fill the patch in successive layers with shovels, and shape to the required grade and contour with rakes and lutes. Do not rake dumped material into the patch. The engineer will not require forms unless necessary to provide the required edge, grade, or alignment.

(3) Compact each layer with engineer-approved compaction equipment. Unless the engineer directs otherwise, compact each layer to a thickness of 6 inches or less. Roll the top layer until flush with the adjacent surface.

(4) Do not open patches to traffic until they are hard enough to prevent rutting or displacement.

390.3.4 Special High Early Strength Concrete Patching

(1) Construct as specified for special high early strength repairs under 416.3.8 except as follows:

- The contractor may delay removal for up to 14 calendar days after cutting the existing pavement.
- Open to traffic as specified for concrete base in 320.3.

(2) Cure exposed patches as specified for concrete pavement in 415.3.12. Use wax-based curing compound conforming to 501.2.9. Do not apply excess curing compound that could cause slippery pavement under traffic.

390.4 Measurement

(1) The department will measure Base Patching Asphaltic by the ton or square yard acceptably completed.

(2) The department will measure Base Patching, Base Patching Concrete, and Base Patching Concrete SHES by the square yard acceptably completed.

390.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
390.0103	Base Patching	SY
390.0201	Base Patching Asphaltic	TON
390.0203	Base Patching Asphaltic	SY
390.0303	Base Patching Concrete	SY
390.0403	Base Patching Concrete SHES	SY

(2) Payment for bid items under this section is full compensation for removing old pavement and disposing of removed materials; for preparing the foundation; for providing, curing, and protecting concrete; and for providing and compacting asphaltic mixture, including the asphaltic material. Payment includes providing tie bars and dowel bars in unhardened concrete and steel within the patch. For tie bars and dowel bars provided in concrete not placed under the contract, the department will pay separately under the Drilled Tie Bars and Drilled Dowel Bars bid items as specified in 416.5.

(3) Base Patching includes providing either concrete or asphalt at the contractor's option. Base Patching Asphaltic includes providing asphaltic material. Base Patching Concrete and Base Patching Concrete SHES include providing concrete.

(4) Payment for Base Patching Concrete SHES is also full compensation for making and testing concrete cylinders and providing test data to the engineer.

(5) The department will pay for sawing the existing concrete pavement for removal under the Sawing Concrete bid item as specified in 690.5.

(6) If the engineer orders the contractor to excavate yielding or unstable subgrade materials and backfill with suitable materials, the department will pay for that work either under pertinent contract bid items, or as extra work.

Part 4 Pavements

Section 405 Coloring and Stamping Concrete

405.1 Description

(1) This section describes coloring and stamping concrete used to construct work under other contract bid items as well as any special materials and special construction techniques associated with using colored concrete. Additional requirements for stamping concrete are in the contract special provisions.

405.2 Materials

405.2.1 Coloring Concrete

405.2.1.1 Concrete

(1) Integrally color concrete using non-fading pigments conforming to ASTM C979.

- For WisDOT red: use synthetic iron oxides at a loading of 6 percent or more by weight of total cementitious material in the mix. Match the concrete color in reasonably close conformance with WisDOT red color, which is similar to Federal Standard 595 - FS 31136.

(2) Add integral concrete colorant according to manufacturer's instructions. Provide a copy of those manufacturer instructions to the engineer before producing material for incorporation into the work.

(3) The department will accept the color based on comparison to WisDOT color samples available for viewing at the department's regional offices.

(4) Maintain mix characteristics for colored concrete requiring a matching finish. Use the same source, brand, type, and color of cement, supplementary cementitious materials, aggregates, and admixtures for colored concrete throughout the project. Use constant cement content, supplementary cementitious material content, and water/cementitious materials ratio to maintain consistent color.

(5) Under the Coloring Concrete Custom bid item conform to additional project-specific requirements modifying 405.2.1 specified in an associated Coloring Concrete Custom contract special provision.

405.2.1.2 Curing Compound

(1) Furnish a liquid membrane-forming clear curing compound conforming to ASTM C1315, type 1.

405.2.1.3 Admixtures

(1) Furnish admixtures designed for use with and compatible with colored concrete pigments. Do not use calcium chloride or other admixtures containing chlorides.

405.2.1.4 Colored Concrete Mix Approval

405.2.1.4.1 General

(1) Obtain the engineer's approval for colored concrete mixes before placing colored concrete. The engineer will base approval either on a successful performance history or on trial batches. The engineer will evaluate color no earlier than 5 days after pouring and sealing the test concrete. Upon the engineer's approval, the submitted sample panel or the test slab will be the visual quality standard for finished work under the contract.

405.2.1.4.2 Performance History

(1) Use the same materials mixed in the same proportions as used on another department project where the engineer approved the color the current contract Coloring Concrete bid item designates. Ensure that all materials, including admixtures, are of the same type and brand and from the same sources. Provide the following to the engineer for review and approval:

1. Project Info: Project ID, and location.
2. Mix proportions: quantities per cubic yard expressed as SSD weights and net water, water to cementitious material ratio, air content, and 28-day or earlier compressive strength.
3. Materials: type, brand, and source.
4. Sample panel: a finished colored concrete sample from the previous project having minimum dimensions of 2-foot by 2-foot by 1.5-inch.

405.2.1.4.3 Trial Batches

(1) The contractor may use preliminary laboratory or field trial batching to establish the mix proportions necessary to conform to the contract-required color.

(2) Produce test slabs to demonstrate the texture, surface finish, color, and color intensity. At least 2 business days in advance, provide the engineer with the date and time for test slab construction.

(3) At an engineer-allowed location on the project, place, finish, and cure a 10-foot by 10-foot by 6-inch colored concrete test slab using the same methods proposed for contract work. Produce test slabs using the same workers designated to perform the contract work. Retain samples of cements, sands, aggregates, and color additives used in test slabs for comparison with materials used in contract work.

Use at least a 2-cubic-yard batch or a batch of the size proposed for production whichever is larger. Dispose of surplus or unsuitable material as specified under 205.3.12.

(4) Submit final mix design information to the engineer. Including specific sources and, if applicable, trade names for materials.

405.2.2 Stamping Colored Concrete

(1) Under the Stamping Colored Concrete bid item, furnish full-depth colored concrete conforming to 405.2.1. An associated Stamping Colored Concrete contract special provision will contain additional project-specific requirements including the following:

- Modifications to 405.2.1 for coloring requirements.
- Provisions for required stamps, stamping materials, and surface staining materials.

405.3 Construction

405.3.1 Coloring Concrete

(1) Construct work incorporating colored concrete conforming to contract specifications under the associate bid items except cure with clear curing compound and use only non-chloride admixtures as as specified in 405.2.

(2) Produce consistently colored concrete in full cubic yard increments. The engineer will not allow variations in the quantities, types, or source of materials with the exception of minor adjustments of water and air-entraining agent. Other changes require mix re-approval.

(3) Schedule placement to minimize exposure to rapid drying conditions, wind, and full sun before applying curing compound. Do not place colored concrete if rain, snow, or freezing temperatures are forecast within 24-hours.

(4) Cover or otherwise protect adjacent concrete work from discoloration and spillage while placing and curing colored concrete. Remove and replace discolored concrete as the engineer directs.

(5) Perform finishing operations consistently to avoid color variation. Do not begin finishing while bleed water is present. The engineer will order removal and replacement of colored concrete if the contractor adds water to the surface to aid in finishing. Apply strokes in the same direction during final finishing and texturing.

(6) Protect colored concrete from premature drying and excessive cold or hot temperatures by promptly applying curing compound. Do not allow plastic sheeting to come in contact with colored concrete.

(7) Protect the colored concrete from damage. Do not permit construction traffic or material storage on colored concrete. Exclude foot traffic from colored concrete for at least 24 hours after placement.

(8) Remove test slabs not permanently incorporated into the work and restore the site after the engineer determines the test slab is no longer needed.

405.3.2 Stamping Colored Concrete

(1) Under the Stamping Colored Concrete bid item, conform to 405.3.1. An associated Stamping Colored Concrete contract special provision contains additional project-specific construction requirements for stamping and surface staining operations.

405.4 Measurement

(1) The department will measure the Coloring Concrete and Stamping Colored Concrete bid items by the cubic yard acceptably incorporated into work done under other contract bid items including material incorporated into one sample panel or one test slab that achieves a color and pattern the engineer accepts as required under 405.3 and the Stamping Colored Concrete contract special provision.

405.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
405.0100 - 0199	Coloring Concrete (color)	CY
405.0200	Coloring Concrete Custom	CY
405.1000	Stamping Colored Concrete	CY

(2) Payment for the Coloring Concrete bid items under this section is full compensation for developing mix designs and providing sample panels or test slabs; for furnishing pigments; for special construction procedures required under 405.3; for removing test slabs, restoring the site, and disposing of waste material; and for other costs associated with coloring the concrete.

(3) Payment for Stamping Colored Concrete is full compensation for the costs of coloring the concrete specified above in 405.5(2); for the costs of stamping the concrete including additional material requirements under 405.2.2 and construction requirements under 405.3.2; for the cost of additional requirements specified in the Stamping Colored Concrete contract special provision; and for other costs associated with stamping the concrete.

(4) The department will pay separately for costs not included in the 405 bid items under the associated contract bid items for work that incorporates colored or colored and stamped concrete.

Section 415 Concrete Pavement

415.1 Description

(1) This section describes constructing concrete pavement as well as approach slabs, alleys, and pavement gaps.

415.2 Materials

415.2.1 Concrete

(1) Furnish grade A, A2, A3, A-FA, A-S, A-S2, A-T, A-IS, A-IP, or A-IT, air-entrained concrete conforming to 501 as modified for class I pavement concrete in 715. Provide QMP for class I pavement concrete as specified in 715.

(2) Furnish high early strength concrete under the HES bid items. The contractor may use special high early strength concrete as specified for SHES concrete repair and replacement in 416.2 for concrete pavement placed in conjunction with the SHES repair and SHES replacement items for repair areas 300 feet long or longer.

(3) Maintain a uniform consistency in consecutive batches of concrete. Use the following slumps for the technique used:

SLIP-FORMED	NOT SLIP-FORMED
2.5 inches or less	4 inches or less

415.2.2 Reinforcement

(1) Furnish steel reinforcement conforming to 505.2.4. Furnish dowel bars and tie bars as the plans show and conforming to 505.2.6.

415.2.3 Expansion Joint Filler

Revise 415.2.3(1) to include foam expansion joint materials. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Furnish expansion joint filler conforming to AASHTO M153, AASHTO M213, or ASTM D8139 in lengths equal to the pavement lane width and of the thickness and height the plans show. Where dowel bars are required, use filler with factory-punched holes at the dowel bar locations and with a diameter not greater than 1/8 inch larger than the nominal dowel bar diameter.

415.2.4 Concrete Curing Compounds

(1) Furnish poly-alpha-methylstyrene (PAM) liquid curing compound conforming to ASTM C309, type 2, class B as modified here in 415.2.4 and as modified for testing in 501.2.9.

(2) Furnish curing compound with a resin consisting of 100 percent poly-alpha-methylstyrene and with, by weight, 42 percent or more total solids. Modify ASTM C309 to ensure the following:

- Loss of water in 24 hours does not exceed 0.15 kg/m^2.
- Loss of water in 72 hours does not exceed 0.40 kg/m^2.
- Reflectance in 72 hours is greater than or equal to 65 percent.
- The volatile organic compound (VOC) content does not exceed 350 g/L.

415.2.5 Concrete Pavement Gaps

(1) Use concrete of the same mix design used for the contiguous pavement. If the engineer allows paving through the gap, use a concrete mix design that will develop 2500 psi opening strength in an engineer-approved maximum time.

415.2.6 Joint Filler

(1) Furnish a hot-poured elastic joint sealer according to ASTM D6690 type II.

415.3 Construction

415.3.1 General

(1) Use handling, weighing, batching, mixing, and hauling equipment and procedures conforming to 501. In addition proportion aggregates and cement for concrete pavement in batching plants by weight using semi-automatic or automatic batching plants.

(2) If using ready-mixed concrete, ensure production and uniform delivery of at least 80 cubic yards per hour to support two-lane slip-form operations and at least 40 cubic yards per hour for single-lane slip-form or hand placement operations.

415.3.2 Concrete Placement and Finishing Equipment

415.3.2.1 Slip-Form Paver

(1) Use an engineer-approved, self-propelled slip-form paver capable of consolidating, screeding, and float-finishing freshly placed concrete in one complete pass of the machine for the required thickness. Use machines equipped to internally vibrate the concrete for the full width and depth placed in a single pass as required to produce a dense, homogeneous pavement. Equip the slip-form paver with devices that accurately space and position required tie bars and that allows for automatic or manual tie bar insertion.

(2) Ensure that paver vibration equipment is capable of producing the frequency and amplitude the paver manufacturer recommends for the placement at hand.

415.3.2.2 Hand Vibrators

(1) Use hand-operated single spud internal vibrators capable of consolidating concrete pavement adjacent to forms, joints, or fixtures. Ensure that vibrators produce a minimum of 7000 impulses per minute.

415.3.2.3 Screeds for Formed Pavement

(1) Use air-vibrated or mechanically-vibrated truss screeds designed for and capable of striking off fixed-form concrete pavement for the size of placement at hand.

415.3.2.4 Forms

(1) Use clean, straight, un-warped steel forms with a vertical face as high or higher than the pavement thickness minus 1 1/2 inches. Ensure that forms have side and base supports capable of supporting finishing equipment and are sufficiently strong to resist concrete pressure without bulging.

(2) The contractor may use wood or plastic forms for forming fillets, widened areas in intersections, curves less than 100-foot radius, and in other engineer-approved locations.

415.3.2.5 Hand Finishing Tools

(1) Use aluminum, magnesium, or wooden hand finishing tools. Do not use steel hand finishing tools.

415.3.2.6 Concrete Saws

(1) Use saws light enough to operate on and capable of sawing new concrete with minimal raveling, chipping, spalling, or otherwise damaging the pavement. Ensure that saws have diamond blades with functioning blade guards and are equipped with guides or other devices to control cut alignment and depth.

415.3.3 Preparing the Foundation

(1) Prepare the base course as specified in 211.3.4 before placing concrete. Repair and re-compact rutted or disturbed base resulting from hauling or paving operations. The engineer may suspend paving operations if the contractor fails to repair and maintain the base course in advance of the paving operation.

(2) Identify areas of yielding subgrade. The engineer may direct or allow EBS to correct subgrade problems as specified in 301.3.5.

415.3.4 Setting Forms

(1) Set forms to the required grade and alignment. Firmly support and anchor forms in a manner that prevents movement during concrete placement. Ensure that forms are sufficiently tight to prevent loss of concrete either under or through the forms.

(2) Immediately before placing concrete recheck the foundation as well as the grade and alignment of the forms. Ensure that the forms are not twisted. Make necessary corrections to the forms and foundation before placing concrete.

415.3.5 Reinforcement

(1) Reinforce the concrete if and as the plans specify. Keep reinforcement clean, free of rust and scale, and supported to prevent distortion. Store reinforcement steel, received on the job, in engineer-approved storage and distribute only as needed for placement.

(2) Protect epoxy coated steel from cumulative exposure to sunlight for more than 2 months by covering with an opaque engineer-approved material. Clear plastic shrink wrap for dowel bar bars and dowel baskets is sufficient protection for up to 4 months exposure.

415.3.6 Placing Concrete

415.3.6.1 General

(1) Unless the engineer allows otherwise, slip-form work that is 300 feet or more in length, a minimum of 10 feet in width or greater, and a constant width. Also use slip-formed placement wherever practicable for other work unless the engineer directs or allows otherwise. In irregular areas or areas inaccessible to self-propelled slip-form paving equipment, construct the pavement using fixed forms.

(2) Use machine methods to strike-off and consolidate the concrete. The contractor may, if the engineer allows, use hand methods for areas with variable slab width, for strips or lanes of pavement uniformly less than 10 feet wide, for transition sections on curves or at other points with variable pavement crown, and for other areas where it is impracticable to use machine methods.

(3) Deposit concrete on the base course continuously in a manner that minimizes segregation. Place to a depth sufficiently above grade so, after consolidating and finishing, the required slab thickness is obtained and the surface conforms to the specified grade and slope.

(4) Use two-lane placement for rural pavement unless project staging dictates single-lane paving. Delay placement of adjoining lanes until completed lanes are sufficiently cured to preclude damage to work already placed. Do not operate paving equipment on pavement not meeting the opening to service criteria specified in 415.3.15.

(5) Shut down placement if paving train equipment breaks down, finishing and curing operations are delayed, or if the materials or work are nonconforming. Cover the concrete at the unfinished end of the placement to maintain moisture during temporary shutdowns. Provide construction joints if interruptions are long enough for the concrete to develop its initial set.

(6) Check the surface of the newly placed concrete with a long-handled 10-foot or longer straightedge. Overlap successive passes by about 1/2 the straightedge length. Cut down high areas. Fill depressions immediately with freshly mixed concrete and strike off, consolidate, and refinish the concrete. Do not add water to correct surface deficiencies except in emergency cases or with engineer authorization.

(7) Set castings and frames for manholes, catch basins, inlets, and other fixtures conforming to 611.3.3. Adjust to required alignment and grade while adjacent concrete is plastic. Hand vibrate concrete adjacent to fixtures to fill voids and openings between fixtures and support structures. Fill remaining voids beneath the base of these fixtures with an engineer-approved non-shrink grout before opening to traffic.

415.3.6.2 Slip-Formed Placement

(1) Coordinate the mixing, delivering, and spreading operations to provide uniform progress. Check and adjust string lines, sensors, and other paver guidance equipment during paving to assure uninterrupted placement to the plan alignment and grade.

(2) Advance the paving train at a slow uniform pace stopping and starting the paver as little as possible. If it is necessary to stop the forward movement of the paver, stop vibrating and tamping immediately, and restart when forward motion resumes.

(3) Ensure that concrete is uniformly consolidated throughout its width and depth, free from honey combed areas, and has a consistent void-free closed surface.

(4) Keep hand finishing efforts on the surface to a minimum to avoid over finishing. Hand-float the surface only as needed to produce a uniform surface and sharp corners. Do not use excess mortar to build up slab edges or round the slab corners.

(5) Measure edge slump according to CMM 8-70. Maintain an edge slump, exclusive of edge rounding, no greater than of 3/8 inch at free edges or 1/8 inch, where abutting other concrete. Correct excessive edge slump before concrete hardens and adjust operations to reduce edge slump to an acceptable level. Tool pavement edges to a 1/4-inch radius ensuring that edges are smooth and true to line.

415.3.6.3 Formed Placement

(1) Deposit concrete as near a possible to its final location to minimize segregation. Consolidate uniformly throughout the depth and systematically across the area of the placement to produce a dense, homogeneous pavement.

(2) Strike off with vibrating screeds unless the engineer directs or allows otherwise. Maintain a uniform quantity of concrete in front of the screed sufficient to fill voids or low areas. Do not allow excessive concrete accumulation in front of the screed, causing the concrete to surge under the screed, or produce ridges or waves in the surface. Do not make more than 2 passes of the vibratory screed on a

given area of concrete. Coordinate forward movement of the screed with vibration frequency to optimize consolidation. Do not vibrate the concrete with the screed in a stationary position.

(3) Augment vibrating screeds with internal vibration in front of the screed for placements over 5 inches deep. Insert single spud hand vibrators vertically in a grid pattern just long enough to bring mortar to the surface. Ensure that areas visibly affected by successive vibrator insertions overlap by 2 - 3 inches. Do not drag spud vibrators through the concrete or move concrete laterally by vibration.

(4) Use single spud hand vibrators to consolidate the concrete adjacent to transverse construction joints and along the full length of dowel basket assemblies. Vibrate to a depth that consolidates the concrete above and below the dowel bars. Vibrate along the forms as required to achieve a void-free formed edge. Do not allow vibrators to contact reinforcement, forms, or the grade during vibration.

(5) Float the surface as needed to produce a uniform surface. Before the concrete's initial set, tool the pavement edges and along each side of transverse isolation joints, formed joints, transverse construction joints, and fixed forms to produce a true-to-line 1/4-inch radius with a smooth, dense mortar finish.

(6) Remove forms after the pavement has cured sufficiently to avoid damaging the concrete. The contractor may remove individual forms sooner to saw transverse joints. Fill voids in the formed surface as soon as practicable after form removal using a well-mixed grout composed of one part cement and 3 parts fine aggregate.

415.3.7 Jointing

415.3.7.1 General

(1) Construct joints as and where the plans show perpendicular to the pavement surface. Use construction joints as dictated by contractor operations to join together work at locations where the plans show no joints. Join new work to existing concrete pavement using tie bars epoxied into the existing pavement as specified in 416.3.3.2 or dowel bars epoxied into the existing pavement as specified in 416.3.4. The contractor may use cast-in-place tie bars or dowel bars in construction joints of pavement placed under the contract.

(2) Maintain the alignment of dowel bars, tie bars, and other reinforcing or embedments when placing joints. Augment machine vibration with hand vibrators if necessary to ensure complete consolidation at joints.

(3) Test joints with a straightedge before the concrete sets. Correct if one side of the joint is higher than the other or if higher or lower than adjacent slabs. Remove any concrete, mortar, or laitance resulting from paving operations before it hardens. Remove concrete fins extending across isolation joints, doweled joints, and expansion joints after the concrete hardens.

(4) Saw joints in a single cut to the width and depth the plans show. Begin sawing as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and finish before conditions induce uncontrolled cracking. Provide artificial light if sawing between sunset and sunrise.

(5) The contractor may saw the transverse joints by the skip method, wherein every third joint is sawed as soon as possible. Following this skip sawing, make the cuts of the remaining intermediate joints.

(6) The contractor may temporarily hand tool joints to reduce the the potential for early cracking. Ensure that hand-tooled joints have a 1/4-inch radius and are smooth and true to line. Saw hand tooled joints to the plan depth as soon as practicable.

415.3.7.2 Longitudinal Joints

(1) If the plans do not show a specific location, construct parallel to the centerline along lane edges. On two-lane pavements, construct along the pavement centerline. On multilane pavements, construct along traffic and taper lane edges. Make joints perpendicular to the pavement surface. Do not deviate more than 1/2 inch in 10 feet from the required line.

415.3.7.3 Transverse Joints

(1) Extend transverse joints across the entire width of paving and through curb or median placed integrally with pavement. When the pavement abuts existing pavement, curb and gutter, or median, construct transverse joints in locations matching existing joints or cracks.

(2) Install dowel bars as follows:

- Within one inch of the planned transverse location and depth.
- Within 2 inches of the planned longitudinal location.
- Parallel to the pavement surface and centerline within a tolerance of 1/2 inch in 18 inches.

(3) Hold dowel bars in the correct position and alignment using an engineer-approved device during construction. Do not allow bonded longitudinal bars or reinforcement to extend across transverse expansion or contraction joints. The contractor need not cut dowel basket tie wires.

(4) If using a mechanical device to install dowel bars, conform to the following:

- Place and consolidate the pavement to full depth before inserting the dowel bars.
- Insert the dowel bars into the plastic concrete in front of the finishing beam or screed.
- Ensure that the installing device consolidates the concrete with no voids around the dowel bars.
- Do not interrupt the forward movement of the finishing beam or screed while inserting the dowel bars.
- Provide a positive method of marking the locations of the transverse joints.

(5) Remove concrete directly above expansion joint filler, if necessary, by sawing the full width of the filler to remove concrete bridging the joint.

(6) Form a construction joint at the end of each day's run or when an interruption long enough for the concrete to develop its initial set occurs by doing one of the following:

- Set a header board to support dowel bars. Use production quality concrete, hand vibrated behind the header board, and protect protruding steel from anything that might damage the bars or weaken the bond.
- Saw back the concrete full depth to expose solid concrete then drill and epoxy in dowel bars.

415.3.8 Surface Finishing

415.3.8.1 General

(1) Finish the pavement surface after straightedging, after excess moisture disappears, and while it is still possible to produce a uniform striated surface texture.

415.3.8.2 Design Speed Less Than 40 MPH

(1) Provide an artificial turf drag surface finish. Use a seamless strip of artificial turf approximately full pavement width and of sufficient length to provide approximately 2 feet of turf in contact with the pavement surface. Pull the drag with a device that allows control of the time and rate of texturing. Operate the drag in a longitudinal direction parallel with the centerline to produce a straight finish. Weight the drag as necessary to maintain contact with the pavement. Keep the drag clean and free of particles of hardened concrete.

(2) Where it is impracticable to apply a turf finish, apply a broom finish.

(3) Restore pavement texture damaged by rain by re-dragging the concrete while still plastic.

415.3.8.3 Design Speed - 40 MPH and Higher

415.3.8.3.1 General

(1) Texture and tine freshly placed pavement as soon as practicable after floating. Texture with an artificial turf drag as specified in 415.3.8.2.

(2) Longitudinally tine with a self-propelled tining machine. Where using a tining machine is impracticable, tine by hand. Produce uniformly deep grooves approximately 1/8 to 3/16 inch deep. Provide a finished surface free of tining defects. Complete before tining tears or unduly roughens the concrete.

(3) For hand work, use longitudinal tining unless the engineer directs or allows otherwise.

(4) When paving next to existing pavement and for repair work, match the existing tining direction whether using machine or hand methods. The contractor may apply transverse tining in locations where the engineer directs or allows.

415.3.8.3.2 Longitudinal Tining

(1) Use a tining machine with an automated horizontal and vertical alignment control system to ensure that tining runs straight and parallel to the longitudinal axis of the pavement. Use a rake with individual 1/8-inch wide tines spaced uniformly 3/4 inches on center. Do not tine, but instead apply an artificial turf drag finish, within 2 inches of a longitudinal sawed joint.

415.3.8.3.3 Transverse Tining

(1) Use a rake with individual 1/8-inch wide tines spaced uniformly 5/8 inches on center. For machine work, use a 10-foot rake drawn transversely across the full pavement width without overlapping passes.

415.3.9 Stamping

(1) At the beginning of each day's run and at the end of the job, stamp the contractor's name and the year of pavement construction into the pavement. Use 2-inch numbers for the year of construction.

415.3.10 Surface Testing and Correction

(1) Test the pavement surface at engineer-selected locations with a 10-foot straightedge or other engineer-specified device. The engineer may direct the contractor to mark and grind down areas showing high spots greater than 1/8 inch but not exceeding 1/2 inch in 10 feet. Grind until there are no deviations greater than 1/8 inch when retested with the straightedge. The engineer may direct the contractor to remove and replace areas with deviations greater than 1/2 inch in 10 feet.

(2) Perform grinding as specified in 415.3.11.

(3) If the engineer directs removal, remove an area at least 6 feet long and extending across the full lane width. Also remove adjacent pavement less than 6 feet from a transverse joint.

415.3.11 Pavement Grinding

(1) Perform grinding with an engineer-approved device specifically designed for pavement grinding having diamond blades uniformly spaced with at least 50 blades per linear foot. Perform additional light grinding as necessary to provide a neat rectangular area of uniform appearance. Perform the grinding parallel with the centerline. Do not use a bush hammer or other impact device.

(2) Complete required grinding or replacement before determining the pavement thickness.

415.3.12 Curing Concrete

415.3.12.1 General

(1) Maintain adequate moisture throughout the concrete mass to support hydration until the concrete develops sufficient strength to open it to service. Except as allowed under 415.3.12.3, apply curing compound as specified in 415.3.12.2. Use PAM except, use curing compound conforming to 501.2.9 on pavement that will get an overlay under the contract.

(2) If the contractor does not cure concrete as specified in this subsection, the engineer may suspend concrete placement operations.

415.3.12.2 Impervious Coating Method

(1) After finishing operations, and as soon as the free water disappears, spray the concrete surface with a uniform coating of curing compound. Seal moisture in the concrete by applying a continuous water-impermeable film on exposed concrete surfaces.

(2) Provide sufficient agitation while spraying to ensure uniform consistency and dispersion of pigment within the curing compound during application.

(3) Apply the curing compound with an engineer-approved self-propelled mechanical power sprayer whenever practicable. The contractor may use hand-operated spraying equipment for the following:

- Irregular, narrow, or variable width sections.
- Re-coating applications or after form removal.
- Special applications the engineer approves.

(4) For tined surfaces, apply the curing compound uniformly at or exceeding a minimum rate of one gallon per 150 square feet. For other surface finishes, apply the curing compound uniformly at or exceeding a minimum rate of one gallon per 200 square feet.

(5) If the curing compound coating is damaged within 72 hours after application, immediately recoat the affected area. If removing forms within 72 hours after placing the concrete, coat newly exposed surfaces within 30 minutes after form removal.

415.3.12.3 Alternate Curing Methods

(1) If the contractor requests, the engineer may approve the use of alternate materials or curing methods. If the engineer requests, supply technical specifications, test results, or performance records to support the proposed alternative method.

(2) The engineer will approve delayed application of curing compound if the contractor uses the impervious sheeting method as specified in 502.3.8.1.2 to protect freshly placed concrete from rain damage, protect adjacent property from overspray damage, or to otherwise accommodate specific job conditions. Apply PAM curing compound immediately after removing the impervious sheeting.

415.3.13 Cold Weather Concreting

415.3.13.1 General

(1) The contractor is responsible for the quality of the concrete placed in cold weather. Take precautions necessary to prevent freezing of the concrete until it has developed sufficient strength to open it to service. Remove and replace frozen or frost damaged concrete.

(2) Unless the engineer issues written permission to continue, suspend concreting operations if a descending air temperature in the shade and away from artificial heat falls below 35 F. Do not resume concreting operations until an ascending air temperature in the shade and away from artificial heat reaches 30 F. The engineer may require the contractor to measure the concrete temperature, at the point of placement, if the ambient air temperature falls below 40 F. Maintain the temperature of the concrete at or above 50 F at the point of placement.

(3) If necessary to maintain placement temperature, the contractor may heat the water, aggregates, or both. Uniformly heat, with steam or by other means, aggregates frozen or containing frost. Accurately control the temperature of the mixing water as it is heated. Do not allow the temperature of either the mixing water or the aggregates to exceed 100 F when placed together with the cement in the mixer. Control the temperature of the water and the aggregates so that the temperature of the concrete discharged from the mixer is between 50 and 80 F inclusive.

(4) Do not heat the cement, add salt or chemical admixtures to the concrete mix to prevent freezing, or place concrete on a frozen base or subgrade.

415.3.13.2 Protective Covering

(1) Arrange to have available a sufficient quantity of material to provide thermal protection for concrete that has yet to conform to the opening criteria specified in 415.3.15. The contractor may provide clear, black, or white polyethylene sheeting conforming to the requirements, except for color and reflectance, specified in 501.2.9. The engineer may allow other curing materials with suitable water resistance, strength, and insulating properties.

(2) If the national weather service forecast for the construction area predicts temperatures of less than 17 F within the next 24 hours, arrange to have available a sufficient quantity of straw or hay to protect concrete that has yet to conform to the opening criteria specified in 415.3.15. If the engineer approves, the contractor may use other materials placed to the thickness necessary to provide the same insulating protection as the required thickness of loose, dry straw or hay.

(3) At any time of the year, if the national weather service forecast for the construction area predicts freezing temperatures within the next 24 hours, or when freezing temperatures actually occur, provide the minimum level of thermal protection specified below for concrete that has yet to conform to the opening criteria specified in 415.3.15.

PREDICTED OR ACTUAL AIR TEMPERATURE	MINIMUM EQUIVALENT LEVEL OF PROTECTION
22 to <28 F	single layer of polyethylene
17 to <22 F	double layer of polyethylene
<17 F	6" of loose, dry straw or hay between 2 layers of polyethylene

(4) Place protective material as soon as the concrete is finished and sets sufficiently to prevent excessive surface marring. Maintain the protective material in place until the concrete conforms to the opening criteria specified in 415.3.15. If necessary to remove the coverings to saw joints or perform other required work, and if the engineer approves, the contractor may remove the covering for the minimum time required to complete that work.

415.3.14 Protecting Concrete

(1) Erect and maintain suitable barricades and, if necessary, provide personnel to keep traffic off the newly constructed pavement until it is opened for service as specified in 415.3.15. Conform to 104.6 for methods of handling and facilitating traffic.

(2) Protect the pavement against both public traffic and construction activities. Repair or replace, as the engineer directs, pavement damaged by traffic or otherwise damaged before acceptance.

(3) Arrange to have available materials for protecting the unhardened concrete against rain damage. If rain is imminent, cover unhardened concrete immediately with plastic or other engineer-approved material secured along pavement edges. Provide drainage as required to protect the work.

415.3.15 Opening to Service

415.3.15.1 General

(1) Maintain moisture, temperature, and physical protection for concrete until it develops sufficient strength to open it to service. The engineer will use the same criteria to allow opening of non-pavement concrete to service as are used to allow opening of pavement to traffic.

(2) The engineer will allow the contractor to open pavement to construction and public traffic when the concrete attains a verified compressive strength of 3000 psi. Absent compressive strength information, the engineer may allow the contractor to open pavement after the following minimum times, as adjusted for changes in the ambient air temperature on the project:

APPLICATION	EQUIVALENT CURING DAYS
High early strength concrete	3
General purpose concrete (grades A, A2, and A3)	4
General purpose concrete (grades A-FA, A-IP, and A-IT)	5
General purpose concrete (grades A-S, A-S2, A-IS, and A-T)	7

(3) The equivalent curing day is based on a daily average ambient temperature of 60 F. The daily average ambient temperature is the average of the high and low engineer-recorded temperatures on the project site for each day. If this daily average ambient temperature falls below 60 F, accumulate equivalent curing days at a reduced rate. For a daily average ambient temperature of:

1. 60 F or more; accumulate one equivalent curing day per calendar day.
2. 40 to less than 60 F ; accumulate 0.6 equivalent curing day per calendar day.
3. Less than 40 F; accumulate 0.3 equivalent curing day per calendar day.

(4) The contractor may operate concrete saws and lightweight profilers on concrete that does not conform to these opening criteria. If the engineer approves, the contractor may operate other necessary light equipment on concrete that does not conform to these opening criteria. The engineer may suspend or delay operations that injure the surface or otherwise damage the concrete. Clean the surface before allowing traffic of any kind on the pavement.

415.3.15.2 Opening Strength

415.3.15.2.1 General

(1) Determine opening strength and provide the engineer with the information required to verify that strength by one or a combination of the following methods:

1. Compressive strength testing of cylinders.
2. Maturity method.
3. Compressive strength testing of cores.

(2) The resulting opening strength, after engineer verification, will apply to concrete on the same project conforming to the following criteria:

- Of the same mix design as the test location.
- Cured under similar or more desirable conditions.
- Placed on or before the test location.

(3) If direct compressive strength test results and maturity data are not available, the engineer may estimate compressive strength based on test results of concrete of the same mix design placed contiguously under similar conditions on the same project.

415.3.15.2.2 Compressive Strength Testing of Cylinders

(1) Submit the compressive strength test results to the engineer for verification. Compute the opening strength as the average of compressive strength test results for 2 cylinders. If the strength of a cylinder is less than 90 percent of the required strength, the engineer will reject the resulting average. Field cure cylinders under conditions similar to those prevailing for the pavement they represent. Fabricate cylinders according to AASHTO T23 and test the cylinders according to AASHTO T22.

415.3.15.2.3 Compressive Strength Testing of Cores

(1) Submit core test results to the engineer for verification. Determine opening strength from the compressive strength of cores obtained and tested according to AASHTO T24.

415.3.15.2.4 Maturity Method

(1) Conform to the concrete maturity method requirements of 502.3.10.1.3.3.

415.3.16 Tolerance in Pavement Thickness

415.3.16.1 General

(1) Construct the plan thickness or thicker. The department will accept pavement thickness based on the results of department-performed magnetic pulse induction acceptance testing. The department may accept thickness of special units using alternate methods.

415.3.16.2 Pavement Units

(1) Divide the pavement into basic units 250 feet long, measured along the pavement centerline. Treat fractional units less than 250 feet but greater than or equal to 100 feet long as whole basic units. Include a fractional unit less than 100 feet long as a part of a contiguous basic unit.

(2) The basic unit is one lane wide, measured from the pavement edge to the adjacent longitudinal joint; from one longitudinal joint to the next; or between pavement edges if there is no longitudinal joint.

(3) Establish special units for areas of fillets, intersections, gaps, and other areas not included in basic units. Also establish special units for shoulders, ramps, and other long areas of constant cross-section less than 10 feet wide. Limit the size of special units to a maximum of 350 square yards.

415.3.16.3 Locating Test Plates

(1) Locate department-furnished test plates at two random locations, within each pavement unit according to CMM 8-70.4.7.2. Do not place plates within 4 feet of a transverse or longitudinal joint containing steel. Plates may not be required for special units where the engineer employs alternate methods.

(2) Anchor test plates to the grade with a 16D common nail or other engineer-approved fastener. Designate each plate location with a sequential number and determine the center of each plate to within 2 feet. Paint the location of the plate center along with the sequential number for each plate location on the hardened concrete.

(3) Within 5 business days after paving, enter the sequential number and associated position data into the department's materials reporting system (MRS) software available at:

http://www.atwoodsystems.com/

415.3.16.4 Acceptance Testing

(1) The department will measure thickness according to CMM 8-70.4.7.3 at one random location in each unit. If the initial measurement falls within the 80 to 50 percent pay range specified in 415.5.2, the department will measure at the second plate in that unit and average the results to determine the pay adjustment. Pavement thinner than the plan thickness by more than 1 inch is unacceptable.

(2) The engineer will direct the contractor to core the hardened concrete to determine the extent of unacceptable areas. Take cores at points approximately 20 feet in each direction of an unacceptable test result on a line parallel to the centerline or longitudinal axis of the unit. Continue coring in each direction until locating a core that is not unacceptable. The engineer will determine the limits of unacceptable areas, at each end, by drawing lines across the unit of pavement midway between the locations of the last 2 cores.

(3) Perform coring according to AASHTO T24. The engineer will evaluate the results according to AASHTO T148. Fill core holes with concrete or mortar.

415.3.17 Concrete Crack Repair

(1) The engineer will inspect concrete pavement and ancillary concrete for transverse cracking, twice, as follows:

1. After attaining opening strength as specified in 415.3.15 but before opening to construction or public service.
2. Before opening to public service or before partial acceptance as defined in 105.11.1, whichever comes first.

(2) The engineer will determine if a transverse crack needs repair and the type of repair needed. Repair the cracked concrete as the engineer directs.

415.3.18 Pavement Gaps

(1) Construct gaps using either doweled or tied construction joints. Locate construction joints and joints within the gap ensuring that the resulting slab lengths are greater than or equal to 6 and less than or equal to 15 feet long. Alternatively, if the engineer approves, the contractor may pave continuously through the gap using concrete conforming to 415.2.5.

415.3.19 Approach Slabs

(1) Unless the engineer directs otherwise, the contractor may construct the approach slab before, at the time of, or after constructing the roadway pavement.

(2) The contractor may use built-up forms instead of full depth metal side forms. Place reinforcing steel as the plans show. Employ engineer-approved methods to support bar steel and dowel bars in their plan position during concrete placing and finishing.

415.3.20 Filling Joints

(1) Fill contraction and expansion joints in concrete pavement not requiring tining under 415.3.8 and in the adjacent curb and gutter with filler conforming to 415.2.6. Fill both transverse and longitudinal joints as soon as practicable, but only after the engineer inspects them.

Revise 415.3.20(2) to require sawing construction joints before filling. This change was implemented in ASP 6 effective with the December 2017 letting.

(2) Clean joints of laitance, curing compound, and other contaminants before filling. Saw construction joints at least 3/4 inches deep before filling. Sawing is not required for tooled joints in curb and gutter.

Sandblast or waterblast exposed joint faces using multiple passes as required to clean joints surfaces of material that might prevent bonding. Blow clean and dry with oil-free compressed air immediately before filling.

(3) Heat filler to the manufacturer's recommended pouring temperature in an engineer-approved double boiler with the space between the inner and outer shells filled with oil or other engineer-approved heat transfer medium. Ensure that the heating kettle is equipped with a mechanical agitator, positive temperature control, and an engineer-approved thermometer. Do not operate the heating kettle on concrete without insulation or a heat shield to protect the concrete surface. If applying only a small amount of filler, the engineer may allow alternate heating equipment.

(4) Do not heat above the maximum safe temperature the filler manufacturer recommends. Discard over-heated material.

(5) Maintain a uniform filler temperature within the manufacturer's recommended working range throughout the filling operation. Cease filling if the temperature in the applicator falls more than I0 F below the manufacturer's recommended pouring temperature.

(6) Completely fill joints without overflowing so that the finished filler is approximately flush with the adjoining surfaces after shrinking. If one pass gives unsatisfactory filling, use 2 passes making sure that at least half of the required filler is poured on the first pass. Make the second pass as soon as practicable after the first pour attains maximum shrinkage but not later than an hour after the first pour.

415.4 Measurement

(1) The department will measure the Concrete Pavement and Concrete Alley bid items by the square yard acceptably completed, measured using the centerline length and the width from outside to outside of completed pavement, but limited to the width the plans show or the engineer directs. The department will include fillets for widened sections, or at drain basins and similar locations, placed monolithic with the pavement. The department will not deduct for fixtures with an area of one square yard or less as measured in the plane of the pavement surface.

(2) The department will measure the Concrete Pavement Approach Slab bid items by the square yard acceptably completed, based on the pay limits the plans show.

(3) The department will measure Concrete Pavement Gaps as each individual gap acceptably completed including eliminated gaps the engineer allows the contractor to pave through, measured separately for each roadway. The department will measure multiple gaps at one roadway location as required to conform to contract staging provisions, but not solely to accommodate the contractor's means and methods.

(4) The department will measure Concrete Pavement Joint Filling by the square yard acceptably completed, measured as the concrete pavement area plus the length times nominal width of adjacent curb and gutter.

415.5 Payment

415.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
415.0060 - 0199	Concrete Pavement (inch)	SY
415.0210	Concrete Pavement Gaps	EACH
415.0310	Concrete Alley	SY
415.0410	Concrete Pavement Approach Slab	SY
415.1080 - 1199	Concrete Pavement HES (inch)	SY
415.1310	Concrete Alley HES	SY
415.1410	Concrete Pavement Approach Slab HES	SY
415.4100	Concrete Pavement Joint Filling	SY

(2) Payment for the Concrete Pavement bid items is full compensation for providing pavement; for preparing the foundation, unless provided otherwise; for placing thickness plates; and for thickness coring and filling core holes as required under 415.3.16.4. Payment also includes providing tie bars and dowel bars within concrete placed under the contract. The department will pay separately for tie bars and dowel bars used to connect the work to concrete not placed under the contract under the Drilled Tie Bars and Drilled Dowel Bars bid items as specified in 416.5. The department will not pay for removal and replacement of pavement not meeting the surface smoothness tolerances specified in 415.3.11.

(3) Payment for Concrete Pavement Gaps is full compensation for providing pavement gaps. If the engineer allows paving through a gap, the department will pay the full contract price for each gap eliminated. Payment for furnishing and placing concrete material is included under Concrete Pavement.

(4) Payment for the Concrete Pavement Approach Slab bid items is full compensation for providing the approach slab; and for bar steel reinforcement, dowel and tie bars, and jointing materials.

(5) The department will pay for engineer-approved EBS to correct subgrade problems beyond the contractor's control as specified in 301.5. Add 415.5.1(6) specify payment for protective covering.

Revise 415.5.1(6) to specify that sawing required before joint filling is incidental. This change was implemented in ASP 6 effective with the December 2017 letting.

(6) Payment for Concrete Pavement Joint Filling is full compensation for filling concrete pavement joints; for filling adjacent curb and gutter joints; and for sawing.

415.5.2 Adjusting Pay for Thickness

(1) The department will adjust pay for pavement thickness under the Nonconforming Thickness Concrete Pavement administrative item as follows:

FOR PAVEMENT THINNER THAN PLAN THICKNESS BY:	PERCENT OF THE CONTRACT UNIT PRICE[1]
> 1/4 inch but <= 1/2 inch	80
> 1/2 inch but <= 3/4 inch	60
> 3/4 inch but <= 1 inch	50

[1] The department adjusts pay based on the average of 2 measurements per unit as specified in 415.3.16.4(1).

(2) If the department determines areas of pavement have unacceptable final thickness, as specified in 415.3.16.4, the engineer will direct the contractor to either:

1. Remove and replace with concrete pavement of conforming thickness. The department will pay for the replaced area at the full contract price.
2. Leave the concrete in place. The department will not pay for the unacceptable area.

415.5.3 Adjusting Pay for Pavement Crack Repairs

(1) The engineer will allocate responsibility and costs for crack repairs, mobilization for traffic control, and traffic control devices, according to CMM 4-24. The department will adjust pay under the Crack Repair Concrete Pavement administrative item.

(2) Pay adjustment for crack repair costs, based on the total repair area in a single panel, includes mobilization for the repair work; sawing; removing pavement; furnishing and placing materials including dowel bars; drilling in tie and dowel bars; and all incidentals. The department will adjust pay for contiguous repair areas in adjacent panels separately. The engineer will compute the pay adjustment for repair costs as follows:

Total Reimbursement = (unit price x repair area + $1700)

Shared Reimbursement = 1/2 of the total reimbursement amount

(3) The department will adjust pay for traffic control devices and mobilization for traffic control separately.

Section 416 Concrete Pavement - Appurtenant Construction

416.1 Description

(1) This section describes constructing concrete driveways; truck aprons; drilling in tie bars to tie existing to new concrete and drilling in dowel bars to transfer load between existing and new concrete; concrete surface drains; concrete rumble strips; and concrete pavement repair and replacement.

416.2 Materials

416.2.1 General

(1) Furnish air-entrained concrete conforming to 501 as modified for class II concrete in 716. Provide QMP for class II ancillary concrete as specified in 716.

(2) Furnish high early strength concrete under the HES bid items. The contractor may use HES concrete even where the contract does not require it.

(3) Furnish calcium chloride for concrete placed under SHES bid items as follows:

1. For use in solid form or on the job preparation of admixture solutions, conform to AASHTO M144, type S, grade 1 or grade 2.
2. For admixture delivered in premixed solution form, conform to AASHTO M144, type L, in a concentration of approximately 30 percent.

416.2.2 Concrete Driveways, Truck Aprons, and Surface Drains

(1) Use grade A, A2, A3, A-FA, A-S, A-S2, A-T, A-IS, A-IP, or A-IT concrete as specified in 501.

416.2.3 Tie bars and Dowel bars

416.2.3.1 General

(1) Furnish tie bars and dowel bars conforming to 505.2.6.

416.2.3.2 Epoxy for Anchoring Dowel Bars and Tie Bars

(1) Furnish epoxy consisting of a 2-component epoxy material of contrasting colors and conforming to AASHTO M235, grade 3 - non-sagging consistency, type IV epoxy, except as modified below:

1. Use class B material for mid-depth slab temperatures between 40 and 60 F.
2. Use class C material for mid-depth slab temperatures between 60 F and the highest temperature allowed by the manufacturer of the product.

(2) Bond strength, tensile strength, and elongation testing is not required.

(3) Achieve a minimum compressive yield strength of 5000 psi at 8 hours for special high early strength concrete, or at 3 days for grades A, C, and E concrete. Test according to AASHTO M235 and ASTM D695, with the following restrictions:

1. Mold and cure compressive test specimens in cylinders with a one-inch nominal diameter.
2. Machine specimen ends square to produce a final specimen length of 2 inches.

(4) Before using the epoxy submit a manufacturer's certificate of compliance, and a certified report of test or analysis from a qualified independent laboratory, to the engineer certifying that the epoxy conforms to these specifications. Identify the temperature classes and compressive strength cure times for which the product is certified.

(5) The contractor may furnish an engineer-approved acrylic adhesive that meets the same physical requirements specified for epoxy.

416.2.4 Concrete Pavement Repair and Replacement

(1) Except as specified in 416.3.6 for inlaid rumble strips, use grade C, C-FA, C-S, C-IS, C-IP, or C-IT concrete as specified in 501.

416.2.5 Special High Early Strength Concrete Pavement Repair and Replacement

416.2.5.1 Composition and Proportioning of Concrete

(1) For the concrete mixture, use a minimum of 846 pounds of cementitious material per cubic yard of concrete. Determine materials and proportions of the concrete mixture to obtain a minimum compressive strength in the concrete of 3000 psi within 8 hours of placement. The contractor may add one or a combination of admixtures to the ingredients or to the mixture in order to obtain the required minimum strength and required air content. Do not retemper the concrete mixture.

(2) Provide calcium chloride, if used in the mix, either as a pre-mixed solution or as a job-mixed solution. Ensure that job-mixed solutions contain 1.0 pounds per quart of 77 percent calcium chloride or 0.9 pounds per quart of 90 percent calcium chloride. Do not exceed the manufacturer's recommended maximum dosage. If the engineer requests, provide a written copy of the manufacturer's dosage recommendations.

(3) Add calcium chloride, in solution, by an engineer-approved procedure to the batch ingredients while placing them in the mixer. Provide sufficient water in job-mixed solutions to dissolve the calcium chloride completely, and ensure that the solution is of a uniform and known concentration. Reduce the quantity of mixing water by the quantity of solution used. Introduce the correct quantity of calcium chloride into the mixer using a method by which the quantity added cannot vary appreciably from the target value.

(4) Discharge all concrete within 45 minutes after adding mixing water to the cement, or the cement to the aggregates, or within 30 minutes after adding an accelerating admixture, whichever comes sooner.

416.2.5.2 Evaluating Strength

(1) At least 3 business days before starting construction, provide the engineer with adequate evidence that the required strength is obtainable in the field with the materials used and at the various temperatures encountered. Conduct a continued strength evaluation, if the engineer requires, during the course of the work to ensure continued compliance with the strength requirements.

(2) Notify the engineer before making test cylinders and, if the engineer chooses, make arrangements for the engineer to observe cylinder production. Use a department qualified laboratory and an HTCP-certified technician to conduct preliminary and continued strength evaluations. Base each reported value on a minimum of 2 cylinders. After submitting data showing obtainment of the required strength, do not change the mix without first submitting a complete new set of test data showing compliance with the requirements.

416.3 Construction

416.3.1 General

(1) The engineer will inspect ancillary concrete, as defined in 416.5.2 and built under 416, for transverse cracking as specified in 415.3.17. Repair cracked concrete as the engineer directs.

416.3.2 Concrete Driveways and Truck Aprons

(1) Construct concrete driveways and truck aprons conforming to 415.3 except the contractor may use engineer-approved wood or plastic forms. Color concrete for roundabout truck aprons red as specified in 405.

416.3.3 Placing Tie Bars in Existing Concrete

416.3.3.1 Force Driven

(1) Drill a suitably sized hole into the edge of the existing concrete. Force drive the tie bar to a depth of 6 inches into the prepared hole as the plans show.

416.3.3.2 Epoxied

(1) Drill holes into the edge of the existing concrete to the dimensions the plans show. Anchor the tie bars into the existing concrete with an epoxy conforming to 416.2.3.2 and install conforming to 416.3.4 except no bond breaker is required.

416.3.4 Placing Dowel Bars in Existing Concrete

(1) Drill holes into the edge of the existing concrete to the dimensions the plans show. Anchor the dowel bars into the existing concrete with an epoxy conforming to 416.2.3.2.

(2) Clean drilling dust, debris, and excess moisture from drill holes before inserting the epoxy and dowel bar.

(3) Inject the epoxy into the back of the drill hole. Use an epoxy with a workable viscosity, pumpable, yet thick enough to remain in the hole. Insert a sufficient volume of epoxy into the hole to provide a small quantity of excess material at the face of the concrete after fully inserting the dowel.

(4) Insert dowel bars in the drill holes and rotate 1/2 turn. Do not force drive dowel bars into the drill holes.

(5) Completely fill the annular space between the dowel bar and the concrete with epoxy. Insert a retaining ring over the bar, and push the ring flush against the concrete surface to retain the epoxy.

(6) Coat the protruding portion of each dowel bar with a thin uniform layer of bond breaking lubricant.

(7) Use a positive fixed displacement dispensing system, equipped with a nozzle of sufficient length to deposit the epoxy at the back of the drilled hole. Use a system equipped with a means of checking the mix ratio of the epoxy components. Use the manufacturer's recommended mix ratio and check the ratio at least once a day.

(8) For minor quantities of dowel bars, the contractor may use hand-powered mixing and injecting equipment capable of thoroughly mixing and depositing the epoxy at the back of the drill hole.

416.3.5 Surface Drains

(1) Install and maintain temporary surface drains at locations designated for permanent drains until permanent drains are completed.

(2) Place and secure steel reinforcement and tie bars in their plan position before placing concrete. Place and cure the concrete conforming to 415.3.

(3) Excavate, prepare the subgrade and aggregate base, and backfill as required to place the drains and restore the grade after placement.

416.3.6 Concrete Rumble Strips

(1) Mill shoulder rumble strips into new or existing concrete shoulders. Mill or form intersection rumble strips into new concrete pavement or, if inlaid into existing HMA or concrete pavements, into work built under the Concrete Pavement Replacement bid item except use concrete conforming to 416.2.2. Do not apply rumble strips across bridges.

(2) If milling, use a rotary head mill with a cutting tip pattern that will produce a relatively smooth cut of the size, shape, spacing, and alignment the plans show. Ensure that cutting heads are on a suspension independent from the power unit to allow the heads to self-align with slopes and irregularities. Also ensure that the machine has a guidance system that consistently provides the plan alignment of the rumble strips.

(3) If forming rumble strips into freshly placed concrete, form or finish the concrete to consistently produce the size, shape, spacing, alignment, and smoothness the plans show.

(4) Before beginning the work, demonstrate to the engineer that the proposed operation achieves the desired surface inside each depression without damaging the pavement. Place rumble strips in the pattern and shape the plans show. For shoulders carrying temporary traffic during construction, do not install rumble strips until after routing traffic back to the mainline.

(5) At the end of each work day, move equipment and material out of the clear zone and sweep or vacuum the traveled way pavement and shoulder areas. Sweep away or vacuum up milling debris before opening adjacent lanes to traffic. Dispose of waste material as specified in 203.3.4; do not place on the finished shoulder surface.

416.3.7 Concrete Pavement Repair and Replacement

(1) Repair concrete pavement at the locations the plans show or where the engineer directs. Conform to the pavement repair plan details. For individual repair areas at least one lane wide and greater than 15 feet to less than 300 feet long, conform to the pavement replacement plan details.

(2) Construct conforming to the following:

- Remove concrete pavement, remove asphaltic patch, and prepare the base as specified under 416.3.8.1.
- Place concrete in repair areas as specified under 416.3.8.2. Disregard the same-day requirements for completion of curing and opening to traffic and instead conform to 415.3.12 through 415.3.15.
- Place concrete in replacement areas conforming to 416.3.8.3 except disregard the same-day requirements for completion of curing and opening to traffic.

416.3.8 Special High Early Strength Concrete Pavement Repair and Replacement

416.3.8.1 General

(1) Repair concrete pavement at the locations the plans show or where the engineer directs. Conform to pavement repair plan details. For individual repair areas at least one lane wide and greater than 15 feet to less than 300 feet long, conform to pavement replacement plan details.

416.3.8.1.1 Removing Concrete Pavement

(1) Remove deteriorated slabs without damaging adjacent pavement. If removing only a portion of an existing slab, make a straight full lane-width full depth saw cut to facilitate removal without damaging the remaining pavement. Ensure that repair areas in adjacent lanes match longitudinally.

(2) If the contractor damages pavement designated to remain in place, repair damaged pavement as the concrete pavement repair and replacement details show. Ensure that the length of the damage repair and the adjacent planned repair are the same and both are a full lane wide. If damage is done to pavement not adjacent to a planned repair, conform to the minimum removal length the repair and replacement details show and remove and repair the full lane width.

(3) Remove concrete with minimal disturbance to the aggregate base. At the close of each day's work, ensure that all slabs have been removed from the project limits and stored away from the roadway. Incorporate or dispose of removed pavement as specified in 203.3.4.

(4) Replace areas of the asphaltic shoulder removed during these pavement removal operations to the elevation of the adjacent shoulder using a commercially produced asphaltic patching material. Before patching, clean, dry, and provide a uniform edge for the repair area.

416.3.8.1.2 Removing Asphaltic Patches

(1) Remove existing asphaltic patches. Saw back the existing pavement full depth in an area of sound concrete as the plans show.

416.3.8.1.3 Base Course

(1) Place the concrete on existing base course shaped to the required cross-section. Remove concrete rubble and foreign material with minimal disturbance of the base.

(2) Fill low areas or depressions in the base following removal operations with either compacted aggregate base or additional concrete.

416.3.8.2 Placing Concrete in Repair Areas

(1) Place, cure, and open special high early strength concrete to traffic on the same day removing the old pavement. Place each repair in one continuous, full depth operation. Consolidate the concrete in place using an immersion type vibrator. Finish the surface by screeding twice, floating, and texturing. Orient the length of the screed parallel to the pavement centerline, unless the repair is over 12 feet in length.

(2) Make the transverse edges of the finished repair flush with the edges of the existing concrete pavement. Make the longitudinal surface form a straight line from edge to edge with a tolerance of +/- 1/8 inch.

(3) Finish the final surface of the full depth concrete repair to match the edge of existing HMA or concrete pavement and, if the abutting pavement is concrete, match the existing pavement texture. Cure, protect, open to service, and adhere to cold weather concreting as specified in 415.3.12 through 415.3.15.

416.3.8.3 Placing Concrete in Replacement Areas

(1) Place, cure, and open special high early strength concrete to traffic by sunset on the same day removing the old pavement. Place each repair in one continuous, full-depth operation conforming to 415.3.6 through 415.3.15 except date each replacement slab with the month and year of construction.

416.4 Measurement

(1) The department will measure the Concrete Driveway bid items by the square yard acceptably completed, measured as specified in 415.4 for Concrete Pavement including the intersection with the sidewalk and the associated driveway apron. The department will only measure area outside the specified limits for the pavement, curbs, gutters, combination curb & gutter or other structures.

(2) The department will measure the Concrete Truck Apron bid items by the square yard acceptably completed.

(3) The department will measure the Drilled Tie Bars and Drilled Dowel Bars bid items as each individual bar acceptably completed.

(4) The department will measure the Concrete Surface Drains bid items by the cubic yard acceptably completed, based on the dimensions the plans show or the engineer directs.

(5) The department will measure Concrete Shoulder Rumble Strips by the linear foot acceptably completed, measured as the length along each side of the traveled way from the center of the first groove in a segment to the center of the last groove in that segment. A segment is a series of grooves including 50-foot and shorter gaps as well as skips at transverse joints the plans show. Gaps greater than 50 feet define a new segment. The department will deduct for skips at transverse joints greater than the plans show.

(6) The department will measure Concrete Intersection Rumble Strips by the square yard acceptably completed, measured to include the area between the milled or cast-in-place grooves, or if inlaid into existing HMA or concrete pavement, the area of the inlay. The department will not deduct the area of embedded fixtures with an area of one square yard as measured in the plane of the pavement surface.

(7) The department will measure the Concrete Pavement Repair and Concrete Pavement Replacement bid items by the square yard acceptably completed.

416.5 Payment

416.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
416.0160 - 0199	Concrete Driveway (inch)	SY
416.0260 - 0299	Concrete Driveway HES (inch)	SY
416.0508 - 0520	Concrete Truck Apron (inch)	SY
416.0610	Drilled Tie Bars	EACH
416.0620	Drilled Dowel Bars	EACH
416.1010	Concrete Surface Drains	CY
416.1015	Concrete Surface Drains HES	CY
416.1110	Concrete Shoulder Rumble Strips	LF
416.1180	Concrete Intersection Rumble Strips	SY
416.1710	Concrete Pavement Repair	SY
416.1715	Concrete Pavement Repair SHES	SY
416.1720	Concrete Pavement Replacement	SY
416.1725	Concrete Pavement Replacement SHES	SY

(2) The department will pay for the Concrete Driveway and Concrete Truck Apron bid items as specified in 415.5.1 and 415.5.2 for Concrete Pavement. The department will pay separately for coloring concrete as required for roundabout truck aprons under the Coloring Concrete Red bid item.

(3) Payment for Drilled Tie Bars is full compensation for providing tie bars, including coating; for drilling holes in concrete not placed under the contract; and for epoxying or driving.

(4) Payment for Drilled Dowel Bars is full compensation for providing dowel bars, including coating; for drilling holes in concrete not placed under the contract; and for epoxying.

(5) Payment for the Concrete Surface Drains bid items is full compensation for providing surface drains; for steel reinforcement and dowel and tie bars; and for excavating, preparing the subgrade and aggregate base, and backfilling.

(6) Payment for Concrete Shoulder Rumble Strips is full compensation for milling; for sweeping or vacuuming; and for disposing of waste materials.

(7) Payment for Concrete Intersection Rumble Strips is full compensation for milling or forming grooves; for sweeping or vacuuming; and for disposing of waste materials. The department will pay separately for new concrete pavement under the Concrete Pavement bid items; and for concrete inlaid in existing HMA or concrete pavement under the Concrete Pavement Replacement bid item.

(8) Payment for the Concrete Pavement Repair and the Concrete Pavement Replacement bid items is full compensation for furnishing, hauling, preparing, placing, curing, and protecting materials; for replacing damaged pavement designated to remain in place; for removing and disposing of existing pavements and excavated materials; for repairing asphaltic shoulders; for sawing joints; for preparing the foundation; for backfilling; and for testing concrete cylinders. The department will pay for individual repairs at least one lane wide and greater than 15 feet to less than 300 feet long as Concrete Pavement Replacement. Payment includes jointing and providing tie bars and dowel bars in unhardened concrete. The department will pay separately for associated work as follows:

- For tie bars and dowel bars provided in concrete not placed under the contract, exclusive of those necessary to repair contractor-caused damage, under the Drilled Tie Bars and Drilled Dowel Bars bid items.
- For sawing existing concrete for removal, under the Sawing Concrete bid item as specified in 690.5.
- For repairs 300 feet long or longer, under the Removing Pavement bid item as specified in 204.5 and the Concrete Pavement bid items as specified in 415.5.

416.5.2 Adjusting Pay for Ancillary Concrete Crack Repairs

(1) The department will adjust pay for crack repairs on ancillary concrete. Ancillary concrete includes curb & gutter whether separately or integrally placed, curb, gutter, medians, sidewalks, loading zones, safety islands, steps, concrete surface drains, truck aprons, and driveways. The engineer will allocate responsibility and costs for crack repairs, mobilization for traffic control, and traffic control devices, according to CMM 4-24. The department will adjust pay under the Crack Repair Ancillary Concrete administrative item.

(2) Pay adjustment for crack repair costs includes mobilization for the repair work; sawing; removals; furnishing and placing materials including dowel bars and steel reinforcement; drilled tie and dowel bars; and all incidentals. The engineer will compute the pay adjustment for repair costs as the contract unit price for the item, times the quantity replaced, multiplied by the appropriate multiplier as follows:

COMPUTED AMOUNT MULTIPLIER PER QUANTITY FOR ANCILLARY CONCRETE

ITEM REPLACED	SHARED REIMBURSEMENT MULTIPLIER	TOTAL REIMBURSEMENT MULTIPLIER
Quantity replaced	6	12

(3) The department will adjust pay for traffic control devices and mobilization for traffic control separately.

Section 420 Diamond Grinding

420.1 Description

(1) This section describes continuous diamond grinding and intermittent diamond grinding for surface restoration of existing or repaired pavement and profile correction for new pavement.

420.2 (Vacant)

420.3 Construction

420.3.1 General

(1) Diamond grind the existing concrete pavement to provide a uniform surface that is reasonably plane, free of excessively large scarification marks, and has the grade and cross slope the plans show or the engineer specifies. Do not damage the remaining pavement. Do not grind deeper than 3/4 inch from the top of the original surface.

(2) Complete full-depth and partial-depth concrete repairs, slab stabilization, dowel bar retrofit, and other pavement repair operations before grinding. Begin and end grinding at lines perpendicular to the roadway centerline at the project limits. Do not overlap adjacent grinding passes by more than 1-inch. Do not leave un-ground surface area between passes.

(3) Grind joint or crack faults so there is no more than a 1/16-inch differential between the adjacent sides of the joints and cracks. Grind warped and curled slabs as required to provide an acceptable ride. Provide smooth transitions from the edge of the mainline to shoulders, adjacent lanes, and ramps leaving no more than a 3/16-inch ridge at transitions. Grind adjacent pavement and paved shoulders as necessary to feather in a smooth transition and maintain drainage. Do not grind approach slabs unless necessary to provide a smooth transition.

(4) Provide lateral drainage by maintaining a constant cross slope between grinding extremities in each lane including feathered areas of the shoulder. Ensure that the finished cross slope conforms to the plans and has no depressions or slope misalignment greater than 1/4-inch in 12 feet when measured perpendicular to the centerline with a 12-foot straightedge.

(5) Do not diamond grind over valves, manholes, or other fixtures. Provide a smooth taper from the diamond ground surface to the top of the fixture.

420.3.2 Equipment

420.3.2.1 General

(1) Use self-propelled grinding machines with depth, grade, and slope controls designed for grinding and texturing concrete. Equip grinding machines with diamond blades and a vacuuming system capable of removing liquid and solid residue from the ground surface. Shroud the machine to prevent discharging loosened material into adjacent work areas or live traffic lanes.

(2) Do not use equipment that causes raveling, aggregate fractures, joint deflection, or other damage to material remaining in place.

(3) Maintain equipment in proper working order. Ensure that the match and depth control wheels are round. Stop grinding and immediately replace out-of-round wheels.

420.3.2.2 Continuous Grinding

(1) Under the Continuous Diamond Grinding Concrete Pavement bid item, ensure that the grinding machine, including the grinding head, weighs 35,000 pounds or more, will grind a strip at least 4 feet wide, and has an effective wheel base of 25 feet or more.

420.3.2.3 Intermittent Grinding

(1) For intermittent grinding required for ride correction under 740, ensure that the grinding machine will grind a strip at least 3 feet wide and has an effective wheel base of 12 feet or more. The engineer may require continuous grinding equipment if intermittent grinding equipment does not produce acceptable results.

420.3.3 Final Surface Finish

(1) Produce a surface that is true in grade and uniform in appearance. Provide a longitudinal line-type texture with corrugations parallel to the outside pavement edge.

(2) Select the number of diamond blades per foot that will provide the proper surface finish for the aggregate type. Determine the sequence of operations and number of passes required to meet the specifications.

(3) Ensure that ridges are 1/16 to 3/16 inches higher than the bottom of the grooves and uniformly spaced as follows:

For limestone: 0.09 to 0.11 inches between grooves.

For gravel: 0.06 to 0.09 inches between grooves.

(4) Ensure that a minimum of 95 percent of any 4-foot by 100-foot section is textured. Remove unbroken fins as the engineer directs.

420.3.4 Residue Disposal

(1) Remove solid and liquid grinding residues from the roadway by vacuuming. Leave the roadway in a clean, damp condition immediately behind the grinding machine. Remove residue immediately in areas of cross traffic. Do not allow residue and water to flow or blow across lanes used by public traffic or to enter any storm sewer, stream, lake, reservoir, marsh, or wetland. Dispose of residue and water at an acceptable material disposal site located off the project limits and as shown in the ECIP.

420.3.5 Smoothness Requirements

(1) Measure IRI for surfaces the contract designates for continuous grinding both before and after grinding. Conform to 740 except as follows:

- Submit smoothness assurance reports to the engineer before and after grinding for IRI and before and after correcting areas of longitudinal surface deviation.
- Straight edging is required to identify depressions or slope misalignment as specified in 420.3.1(4).
- No quality control plan is required. The contractor need only provide the name and certifications for the profiler operator and identify segment locations of each profile run.
- The profiler and operator need only be on site when before-grinding and after-grinding profiles are run; and when conducting corrective grinding operations.

(2) The department will adjust pay for smoothness based on the final ride measured after initial grinding and corrective grinding done under 740.3.4.4 is completed.

420.4 Measurement

(1) The department will measure Continuous Diamond Grinding Concrete Pavement by the square yard acceptably completed, measured as the final textured surface area regardless of the number of passes required to achieve acceptable results. The department will include minor areas of un-ground surface within the ground area.

(2) If conditions require a feather pass into the shoulder, adjacent lanes, or ramps, the department will also measure an area 2 feet wide times the length of the feather pass or an additional 20 square yards whichever is greater.

420.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
420.1000	Continuous Diamond Grinding Concrete Pavement	SY

(2) Payment for Continuous Diamond Grinding Concrete Pavement is full compensation for grinding to improve ride including measuring IRI before and after grinding; for feathering in adjacent surfaces; for removing unbroken fins; and for hauling and off-site disposal of grinding residue. The department will adjust pay for smoothness as specified in 740.5.

(3) Corrective grinding for new pavement required under 740 is incidental to the contract.

Section 450 General Requirements for Asphaltic Pavements

450.1 Description

(1) This section describes requirements common to plant mixed asphaltic bases and pavements. Exceptions and additional requirements are specified in 455 through 475.

450.2 Materials

450.2.1 Acronyms and Definitions

(1) Interpret materials related acronyms used in sections 450 through 499 as follows:

FRAP	Fractioned reclaimed asphaltic pavement
HMA	Hot mix asphalt
JMF	Job mix formula
PG	Performance graded
RAP	Reclaimed asphaltic pavement
RAS	Recycled asphalt shingles
SMA	Stone matrix asphalt
VMA	Voids in mineral aggregate
WMA	Warm mix asphalt

(2) Interpret materials related definitions used in sections 450 through 499 as follows:

Additive	A material blended with asphaltic binder or aggregate to enhance the characteristics of the final HMA blend, but that does not alter the binder performance grade.
Asphaltic binder	The predominant asphalt cement in HMA.
Filler	Mineral fillers, used primarily to fill voids between aggregate particles to meet gradation requirements.
Fractionated reclaimed asphaltic pavement	Reclaimed asphalt pavement processed by screening and separating by maximum and minimum particle size, asphalt content, asphalt performance grade, and aggregate characteristics.
Leveling layer	A thin HMA layer placed to eliminate irregularities in the profile or thickness of underlying pavement layers.
Lower layer	An asphaltic pavement layer below the upper layer in the completed pavement structure. There may be multiple lower layers.
Modifier	A material blended with the asphaltic binder to enhance its characteristics by modifying the performance grade of the binder.
Reclaimed asphaltic pavement	Material resulting from cold milling or crushing existing asphaltic pavement.
Recycled asphalt shingles	Waste material from a shingle manufacturing facility, either new or used material salvaged from residential roofing operations, or any combination of these materials ground to ensure that 100 percent will pass a 3/8 sieve and processed to remove deleterious material.
Upper layer	The top asphaltic pavement layer in direct contact with traffic in the completed pavement structure. There is only one upper layer.
Warm mix asphalt	Asphaltic mixture containing a warm mix additive or using a warm mix process that reduces the mixing and compaction temperatures typically required for that application.
Wedging	A tapered layer of asphaltic pavement used to build up an existing surface. Wedging layers may be thicker or thinner than standard pavement layers.

450.2.2 Aggregate Sampling and Testing

(1) The department and the contractor will sample and test according to the following methods, except as revised with the engineer's approval:

Sampling aggregates	AASHTO T2
Material finer than No. 200 sieve	AASHTO T11
Sieve analysis of aggregates	AASHTO T27
Mechanical analysis of extracted aggregate	AASHTO T30
Sieve analysis of mineral filler	AASHTO T37
Los Angeles abrasion of coarse aggregate	AASHTO T96
Freeze-thaw soundness of coarse aggregate	AASHTO T103

Sodium sulfate soundness of aggregates (R-4, 5 cycles) ..... AASHTO T104
Extraction of bitumen ..... AASHTO T164

450.3 Construction

450.3.1 Equipment

450.3.1.1 Asphalt Plants

450.3.1.1.1 Plant Scales

(1) Provide beam, springless, dial, or digital scales on weigh boxes and silos. Use scales of a standard make and design accurate to within 0.5 percent of the maximum required load. For each plant, provide at least ten standard 50 pound weights accurate to within 0.1 percent. For each scale, provide a suitable cradle or platform for applying test loads.

(2) If using beam scales for aggregate, provide a separate beam for each size of aggregate. Also provide a device that warns when the applied load is within 200 pounds of the required load.

(3) If using beam scales for asphaltic materials, provide a tare beam and a full capacity beam with a minimum graduation no greater than 2 pounds. Also provide a device that warns when the applied load is within 20 pounds of the required load.

(4) If using dial scales, provide a standard make springless scale designed, constructed, and installed to be vibration free. Ensure that all dials are plainly visible to the operator at all times. Equip with adjustable pointers for marking the weight of each material batched.

(5) If using digital scales, conform to National Bureau of Standards Handbook 44.

450.3.1.1.2 Automatic Batching

(1) On contracts with 10,000 tons or more, provide automated batch plants. Ensure that the plants' control system can coordinate mixture proportioning, timing, and discharge by the operation of a single control. Also provide an automatic batch weighing, cycling, and monitoring system.

(2) On contracts with less than 10,000 tons, if the contractor elects to use batch plant automatic systems, conform to the requirements here under 450.3.1.1.2. The contractor need not use automatic recordation. If the contractor elects to use automatic recordation, conform to 450.3.1.1.4 for truck loads, or 450.3.1.1.3 for batch weights.

(3) Ensure that the system accurately proportions mixture components by weight or volume in the proper order and controls the mixing cycle sequence and timing. Provide interlocks that ensure that the scale is at zero before a batch can start and that the batch is mixed completely before discharge. Do not start subsequent batches before completely discharging the previous batch. Also provide interlocks that ensure that all batch materials are in the mixer before the batch can discharge. Ensure that unauthorized personnel cannot alter mix designs and that equipment emits an audible signal if discharging a batch with out-of-tolerance component weights. Ensure that this signal is loud enough to hear throughout the plant area under normal operating conditions.

(4) Provide adjustable timing devices to control individual component batching and mixing operations. Provide auxiliary interlock cutoff circuits necessary to stop automatic cycling whenever an weighing error exceeding a specified tolerance occurs or when another part of the control system malfunctions.

(5) Ensure that the batching system automatic control can stop the cycle in the underweight check position and the overweight check position for each material to check tolerance limits.

(6) Ensure that the scale system is equipped with a device that applies pressure to a scale lever to simulate batching operations for tolerance checks.

(7) Consistently deliver materials within the full range of batch sizes within the following tolerances:

MATERIAL	PERCENT OF TOTAL MATERIAL BATCH WEIGHT
Coarse aggregate	+ 1.0
Fine aggregate	+ 1.0
Aggregate for use with salvaged or reclaimed pavement materials	+ 1.5
Mineral filler	+ 0.5
Salvaged or reclaimed asphaltic pavement material	+ 1.5
Asphaltic material	+ 0.1
Zero return for aggregate	+ 0.5
Zero return for salvaged or reclaimed material	+ 0.5
Zero return for asphaltic material	+ 0.1

(8) Unless providing separate tolerance controls for batching mineral filler, reduce aggregate tolerances to +/- 0.5 percent for aggregates delivered before the filler.

(9) Ensure that the total weight of the batch does not vary by more than +/- 2.0 percent of the designated batch weight.

(10) Ensure that the electrical circuits for the above delivery tolerances of each cutoff interlock are capable of providing the total span for the full allowable tolerance for maximum batch size. Provide tolerance controls automatically or manually adjustable to provide spans suitable for less than full-size batches. Ensure that the automatic controls and interlock cutoff circuits are consistently coordinated with the batching scale or meter within an accuracy of 0.2 percent of the scale or meter nominal capacity[1] throughout the full range of the batch sizes.

[1] Nominal capacity of a scale is defined as the maximum quantity which the scale or meter can measure.

(11) If the automatic control or monitoring systems break down, the contractor may operate the plant manually for up to 2 working days.

450.3.1.1.3 Recording Batch Weights

(1) On contracts involving 10,000 tons or more of asphaltic mixtures, unless the contractor elects to record truck loads as provided in 450.3.1.1.4, produce an automatic digital record for each batch indicating the proportions of each aggregate component, mineral filler, and asphaltic material.

(2) Provide a digital recorder that can print multiple copies of mixture reports that give the total weight of asphaltic mixture and asphaltic material both per load and per batch. Include weights of the individual aggregates and fillers. Reports need not provide tare weight and may use accumulative weights. Ensure that reported weights are accurate within +/- 1 kg/500 kg. Allow sufficient time for the scale to come to rest before printing each weight.

(3) The contractor may use mixture storage silos with digital recorder equipped batch plants if the department determines the storage silo output is coordinated with the recorded batch weights.

(4) If the recording system breaks down, the contractor may operate the plant without automatic recording for up to 2 working days.

450.3.1.1.4 Recording Truck Loads

(1) If not using automatic batch recording, install a digital recorder as part of the platform truck or storage silo scales. Ensure that the recorder can produce a printed digital record of at least the gross or net weights of delivery trucks. Provide gross, tare, net weights, load count, and the cumulative tonnage; the date, time, ticket number, WisDOT project ID, and mix 250 number; and the mix type including the traffic, binder, and mix designation codes specified in 460.3.1. Ensure that scales cannot be manually manipulated during the printing process. Provide an interlock to prevent printing until the scales come to rest. Size the scales and recorder to accurately weigh the heaviest loaded trucks or tractor-trailers hauling asphaltic mixture. Ensure that recorded weights are accurate to within 0.1 percent of the nominal capacity of the scale.

(2) Ensure that tickets identify additives not included in the mix design submittal or cold weather paving plan. Indicate on the ticket if the mixture is placed under a cold weather paving plan.

450.3.1.2 Asphaltic Mixture Hauling Vehicles

(1) Provide trucks for hauling asphaltic mixtures with tight, clean, and smooth boxes. The contractor may thinly coat boxes with a release agent chosen from the department's APL. Drain excess release agent after coating. Equip each box with a cover big enough to protect the mixture. Do not use trucks that show oil leaks of any magnitude.

450.3.1.3 Transfer Devices

(1) Ensure that transfer devices have surge bin capacity adequate to pave continuously at a uniform speed. If maintaining uniform and continuous paving, the engineer may allow the contractor to omit the surge bin. Do not use devices that cause vibrations or other motion that adversely affect the finished ride.

450.3.1.4 Pavers

(1) Ensure that the screed or strike-off assembly produces a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Use a screed adjustable for the required crown and cross-section of the finished pavement.

(2) Ensure that pavers are equipped with an activated screed or strike-off assembly and use activation at all times during paving unless the engineer allows otherwise. Do not extend the screed with one or more static extensions totaling more than 12 inches at either screed end, except at the shoulder end for paving shoulders.

(3) Provide pavers with department-approved automatics that control the elevation and slope of the screed. The department will not require automatic controls when paving entrances, approaches, side road connections, small irregular areas, or if the engineer determines using automatic controls is impracticable. Use both grade and slope controls whenever automatics are required, except the engineer may waive the longitudinal or grade control requirement for the final surface. Ensure that the operator can adjust or vary the slope throughout super elevated curves and transitions. Also ensure that the system allows the sensor to operate on either side of the paver.

(4) If automatics break down, the contractor may pave under manual control only until the end of that working day.

450.3.1.5 Compaction Equipment

(1) Ensure rollers are in good mechanical condition, capable of operating both forwards and backwards, and the operating mechanism allows for starting, stopping, or reversing direction in a smooth manner, without loosening or distorting the surface being rolled.

(2) Equip rollers with a drum or tire lubricator. Do not lubricate with petroleum or tar products.

450.3.2 Constructing Asphaltic Mixtures

450.3.2.1 General

450.3.2.1.1 Preparation and Paving Operations

(1) Do not place asphaltic mixture when the air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 36 F for upper layers or 32 F for lower layers unless the engineer allows in writing. The contractor should place HMA pavement for projects in the northern asphalt zone between May 1 and October 15 inclusive and for projects in the southern asphalt zone between April 15 and November 1 inclusive. CMM 4-53 figure 2 defines asphalt zones. Notify the engineer at least one business day before paving.

(2) Unless the contract specifies otherwise, conform to the following:

- Keep the road open to all traffic during construction.
- Prepare the existing foundation for treatment as specified in 211.
- Incorporate loose roadbed aggregate as a part of preparing the foundation, in shoulder construction, or dispose of as the engineer approves.

(3) Place asphaltic mixture only on a prepared, firm, and compacted base, foundation layer, or existing pavement substantially surface-dry and free of loose and foreign material. Do not place over frozen subgrade or base, or where the roadbed is unstable.

450.3.2.1.2 Cold Weather Paving

450.3.2.1.2.1 General

(1) Conform to these cold weather paving provisions for work performed under the following:

- The 460 HMA Pavement bid items.
- The 465 Asphaltic Surface bid items.
- Special provisions that require placing mixture conforming to the contract requirements under 460 for HMA pavement or under 465 for asphaltic surface.

450.3.2.1.2.2 Cold Weather Paving Plan

(1) Submit a written cold weather paving plan to the engineer at the preconstruction meeting. In that plan outline material, operational, and equipment changes for paving when the air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40 F. Include the following:

- Use a department-accepted HMA mix design that incorporates a warm mix additive from the department's APL. Do not use a foaming process that introduces water into the mix.
- Identify the warm mix additive and dosage rate.
- Identify modifications to the compaction process and when to use them.

(2) Engineer written acceptance is required for the cold weather paving plan. Engineer acceptance of the plan does not relieve the contractor of responsibility for the quality of HMA pavement placed in cold weather except as specified in 450.5.2(3).

450.3.2.1.2.3 Cold Weather Paving Operations

(1) Do not place asphaltic mixture when the air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40 F unless a valid engineer-accepted cold weather paving plan is in effect.

(2) If the national weather service forecast for the construction area predicts ambient air temperature less than 40 F at the projected time of paving within the next 24 hours, confirm or submit revisions to the cold weather paving plan for engineer validation. Update the plan as required to accommodate the conditions anticipated for the next day's operations. Upon validation of the plan, the engineer will allow paving for the next day. Once in effect, pave conforming to the engineer-accepted cold weather paving plan for the balance of that work day or shift regardless of the temperature at the time of paving.

450.3.2.2 Preparing and Storing Mixtures

(1) Heat and combine aggregate and asphaltic material to produce a mixture within the temperature range the mixture design specifies when discharged from the mixer. Mix until achieving a homogeneous mixture with uniformly coated aggregate. The contractor may store the mixture in silos.

450.3.2.3 Transporting and Delivering Mixtures

(1) Deliver the mixture to the paver receiving hopper at a temperature within 20 F of the temperature the asphaltic material supplier recommends. Cover loads during inclement weather or when the ambient air temperature falls below 65 F.

(2) If depositing asphaltic mixture on the roadway, provide equipment to pick up substantially all of the asphaltic mixture from the roadway and load it directly into the paver receiving hopper. Use either a device integral to the paver or intermediate transfer equipment.

450.3.2.4 Correcting Base

(1) Before placing asphaltic base or surface courses, correct the existing pavement by filling potholes, sags, and depressions; altering the existing crown; or other corrections the engineer requires. Place asphaltic lower layer mixtures where and as the engineer directs. The contractor may hand place or use blade graders or mechanical spreaders to place mixture used for wedging, leveling layers, or filling holes. Feather the mixture out to become co-planar with adjoining areas and, unless the engineer directs otherwise, compact uniformly as specified in 450.3.2.6.2.

450.3.2.5 Spreading and Finishing Mixture

(1) Place asphaltic mixtures in layers to the typical sections the plans show with self-propelled pavers. Pave at a constant speed, appropriate for the paver and mixture, that ensures uniform spreading and strike-off with a smooth, dense texture and no tearing or segregation. Do not pave faster than the average delivery rate of asphaltic mixture to ensure, as nearly as possible, continuous paving.

(2) If placing the initial lane of a given layer, sense off a tight string line, a mobile string line, or a traveling straightedge whichever the engineer approves for the specific field conditions. On subsequent lanes of the layer, the contractor may sense off the adjacent lane surface.

(3) Avoid raking over machine spread and finished material on surface courses to the extent possible to prevent segregation.

(4) The contractor may spread material by hand in areas not accessible to pavers. Dump material outside the placement area, spread into place with shovels, and shape to the required grade and contour with rakes and lutes. Do not rake material from a pile of dumped material.

(5) Do not haul over any portion of a placed layer until after the final rolling is complete on that portion.

(6) If a longitudinal joint other than the notched wedge joint is constructed, place multilane pavement so that each day's placement in all lanes ends at the same station, unless the engineer directs or allows otherwise.

450.3.2.6 Compaction

450.3.2.6.1 General

(1) Unless the contract specifies otherwise for the particular type of work, compact using the ordinary compaction procedure. After spreading and strike-off and while still hot, compact each layer thoroughly and uniformly by rolling. Roll during daylight hours unless providing artificial light the engineer finds satisfactory. Use the appropriate number of rollers to achieve the specified compaction, surface finish, and smoothness requirements. Ensure that the compacted surface is smooth and true to the established crown and grade.

(2) Roll the entire surface until achieving the specified compaction and, to the extent practicable, eliminate roller marks. If turning or reversing the roller, or other operations, causes any scuffing or displacement, immediately correct the damage and revise the rolling procedure to prevent further damage. Keep roller wheels moistened to keep mixture from sticking to them. Do not use excess water. Do not disturb the line and grade elevation of edges of the asphaltic pavement or surfacing.

(3) Along forms, curbs, headers, walls, and at other places not accessible to the roller, compact the mixture thoroughly with hot hand tampers or mechanical tampers giving equivalent compression. On depressed areas, use a trench roller or other engineer-approved equipment.

(4) Remove and replace material that is loose and broken, mixed with dirt, or is otherwise unacceptable with fresh hot mixture. Also remove and replace areas with excess asphaltic material. Compact replaced mixture immediately flush with the adjacent placement.

450.3.2.6.2 Ordinary Compaction

(1) Unless the contract specifies otherwise, compact patching, leveling, and wedging layers of asphaltic pavement or surfacing; all layers of plant mixed asphaltic base and base widening; driveways; and other non-traffic areas until no further appreciable consolidation is visible under the action of the compaction equipment. Use 2 or more rollers per paver if placing more than approximately 165 tons of mixture per hour.

(2) The engineer will assess the compacted density using the methods specified for the particular type of work.

450.3.2.7 Applying Tack Coat

(1) Apply tack coat as specified in 455.3.2 to each layer of a plant-mixed asphaltic base or pavement that will be overlaid with asphaltic mixture under the same contract.

450.3.2.8 Jointing

(1) Place all layers as continuously as possible without joints. Do not roll over an unprotected end of freshly laid mixture unless interrupting placement long enough for the mixture to cool. If interrupting placement, ensure proper bond with the new surface. Form joints by cutting back on the previous run to expose the full depth of the layer. After resuming placement, place the fresh mixture against the joint to form intimate contact and be co-planar with the previously completed work after consolidation.

(2) Where placing against existing HMA pavement, cut back the existing mat to form a full-depth butt joint.

(3) Construct notched wedge longitudinal joints for mainline paving if the pavement thickness conforms to the minimums specified in 460.3.2, unless the engineer directs or allows an alternate joint. Taper each layer at a slope no greater than 12:1. Extend the taper beyond the normal lane width, or as the engineer directs. Ensure that tapers for all layers directly overlap and slope in the same direction.

(4) Place a 1/2 to one inch vertical notch after compaction at the top of tapers on all layers. Place the finished longitudinal joint line of the upper layer at the pavement centerline for 2-lane roadways, or at the lane lines if the roadway has more than 2 lanes.

(5) Construct the tapered portion of each layer using an engineer-approved strike-off device that will provide a uniform slope and will not restrict the main screed. Apply a weighted steel side roller wheel, as wide as the taper, to the tapered section. Compact the initial taper section to as near the final density as possible. Apply a tack coat to the taper surface before placing the adjacent lane.

(6) Clean longitudinal and transverse joints coated with dust and, if necessary, paint with hot asphaltic material, a cutback, or emulsified asphalt to ensure a tightly bonded, sealed joint.

450.3.2.9 Surface Requirements

(1) Test the surface at engineer-selected locations with a 10-foot straightedge or other engineer-specified device. Ensure that upper layers show no variation greater than 1/8 inch between any 2 surface contacts. Ensure that lower layers, shoulder surfacing, and surfacing on temporary connections and bypasses show no variation greater than 1/4 inch between any 2 surface contacts.

(2) Remove and replace or otherwise correct, using engineer-approved methods, humps or depressions exceeding the specified tolerance.

450.3.2.10 Paving Shoulders

(1) Conform to the other requirements under 450.3.2 except, if constructing shoulders separately and the placement width is too narrow to accommodate the required pavers and rollers, the contractor may use engineer-approved alternate spreading and compaction equipment. Alternate equipment must be capable of satisfactorily laying mixture to the required width, thickness, texture, and smoothness.

450.3.2.11 Safety Edge[SM]

(1) Construct safety edge monolithically with and extending beyond the edge of pavements that have no paved shoulder, have paved shoulders 3 feet wide or less, and at other locations the plans show. Safety edge is not required on edges that abut other HMA or concrete elements or where the engineer excludes for constructability issues.

(2) Compact conforming to 450.3.2.6. Ensure that after final rolling the safety edge angle is within the tolerances the plans show. The contractor may use full depth sawing to remove formed edges integrally placed with pavement where safety edge is not required.

(3) Use a paver equipped with a wedge maker from the department's APL capable of constructing the specified edge cross-section. Do not use a single plate strike off.

(4) Place the finished shoulder material to the top of the safety edge conforming to 305.3.3.

450.3.3 Maintaining the Work

(1) Protect and repair the prepared foundation, tack coat, base, paved traffic lanes, shoulders, and seal coat. Correct rich or bleeding areas, breaks, raveled spots, or other nonconforming areas in the paved surface.

450.4 Measurement

(1) The department will measure asphaltic mixtures by the ton of mixed aggregate and asphaltic material incorporated in the work unless the measurement subsection for a particular application specifies otherwise. Provide the engineer with weigh tickets showing the net weight of each load of material delivered. The department or department-authorized testing firms or agencies will test the contractor's truck, storage silo, or plant scales.

(2) For minor quantities of mixtures and if the engineer approves, the contractor may report batch weights from plant scales as described in 450.3.1.1.1, instead of truck or storage silo scale weights.

(3) The department will measure HMA Cold Weather Paving by the ton of HMA mixture placed conforming to an engineer-accepted cold weather paving plan.

450.5 Payment

450.5.1 General

(1) All costs of furnishing, maintaining, and operating the truck scale or other weighing equipment and furnishing the weigh tickets are incidental to the contract.

(2) Nonconforming material allowed to remain in place is subject to price adjustment under 105.3.2.

(3) Full-depth sawing to remove integrally placed safety edge where not required is incidental to the contract.

(4) The contractor is responsible for the quality of HMA placed in cold weather.

450.5.2 Cold Weather Paving

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
450.4000	HMA Cold Weather Paving	TON

(2) Payment for HMA Cold Weather Paving is full compensation for additional materials and equipment specified for cold weather paving under 450.3.2.1.2 including costs for preparing, administering, and following the contractor's cold weather paving plan. The department will not pay for HMA Cold Weather Paving for HMA placed as follows:

- If the lot density is less than the minimum specified in table 460-3 for mixture placed under 460.
- On days when the department is assessing liquidated damages.

(3) If because of an excusable compensable delay under 108.10.3, the engineer directs the contractor to pave when the temperature is less than 36 F for the upper layer or less than 32 F for lower layers, the department:

- Will relieve the contractor of responsibility for damage and defects the engineer attributes to cold weather paving.
- Will not assess disincentives for density or ride.

(4) If HMA pavement is placed under 450.3.2.1.2 and the HMA Cold Weather Paving bid item is not in the contract, the department will pay for the additional costs specified in 450.5.2(2) as extra work. The department will pay separately for providing HMA pavement and HMA surface under 460.5, 465.5, and the contract special provisions.

Section 455 Asphaltic Materials

455.1 Description

(1) This section describes asphaltic materials including asphaltic binders, cements, cut-back asphalts, emulsified asphalts, and similar products. This section also describes applying tack coat.

455.2 Materials

455.2.1 General

(1) Furnish asphaltic material that meets the minimum PG binder grade the contract specifies. Furnish binder with an S designation unless the contract specifies otherwise. Ensure that the material furnished conforms to the department's Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

455.2.2 Sampling

455.2.2.1 PG Asphalts

(1) Sample according to the department's Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

455.2.2.2 MC, SC, and Emulsified Asphalts

(1) Sample asphaltic material at the job site either before or during unloading. Obtain the engineer's approval of sampling methods and have the engineer observe the sampling. If sampling outside established job working hours, arrange for a department representative to be present.

(2) Obtain representative samples at the frequency specified in CMM 8-50 exhibit 1 and according to AASHTO R66 except as follows:

- If bleeding through a drain-cock in the transfer line, allow at least 5 minutes between samples.
- If sampling from a valve installed in the side or end of the delivery vehicle tank, the valve must be between the quarter points of the tank's vertical diameter. Draw off and discard enough material to clear the intake line of material from previous loads before sampling.

(3) Use only clean, dry sample containers free from cleaning oil or other contamination. Do not contaminate samples. Tightly seal, mark for identification, and submit to the engineer immediately after filling. The department's laboratory will test the material.

455.2.3 Testing

455.2.3.1 PG Asphalts

(1) Test according to the department's Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

455.2.3.2 MC, SC, and Emulsified Asphalts

(1) Test MC and SC materials according to the following:

TEST	AASHTO	ASTM
Flash point, open tag	T 79	___
Flash point, Cleveland cup	T 48	ASTM D92
Kinematic viscosity	T 201	ASTM D2170
Distillation	T 78	ASTM D402
Penetration	T 49	ASTM D5
Ductility	T 51	___
Solubility in trichloroethylene	T 44	ASTM D2042
Water	T 55	ASTM D95

(2) Test emulsified asphalts according to AASHTO T59.

455.2.4 Physical Properties

455.2.4.1 PG Asphalts

(1) Furnish material conforming to the department's Combined State Binder Group Method of Acceptance for Asphalt Binders available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/csbg-policy.pdf

455.2.4.2 MC and SC Asphalts

(1) Furnish material conforming to the following:

Type MC asphalts ..... AASHTO M82
Type SC asphalts ..... AASHTO M141

(2) If sampling at the job site, also conform to kinematic viscosity requirements as follows:

TYPE	GRADE	VISCOSITY (in centistokes at 60 C) MINIMUM	MAXIMUM
MC	30	25	70
MC and SC	70	60	160
MC and SC	250	230	540
MC and SC	800	700	1800
MC and SC	3000	2600	7000

455.2.4.3 Emulsified Asphalts

(1) Furnish material conforming, before dilution, to the following:

Anionic emulsified asphalts ..... AASHTO M140
Cationic emulsified asphalts ..... AASHTO M208
Polymer-modified cationic emulsified asphalts ..... AASHTO M316

(2) If diluting emulsified asphalt, mix thoroughly with an equal quantity of potable water. If undiluted samples are not available, test the diluted material and modify AASHTO M140, M208, or M316 to reflect properties resulting from dilution of the asphalt.

455.2.5 Tack Coat

Revise 455.2.5(1) to add more options for tack coat material.

(1) Under the Tack Coat bid item, furnish type MS-2, SS-1, SS-1h, CSS-1, CSS-1h, QS-1, QS-1h, CQS-1, CQS-1h, or modified emulsified asphalt, unless the contract specifies otherwise.

455.3 Construction

455.3.1 General

(1) Heat asphaltic materials so that the temperature when entering the mixer or at application is within the limits the supplier specifies.

455.3.2 Tack Coat

455.3.2.1 General

(1) Apply tack coat only when the air temperature is 32 F or more unless the engineer approves otherwise in writing. Before applying tack coat ensure that the surface is reasonably free of loose dirt, dust, or other foreign matter. Do not apply to surfaces with standing water. Do not apply if weather or surface conditions are unfavorable or before impending rains.

(2) Use tack material of the type and grade the contract specifies. The contractor may, with the engineer's approval, dilute tack material as allowed under 455.2.4. Provide calculations using the asphalt content as-received from the supplier and subsequent contractor dilutions to show that as-placed material has 50 percent or more residual asphalt content. Apply at 0.050 to 0.070 gallons per square yard, after dilution, unless the contract designates otherwise. The engineer may adjust the application rate based on surface conditions. Limit application each day to the area the contractor expects to pave during that day.

(3) Unless the contract specifies otherwise, keep the road open to all traffic during the work. Plan and prosecute tacking operations to adequately provide for traffic without damaging the work.

455.3.2.2 Equipment

455.3.2.2.1 General

(1) Have all necessary equipment available on the job before beginning tack coat operations.

455.3.2.2.2 Tank Car Heating Equipment

(1) Heat the tack material by circulating steam through the coils of the tank or use another engineer-approved system. Use equipment designed to heat without burning or overheating any portion of the material. Provide effective and positive control of the heat at all times.

(2) The department will reject tack material from tank cars without heating coils, or with defective heating coils, unless the contractor uses engineer-approved alternate methods to heat the material without introducing moisture. Do not agitate or heat the tack coat material by directly introducing live steam.

455.3.2.2.3 Tack Distributors

(1) Provide a tachometer, pressure gauges, and accurate volume measuring devices or a calibrated tank. Also provide a thermometer for measuring the temperature of the tank contents.

(2) Equip distributors with a pump power unit and full circulation spray bars adjustable laterally and vertically. Provide a heating system that circulates material through the spray bar during the entire heating process. Also provide a hose and spray nozzle to apply tack to areas inaccessible to the spray bar.

455.3.2.3 Preparing the Existing Surface

(1) Prepare the base or existing surface as specified for preparing the foundation for asphalt surfacing in 211. Immediately before applying tack material, sweep existing surfaces to remove dust, dirt, or other objectionable material.

455.3.2.4 Heating and Applying Asphaltic Materials

(1) The department will reject overheated or otherwise damaged tack material.

(2) Place tack in a single application unless the contract or engineer specifies otherwise. Determine the appropriate width for the application based on traffic handling and sequencing of subsequent surface course construction. Distribute uniformly over the surface to be treated.

(3) Determine an application rate for the surface condition required to effectively bond the overlying material. Obtain the engineer's approval for the application rate. Correct for under application by applying additional material. If the contractor cannot maintain the application rate within tolerances, discontinue operations and make the necessary corrections to personnel or equipment required to remedy the problem.

(4) Turn outside edges nozzles to spray parallel to the road centerline. Do not operate with any clogged nozzles.

(5) Protect structures, as the engineer approves, to prevent spatter or marring by tacking operations. Include surfaces of railings, curbs, gutters, and other appurtenances of existing structures. Also protect adjacent concrete pavement that will not be resurfaced with asphaltic pavement or surfacing.

455.3.2.5 Maintaining Tack Coat

(1) Protect and repair the existing surface and the tack coat. Correct areas with excess or deficient tack material and any breaks, raveled spots, or other areas where bond might be affected.

455.4 Measurement

455.4.1 General

(1) The department will measure the Asphaltic Material Seal Coat and Tack Coat bid items by the ton or gallon acceptably completed, based on either shipment net weight, or corrected volume. The department will not measure nonconforming materials unless the engineer allows those materials to remain in place. The department will deduct for material wasted or not actually incorporated in the work.

455.4.2 Corrected Volume

(1) The department will measure asphaltic material for seal coats, tack coats, and similar products in calibrated tank cars, tank trucks, or storage tanks. Calibrate storage tanks and provide the engineer with charts indicating the depth versus liquid volume relationship.

(2) The department will correct the measured volume to a temperature of 60 F for PG, MC, and SC asphalts as follows:

- If the specific gravity at 60 F is greater than 0.966:

$$V = V1(1.021 - 0.00035T)$$

- If the specific gravity at 60 F is from 0.850 to 0.966 inclusive:

$$V = V1(1.0246 - 0.00041T)$$

Where:

V = Volume in gallons at 60 F.

V1 = Volume in gallons at observed temperature, F.

T = Observed temperature, F.

(3) Calculate the volume correction for emulsified asphalts as follows:

$$V = V1 / (0.985 + 0.00025T)$$

Where:

V = Volume in gallons at 60 F.

V1 = Volume in gallons at observed temperature, F.

T = Observed temperature, F.

455.5 Payment

455.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
455.0500	Asphaltic Material Seal Coat	TON
455.0505	Asphaltic Material Seal Coat	GAL
455.0600	Tack Coat	TON
455.0605	Tack Coat	GAL

455.5.2 Asphaltic Material Seal Coat

(1) Payment for Asphaltic Material Seal Coat is full compensation for furnishing asphaltic material used in seal coats provided under 475. The department will pay for nonconforming seal coat material the engineer allows to remain in place at 75 percent of the contract unit price.

455.5.3 Tack Coat

(1) Payment for Tack Coat is full compensation for providing tack coat; for preparing the surface; and for maintaining the completed work.

Revise 455.5.3(2) to allow penalties greater than 25% for nonconforming tack coat. This change was implemented in ASP 6 effective with the December 2017 letting.

(2) The department will adjust pay for Tack Coat, under the Nonconforming Tack Coat administrative item, for nonconforming material the engineer allows to remain in place at a maximum of 75 percent of the contract unit price.

Section 460 Hot Mix Asphalt Pavement

460.1 Description

(1) This section describes HMA mixture design, providing and maintaining a quality management program for HMA mixtures, and constructing HMA pavement. Unless specifically indicated otherwise, references within 460 to HMA also apply to WMA.

460.2 Materials

460.2.1 General

(1) Furnish a homogeneous mixture of coarse aggregate, fine aggregate, mineral filler if required, SMA stabilizer if required, recycled material if used, warm mix asphalt additive or process if used, and asphaltic material. Design mixtures conforming to table 460-1 and table 460-2 to 4.0 percent air voids to establish the aggregate structure.

(2) Determine the target JMF asphalt binder content for production from the mix design data corresponding to 3.0 percent air voids (97 percent Gmm) target at the design the number of gyrations (Ndes). Add liquid asphalt to achieve the required air voids at Ndes.

(3) For SMA, determine the target JMF asphalt binder content for production from the mix design data corresponding to 4.0 percent air voids (96 percent Gmm) target at Ndes.

460.2.2 Aggregates

460.2.2.1 General

(1) Provide coarse aggregates from a department-approved source as specified under 106.3.4.2. Obtain the engineer's approval of the aggregates before producing HMA mixtures.

(2) Furnish an aggregate blend consisting of hard durable particles containing no more than a combined total of one percent, by weight, of lumps of clay, loam, shale, soft particles, organic matter, adherent coatings, and other deleterious material. Ensure that the aggregate blend conforms to the percent fractured faces and flat & elongated requirements of table 460-2. If the aggregate blend contains materials from different deposits or sources, ensure that material from each deposit or source has an LA wear percent loss meeting the requirements of table 460-2.

460.2.2.2 Freeze-Thaw Soundness

(1) If the aggregate blend contains materials from different deposits or sources, ensure that material from each deposit or source has a freeze-thaw loss percentage meeting the requirements of table 460-2 and 106.3.4.2.2.2.

460.2.2.3 Aggregate Gradation Master Range

(1) Ensure that the aggregate blend, including recycled material and mineral filler, conforms to the gradation requirements in table 460-1. The values listed are design limits; production values may exceed those limits.

TABLE 460-1 AGGREGATE GRADATION MASTER RANGE AND VMA REQUIREMENTS

SIEVE	PERCENT PASSING DESIGNATED SIEVES						
	NOMINAL SIZE						
	No. 1 (37.5 mm)	No. 2 (25.0 mm)	No.3 (19.0 mm)	No. 4 (12.5 mm)	No. 5 (9.5 mm)	SMA No. 4 (12.5 mm)	SMA No. 5 (9.5 mm)
50.0-mm	100						
37.5-mm	90 –100	100					
25.0-mm	90 max	90 -100	100				
19.0-mm	___	90 max	90 -100	100		100	
12.5-mm	___	___	90 max	90 -100	100	90 - 97	100
9.5-mm	___	___	___	90 max	90 -100	58 - 72	90 - 100
4.75-mm	___	___	___	___	90 max	25 - 35	35 - 45
2.36-mm	15 - 41	19 - 45	23 - 49	28 - 58	32 - 67	15 - 25	18 - 28
75-µm	0 - 6.0	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0	8.0 - 12.0	10.0 - 14.0
% MINIMUM VMA	11.0	12.0	13.0	14.0[1]	15.0[2]	16.0	17.0

[1] 14.5 for LT and MT mixes.

[2] 15.5 for LT and MT mixes.

460.2.3 Asphaltic Binders

(1) The department will designate the grade of asphaltic binder in the HMA Pavement bid item. Use the binder grade the bid item specifies. Do not change the PG binder grade without the engineer's written approval. The department will designate the grade of virgin asphaltic binder in the contract, however, the contractor may use virgin binder, modified binder, a blend of virgin and recovered binder, or a blend of modified and recovered binder. When the percent asphalt binder replaced exceeds the allowable limits in 460.2.5, provide test results from extracted and recovered binder to ensure that the resultant asphaltic binder conforms to the contract specifications.

460.2.4 Additives

460.2.4.1 Hydrated Lime Antistripping Agent

(1) If used in HMA mixtures, furnish hydrated lime conforming to ASTM C977 and containing no more than 8 percent unhydrated oxides. Percent added is by weight of the total dry aggregate.

460.2.4.2 Liquid Antistripping Agent

(1) If used in HMA mixtures, add liquid antistripping agent to the asphaltic binder before introducing the binder into the mixture. Provide documentation indicating that addition of liquid antistripping agent will not alter the characteristics of the original asphaltic binder performance grade (PG).

460.2.4.3 Stone Matrix Asphalt Stabilizer

(1) Add an organic fiber, an inorganic fiber, a polymer-plastic, a polymer-elastomer, or approved alternate stabilizer to all SMA mixtures. If proposing an alternate, submit the proposed additive system, asphaltic binder, and stabilizer additive, along with samples of the other mixture materials to the department at least 14 days before the project let date. The department will approve or reject that proposed alternate additive system no later than 48 hours before the project let date.

(2) Use a single additive system for all SMA pavement in the contract.

460.2.4.4 Warm Mix Asphalt Additive or Process

(1) Use additives or processes from the department's APL. Follow supplier or manufacturer recommendations for additives and processes when producing WMA mixtures.

460.2.5 Recycled Asphaltic Materials

(1) The contractor may use recycled asphaltic materials from FRAP, RAP, and RAS in HMA mixtures. Stockpile recycled materials separately from virgin materials and list each as individual JMF components.

(2) Control recycled materials used in HMA by evaluating the percent binder replacement, the ratio of recovered binder to the total binder. Conform to the following:

MAXIMUM ALLOWABLE PERCENT BINDER REPLACEMENT

RECYCLED ASPHALTIC MATERIAL	LOWER LAYERS	UPPER LAYER
RAS if used alone	25	20
RAP and FRAP in any combination	40	25
RAS, RAP, and FRAP in combination[1]	35	25

[1] When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate blend.

460.2.6 Recovered Asphaltic Binders

Revise 460.2.6(1) to allow the use of the Asphalt Analyzer™.

(1) Establish the percent of recovered asphaltic binder from FRAP, RAP, and RAS for the mixture design using an Asphalt Analyzer™ or according to AASHTO T164 using the appropriate dust correction procedure. If production test results indicate a change in the percent of recovered asphaltic binder, the contractor or the engineer may request a change in the design recovered asphaltic binder. Provide the department with documentation of at least 2 recent extraction samples supporting that change. Ensure that those samples were prepared by a WisDOT qualified laboratory.

(2) The contractor may replace virgin binder with recovered binder up to the maximum percentage allowed under 460.2.5 without changing the asphaltic binder grade. If using more than the maximum allowed under 460.2.5, furnish test results indicating that the resultant binder meets the grade the contract originally specified.

460.2.7 HMA Mixture Design

Add footnote [7] to table 460-2 to specify the asphalt content for TSR testing. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) For each HMA mixture type used under the contract, develop and submit an asphaltic mixture design according to CMM 8-66 and conforming to the requirements of table 460-1 and table 460-2. The values listed are design limits; production values may exceed those limits. The department will review mixture designs and report the results of that review to the designer according to CMM 8-66.

TABLE 460-2 MIXTURE REQUIREMENTS

Mixture type	LT	MT	HT	SMA
ESALs x 10^6 (20 yr design life)	<2.0	2 - <8	>8	___
LA Wear (AASHTO T96)				
100 revolutions(max % loss)	13	13	13	13
500 revolutions(max % loss)	50	45	45	40
Soundness (AASHTO T104) (sodium sulfate, max % loss)	12	12	12	12
Freeze/Thaw (AASHTO T103) (specified counties, max % loss)	18	18	18	18
Fractured Faces (ASTM D5821 as modified in CMM 8-60) (one face/2 face, % by count)	65/___	75 / 60	98 / 90	100/90
Flat & Elongated (ASTM D4791) (max %, by weight)	5 (5:1 ratio)	5 (5:1 ratio)	5 (5:1 ratio)	20 (3:1 ratio)
Fine Aggregate Angularity (AASHTO T304, method A, min)	40	43	45	45
Sand Equivalency (AASHTO T176, min)	40	40	45	50
Gyratory Compaction				
Gyrations for N_{ini}	6	7	8	8
Gyrations for N_{des}	40	75	100	65
Gyrations for N_{max}	60	115	160	160
Air Voids, $\%V_a$ ($\%G_{mm}$ N_{des})	4.0 (96.0)	4.0 (96.0)	4.0 (96.0)	4.0 (96.0)
% G_{mm} N_{ini}	<= 91.5[1]	<= 89.0[1]	<= 89.0	___
% G_{mm} N_{max}	<= 98.0	<= 98.0	<= 98.0	___
Dust to Binder Ratio[2] (% passing 0.075/P_{be})	0.6 - 1.2	0.6 - 1.2	0.6 - 1.2	1.2 - 2.0
Voids filled with Binder (VFB or VFA, %)	68 - 80[4] [5]	65 - 75[3] [5]	65 - 75[3] [5]	70 - 80
Tensile Strength Ratio (TSR) (AASHTO T283)[6] [7]				
no antistripping additive	0.75 min	0.75 min	0.75 min	0.75 min
with antistripping additive	0.80 min	0.80 min	0.80 min	0.80 min
Draindown (AASHTO T305) (%)	___	___	___	0.30

[1] The percent maximum density at initial compaction is only a guideline.

[2] For a gradation that passes below the boundaries of the caution zone (ref. AASHTO M323), the dust to binder ratio limits are 0.6 - 1.6.

[3] For No. 5 (9.5mm) and No. 4 (12.5 mm) nominal maximum size mixtures, the specified VFB range is 70 - 76 percent.

[4] For No. 2 (25.0mm) nominal maximum size mixes, the specified VFB lower limit is 67 percent.

[5] For No. 1 (37.5mm) nominal maximum size mixes, the specified VFB lower limit is 67 percent.

[6] WisDOT eliminates freeze-thaw conditioning cycles from the TSR test procedure.

[7] Run TSR at asphalt content corresponding to 3.0% air void regressed design using distilled water for testing.

460.2.8 Quality Management Program

460.2.8.1 General

(1) Provide and maintain a QC program defined as all activities, including mix design, process control inspection, sampling and testing, and process adjustments related to producing and placing HMA pavement conforming to the specifications.

(2) The department will provide product quality verification as follows:

1. By conducting verification testing of independent samples.
2. By periodically observing contractor sampling and testing.
3. By monitoring required control charts exhibiting test results and control parameters.
4. By the engineer directing the contractor to take additional samples at any time during production.

(3) Refer to CMM 8-36 for detailed guidance on sampling, testing, and documentation under the QMP.

460.2.8.2 Contractor Testing

460.2.8.2.1 Required Quality Control Program

460.2.8.2.1.1 Personnel Requirements

Revise 460.2.8.2.1.1 to specify minimum HTCP certifications for contractors at HMA production facilities.

(1) Provide HTCP-certified sampling and testing personnel. Provide at least one full-time technician minimally qualified as an HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT) at each plant site furnishing material to the project. Before mixture production begins, provide an organizational chart in the contractor's laboratory. Include the names, telephone numbers, and current certifications of personnel with QC responsibilities. Keep the chart updated.

(2) Ensure that sampling and testing personnel are minimally qualified as follows[1]:

- HMA technician certified at a level appropriate for sampling, Transportation Materials Sampling Technician (TMS).
- HMA technician certified at a level appropriate for production control testing (HMA-IPT).
- Assistant Certified Technician (ACT)[2].

[1] After informing the engineer, a non-certified person under the direct observation of an HTCP-certified HMA technician may sample for a period not to exceed 3 calendar days.

[2] An HTCP-certified HMA technician must coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single HTCP-certified technician.

(3) Have an HMA-IPT technician ensure that sampling and testing is performed correctly, analyze test results, and post resulting data.

(4) Have an HTCP-certified Hot Mix Asphalt, Trouble Shooting, Process Control (HMA-TPC) technician or HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technician available to make necessary process adjustments.

460.2.8.2.1.2 Laboratory Requirements

(1) Conduct QC testing in a facility conforming to the department's laboratory qualification program.

(2) Ensure that testing equipment conforms to the equipment specifications applicable to the required testing methods.

460.2.8.2.1.3 Required Sampling and Testing

460.2.8.2.1.3.1 Contracts with 5000 Tons of Mixture or Greater

(1) Furnish and maintain a laboratory at the plant site fully equipped for performing contractor QC testing. Have the laboratory on-site and operational before beginning mixture production.

(2) Obtain random samples and perform tests according to CMM 8-36. Obtain HMA mixture samples from trucks at the plant. Perform tests the same day taking the sample.

(3) Retain the split portion of the contractor HMA mixture and blended aggregate samples for 14 calendar days at the laboratory site in a dry, protected area. The engineer may decrease this 14-day retention period. At project completion the contractor may dispose of remaining samples if the engineer approves.

Revise 460.2.8.2.1.3.1(4) to eliminate the bucket method and allow only ignition oven, chemical extraction, or Asphalt Analyzer™ methods for determining AC content.

(4) Use the test methods identified below, or other methods the engineer approves, to perform the following tests at a frequency greater than or equal to that indicated:

Blended aggregate gradations:

Drum plants:

- Field extraction by ignition oven according to AASHTO T308 (CMM 8-36.6.3.6), chemical extraction according to AASHTO T-164, or Asphalt Analyzer™ according to manufacturer recommendations. Gradation of resulting aggregate sample determined according to AASHTO T30.
- Belt samples, optional for virgin mixtures, obtained from stopped belt or from the belt discharge using an engineer-approved sampling device and performed according to AASHTO T11 and T27.

Batch plants:

- Field extraction by ignition oven according to AASHTO T308 (CMM 8-36.6.3.6), chemical extraction according to AASHTO T-164, or Asphalt Analyzer™ according to manufacturer recommendations. Gradation of resulting aggregate sample determined according to AASHTO T30.

Asphalt content (AC) in percent:

AC by ignition oven according to AASHTO T308 (CMM 8-36.6.3.6), chemical extraction according to AASHTO T-164, or Asphalt Analyzer™ according to manufacturer recommendations. Gradation of resulting aggregate sample determined according to AASHTO T30.

Bulk specific gravity of the compacted mixture according to AASHTO T166.

Maximum specific gravity according to AASHTO T209.

Air voids (V_a) by calculation according to AASHTO T269.

VMA by calculation according to AASHTO R35.

(5) Test each design mixture at a frequency at or above the following:

TOTAL DAILY PLANT PRODUCTION FOR DEPARTMENT CONTRACTS in tons	SAMPLES PER DAY[1]
50 to 600	1
601 to 1500	2
1501 to 2700	3
2701 to 4200	4
greater than 4200	see footnote[2]

[1] Frequencies are for planned production. If production is other than planned, conform to CMM 8-36.

[2] Add a random sample for each additional 1500 tons or fraction of 1500 tons.

Revise 460.2.8.2.1.3.1(6) to contractually mobilize the CMM for production TSR testing requirements. This change was implemented in ASP 6 effective with the December 2017 letting.

(6) Conduct TSR tests during mixture production according to CMM 8-36.6.14. Test each full 50,000 ton production increment, or fraction of an increment, after the first 5000 tons of production. Perform required increment testing in the first week of production of that increment. If production TSR values are below the limit specified in CMM 8-36.6.14, notify the engineer. The engineer and contractor will jointly determine a corrective action.

460.2.8.2.1.3.2 Contracts with Less Than 5000 Tons of Mixture

(1) Conform to 460.2.8.2.1.3.1 modified as follows:

- The contractor may conduct QC tests in an off-site laboratory.
- No field tensile strength ratio testing is required.

460.2.8.2.1.3.3 Contracts with Less Than 500 Tons of Mixture

(1) The engineer may waive QC testing on contracts with less than 500 tons of mixture. If testing is waived, acceptance will be by visual inspection unless defined otherwise by contract change order.

(2) If HMA density testing is waived under 460.3.3.3, QC testing is also waived.

460.2.8.2.1.3.4 Temporary Pavements

(1) The engineer may waive all testing for temporary pavements, defined for this purpose as pavements that will be placed and removed before contract completion.

460.2.8.2.1.4 Documentation

460.2.8.2.1.4.1 Records

(1) Document observations, inspection records, mixture adjustments, and test results daily. Note observations and inspection records in a permanent field record as they occur. Record process adjustments and JMF changes. Submit copies of the running average calculation sheets for blended aggregate, mixture properties, and asphalt content along with mixture adjustment records to the engineer each day. Submit testing records and control charts to the engineer in a neat and orderly manner within 10 days after paving is completed.

(2) Continue charts, records, and testing frequencies, for a mixture produced at one plant site, from contract to contract.

460.2.8.2.1.4.2 Control Charts

(1) Maintain standardized control charts at the laboratory. Record contractor test results on the charts the same day as testing. Record data on the standardized control charts as follows:

- Blended aggregate gradation tests in percent passing. Of the following, plot those sieves the design specifications require: 37.5-mm, 25.0-mm, 19.0-mm, 12.5-mm, 9.5-mm, 2.36-mm, and 75-µm.
- Asphalt material content in percent.
- Air voids in percent.
- VMA in percent.

(2) Plot both the individual test point and the running average of the last 4 data points on each chart. Show QC data in black with the running average in red. Draw the warning limits with a dashed green line and the JMF limits with a dashed red line. The contractor may use computer generated black-and-white printouts with a legend that clearly identifies the specified color coded components.

460.2.8.2.1.5 Control Limits

(1) Conform to the following control limits for the JMF and warning limits based on a running average of the last 4 data points:

ITEM	JMF LIMITS	WARNING LIMITS
Percent passing given sieve:		
37.5-mm	+/- 6.0	+/- 4.5
25.0-mm	+/- 6.0	+/- 4.5
19.0-mm	+/- 5.5	+/- 4.0
12.5-mm	+/- 5.5	+/- 4.0
9.5-mm	+/- 5.5	+/- 4.0
2.36-mm	+/- 5.0	+/- 4.0
75-µm	+/- 2.0	+/- 1.5
Asphaltic content in percent	- 0.3	- 0.2
Air voids in percent[1]	+1.3/-1.0	+1.0/-0.7
VMA in percent[2]	- 0.5	- 0.2

[1] For SMA, JMF limits are +/-1.3 and warning limits are +/-1.0.

[2] VMA limits based on minimum requirement for mix design nominal maximum aggregate size in table 460-1.

(2) Warning bands are defined as the area between the JMF limits and the warning limits.

460.2.8.2.1.6 Job Mix Formula Adjustment

Revise 460.2.8.2.1.6 to specify minimum HTCP certification for QC HMA Technicians requesting adjustment to the JMF.

(1) The contractor may request adjustment of the JMF according to CMM 8-36.6.13.1. Have an HTCP-certified Hot Mix Asphalt, Trouble Shooting, Process Control (HMA-TPC) technician or HTCP-certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technician submit a written JMF adjustment request. Ensure that the resulting JMF is within specified master gradation bands. The department will have an HMA-MD technician review the proposed adjustment and, if acceptable, issue a revised JMF.

(2) The department will not allow adjustments that do the following:

- Exceed specified JMF tolerance limits.
- Reduce the JMF asphalt content unless the production VMA running average meets or exceeds the minimum VMA design requirement defined in table 460-1 for the mixture produced.

(3) Have an HMA-TPC technician make related process adjustments. If mixture redesign is necessary, have an HMA-MD technician submit a new JMF, subject to the same specification requirements as the original JMF.

460.2.8.2.1.7 Corrective Action

(1) When running average values trend toward the warning limits, consider taking corrective action. Document corrective action undertaken. Include test results in the contract files and in running average calculations.

(2) Notify the engineer if running average values exceed the warning limits. If two consecutive running average values exceed the warning limits, stop production and make adjustments. Do not restart production until after notifying the engineer of the adjustments made. Do not calculate a new running average until the fourth test after the required production stop.

(3) If the process adjustment improves the property in question so that the running average after 4 additional tests is within the warning limits, the contractor may continue production with no reduction in payment.

(4) If the adjustment does not improve the properties and the running average after 4 additional tests stays inside the warning bands, the mixture is nonconforming and subject to pay adjustment.

(5) If the contractor fails to stop production and make adjustments when required, all mixture produced from the stop point to the point when the running average is back inside the warning limits is nonconforming and subject to pay adjustment.

(6) If the running average values exceed the JMF limits, stop production and make adjustments. Do not restart production until after notifying the engineer of the adjustments made. Continue calculating the running average after the production stop.

(7) If the air voids running average of 4 exceeds the JMF limits, the material is nonconforming. Remove and replace unacceptable material. The engineer will determine the quantity of material to replace based on the testing data using the methods in CMM 8-36 and an inspection of the completed pavement. If the engineer allows the mixture to remain in place, the department will pay for the mixture and asphaltic material as specified in 460.5.2.1.

(8) If the running average of 4 exceeds the JMF limits for other properties, and the engineer allows the mixture to remain in place, the department will pay for the mixture as specified in 460.5.2.1. The engineer will determine the quantity of material subject to pay reduction based on the testing data and an inspection of the completed pavement.

460.2.8.3 Department Testing

460.2.8.3.1 Quality Verification Program

460.2.8.3.1.1 General

(1) The engineer will conduct QV tests to determine the quality of the final product and measure characteristics that predict relative performance.

460.2.8.3.1.2 Personnel Requirements

Revise 460.2.8.3.1.2 to specify minimum HTCP certification for HMA Technicians working for the department.

(1) The department will provide at least one HTCP-certified Transportation Materials Sampling Technician (TMS) technician to observe QV sampling of project mixtures.

(2) An HTCP-certified Hot Mix Asphalt, Technician I, Production Tester (HMA-IPT) or an HMA ACT working under the HTCP-certified technician, will split samples and do the testing. An HMA-IPT technician will coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single certified technician.

(3) An HMA-IPT technician will ensure that sampling and testing is performed correctly, analyze test results, and post resulting data.

(4) The department will make an organizational chart available at the testing laboratory and to the contractor before mixture production begins. The department's chart will include names, telephone numbers, and current certifications of QV testing personnel. The department will update the chart with appropriate changes, as they become effective.

460.2.8.3.1.3 Laboratory Requirements

(1) The department will furnish and maintain a facility for QV testing conforming to the department's laboratory qualification program requirements and fully equipped to perform QV testing. In all cases, the department will conduct testing in a separate laboratory from the contractor's laboratory.

460.2.8.3.1.4 Department Verification Testing Requirements

(1) HTCP-certified department personnel will obtain random samples by directly supervising HTCP-certified contractor personnel sampling from trucks at the plant. The department will sample according to CMM 8-36. Sample size must be adequate to run the appropriate required tests in addition to one set of duplicate tests that may be required for dispute resolution. The engineer will split the sample for testing and retain the remaining portion for additional testing if needed.

(2) The department will verify product quality using the test methods specified in 460.2.8.3.1.4(3), other engineer-approved methods, or other methods the industry and department HMA technical team recognizes. The department will identify test methods before construction starts and use only those methods during production of that material unless the engineer and contractor mutually agree otherwise.

(3) The department will perform testing conforming to the following standards:

Bulk specific gravity (G_{mb}) of the compacted mixture according to AASHTO T166.

Maximum specific gravity (G_{mm}) according to AASHTO T209.

Air voids (V_a) by calculation according to AASHTO T269.

VMA by calculation according to AASHTO R35.

(4) The department will randomly test each design mixture at the following minimum frequency:

FOR TONNAGES TOTALING:

Less than 501 tons ..... no tests required

From 501 to 5,000 tons..... one test

More than 5,000 tons..... add one test for each additional 5,000-ton increment

460.2.8.3.1.5 Documentation

(1) The engineer will document observations during QV sampling, and review QC mixture adjustments and QC test results daily. The engineer will note results of observations and inspection records in a permanent field record as they occur.

460.2.8.3.1.6 Acceptable Verification Parameters

(1) The engineer will provide test results to the contractor within 2 mixture-production days after obtaining the sample. The quality of the product is acceptably verified if it meets the following limits:

- Va is within a range of 2.0 to 4.3 percent. For SMA, Va is within a range of 2.7 to 5.3 percent.
- VMA is within minus 0.5 of the minimum requirement for the mix design nominal maximum aggregate size.

(2) If QV test results are outside the specified limits, the engineer will investigate immediately through dispute resolution procedures. The engineer may stop production while the investigation is in progress if the potential for a pavement failure is present.

(3) If production continues for that mixture design, the engineer will provide additional retained sample testing at the frequency provided for in CMM 8-36. This supplemental testing will continue until the material meets allowable differences or as the engineer and contractor mutually agree.

460.2.8.3.1.7 Dispute Resolution

(1) When QV test results do not meet the specified limits, the bureau's AASHTO accredited laboratory and certified personnel will referee test the retained portion of the QV sample and the retained portion of the nearest available previous QC sample.

(2) The department will notify the contractor of the referee test results within 3 business days after receipt of the samples.

(3) The department will determine mixture conformance and acceptability by analyzing referee test results, reviewing mixture project data, and inspecting the completed pavement all according to CMM 8-36.

460.2.8.3.1.8 Corrective Action

(1) Remove and replace unacceptable material at no additional expense to the department.

(2) The department will reduce pay for the tonnage of nonconforming mixture, as determined during QV dispute resolution, if the engineer allows that mixture to remain in place. If production of that mixture design continued during the investigation, the department will also adjust pay for that mixture forward to the next conforming QV or QC point. The department will pay for the affected mixture as specified in 460.5.2.1.

460.2.8.3.2 Independent Assurance Testing

(1) The department will evaluate both the contractor and department testing personnel and equipment as specified in 106.3.4.3.4.

460.3 Construction

460.3.1 General

(1) Construct HMA pavement of the type the bid item indicates encoded as follows:

Combined Bid Item Encoding

3	LT	58-34	S
Gradation	**Traffic**	**Binder**	**Designation**

GRADATIONS (NMAS)		TRAFFIC VOLUME		BINDER DESIGNATION LEVEL	
1	37.5 mm	LT	Low	S	Standard
2	25.0 mm	MT	Medium	H	Heavy
3	19.0 mm	HT	High	V	Very Heavy
4	12.5 mm			E	Extremely Heavy
5	9.5 mm				
6	4.75 mm				

(2) Construct HMA pavement conforming to the general provisions of 450.3.

460.3.2 Thickness

Revise 460.3.2 to reduce the minimum layer thickness for No. 5 (9.5 mm) aggregate from 1.5 inches to 1.25 inches.

(1) Provide the plan thickness for lower and upper layers limited as follows:

NOMINAL SIZE	MINIMUM LAYER THICKNESS (in inches)	MAX LOWER LAYER THICKNESS (in inches)	MAX UPPER LAYER THICKNESS (in inches)	MAX SINGLE LAYER THICKNESS[3] (in inches)
No. 1 (37.5 mm)	4.5	6	4.5	6
No. 2 (25.0 mm)	3.0	5	4	6
No. 3 (19.0 mm	2.25	4	3	5
No. 4 (12.5 mm)[1] [4]	1.75	3[2]	2.5	4
No. 5 (9.5 mm)[1] [4]	1.25	3[2]	2	3

[1] SMA mixtures use nominal size No. 4 (12.5 mm) or No. 5 (9.5 mm).

[2] SMA mixtures with nominal sizes of No. 4 (12.5 mm) and No. 5 (9.5 mm) have no maximum lower layer thickness specified.

[3] For use on cross-overs and shoulders.

[4] Can be used for a leveling layer or scratch coat at a reduced thickness.

460.3.3 HMA Pavement Density Maximum Density Method

460.3.3.1 Minimum Required Density

(1) Compact all layers of HMA mixture to the density table 460-3 shows for the applicable mixture, location, and layer.

TABLE 460-3 MINIMUM REQUIRED DENSITY[1]

LOCATION	LAYER	PERCENT OF TARGET MAXIMUM DENSITY		
		MIXTURE TYPE		
		LT and MT	HT	SMA[5]
TRAFFIC LANES[2]	LOWER	93.0[3]	93.0[4]	___
	UPPER	93.0	93.0	___
SIDE ROADS, CROSSOVERS, TURN LANES, & RAMPS	LOWER	93.0[3]	93.0[4]	___
	UPPER	93.0	93.0	___
SHOULDERS & APPURTENANCES	LOWER	91.0	91.0	___
	UPPER	92.0	92.0	___

[1] The table values are for average lot density. If any individual density test result falls more than 3.0 percent below the minimum required target maximum density, the engineer may investigate the acceptability of that material.

[2] Includes parking lanes, bike lanes, and park-and-ride lots as defined by the contract plans.

[3] Minimum reduced by 2.0 percent for a lower layer constructed directly on crushed aggregate or recycled base courses.

[4] Minimum reduced by 1.0 percent for a lower layer constructed directly on crushed aggregate or recycled base courses.

[5] The minimum required densities for SMA mixtures are determined according to CMM 8-15.

460.3.3.2 Pavement Density Determination

(1) The engineer will determine the target maximum density using department procedures described in CMM 8-15. The engineer will determine density as soon as practicable after compaction and before placement of subsequent layers or before opening to traffic.

(2) Do not re-roll compacted mixtures with deficient density test results. Do not operate continuously below the specified minimum density. Stop production, identify the source of the problem, and make corrections to produce work meeting the specification requirements.

(3) A lot is defined in CMM 8-15 and placed within a single layer for each location and target maximum density category indicated in table 460-3. The lot density is the average of all samples taken for that lot. The department determines the number of tests per lot according to either the linear sublot system or the nominal tonnage system defined in CMM 8-15.

Revise 460.3.3.2(4) to specify minimum HTCP certifications for department or contractor nuclear density technicians.

(4) An HTCP-certified Nuclear Density Technician I (NUCDENSITYTEC-I) or a nuclear density ACT working under a NUCDENSITYTEC-I technician, will locate samples and perform the testing. A NUCDENSITYTEC-I technician will coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single NUCDENSITYTEC-I technician. The responsible NUCDENSITYTEC-I technician will ensure that sample location and testing is performed correctly, analyze test results, and provide density results to the contractor weekly.

460.3.3.3 Waiving Density Testing

(1) The engineer may waive density testing for one or more of the following reasons:

1. It is impracticable to determine density by the lot system.
2. The contract contains less than 750 tons of a given mixture type placed within the same layer and target maximum density category.

(2) If the department waives density testing notify the contractor before paving. The department will accept the mixture by the ordinary compaction procedure as specified in 450.3.2.6.2.

(3) If HMA QC testing is waived under 460.2.8.2.1.3.3, density testing is also waived.

460.4 Measurement

(1) The department will measure the HMA Pavement bid items acceptably completed by the ton as specified in 450.4.

460.5 Payment

460.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
460.5000 - 5999	HMA Pavement (gradation) LT (binder)(designation)	TON
460.6000 - 6999	HMA Pavement (gradation) MT (binder)(designation)	TON
460.7000 - 7999	HMA Pavement (gradation) HT (binder)(designation)	TON
460.8000 - 8999	HMA Pavement (gradation) SMA (binder)(designation)	TON
460.2000	Incentive Density HMA Pavement	DOL

460.5.2 HMA Pavement

460.5.2.1 General

(1) The department will pay for the HMA Pavement bid items at the contract unit price subject to one or more of the following adjustments:

1. Disincentive for density of HMA pavement as specified in 460.5.2.2.
2. Incentive for density of HMA pavement as specified in 460.5.2.3.
3. Reduced payment for nonconforming smoothness as specified in 450.3.2.9.
4. Reduced payment for nonconforming QMP HMA mixtures as specified in 460.2.8.2.1.7.

(2) Payment for the HMA Pavement bid items is full compensation for providing HMA pavement including binder; for mixture design; for preparing the foundation; and for QMP and aggregate source testing.

(3) If provided for in the plan quantities, the department will pay for a leveling layer, placed to correct irregularities in an existing paved surface before overlaying, under the pertinent paving bid item. Absent a plan quantity, the department will pay for a leveling layer as extra work.

(4) The department will administer pay reduction for nonconforming QMP mixture under the Nonconforming QMP HMA Mixture administrative item. The department will reduce pay based on the contract unit price for the HMA Pavement bid item.

(5) The department will reduce pay for nonconforming QMP HMA mixtures as specified in 460.2.8.2.1.7, starting from the stop point to the point when the running average of 4 is back inside the warning limits. The engineer will determine the quantity of material subject to pay reduction based on the testing data and an inspection of the completed pavement. The department will reduce pay as follows:

PAYMENT FOR MIXTURE[1] [2]

ITEM	PRODUCED WITHIN WARNING BANDS	PRODUCED OUTSIDE JMF LIMITS
Gradation	90%	75%
Asphalt Content	85%	75%
Air Voids	70%	50%
VMA	90%	75%

[1] For projects or plants where the total production of each mixture design requires less than 4 tests refer to CMM 8-36.

[2] Payment is in percent of the contract unit price for the HMA Pavement bid item. The department will reduce pay based on the nonconforming property with lowest percent pay.

[3] In addition to any pay adjustment listed in the table above, the department will adjust pay for nonconforming binder under the Nonconforming QMP Asphaltic Material administrative item. The department will deduct 25 percent of the contract unit price of the HMA Pavement bid item per ton of pavement placed with nonconforming PG binder the engineer allows to remain in place.

(6) If during a QV dispute resolution investigation the department discovers mixture with 1.5 > Va > 5.0 or VMA more than 1.0 below the minimum allowed in table 460-1, and the engineer allows that mixture to remain in place, the department will pay for the quantity of affected material at 50 percent of the contract price.

(7) If the department waives density testing under 460.3.3.3, the department will not adjust pay under either 460.5.2.2 or 460.5.2.3.

(8) Restore the surface after cutting density samples as specified in 460.3.3.2(1) at no additional cost to the department.

460.5.2.2 Disincentive for HMA Pavement Density

(1) The department will administer density disincentives under the Disincentive Density HMA Pavement administrative item. If the lot density is less than the specified minimum in table 460-3, the department will reduce pay based on the contract unit price for the HMA Pavement bid item for that lot as follows:

DISINCENTIVE PAY REDUCTION FOR HMA PAVEMENT DENSITY

PERCENT LOT DENSITY BELOW SPECIFIED MINIMUM	PAYMENT FACTOR (percent of contract price)
From 0.5 to 1.0 inclusive	98
From 1.1 to 1.5 inclusive	95
From 1.6 to 2.0 inclusive	91
From 2.1 to 2.5 inclusive	85
From 2.6 to 3.0 inclusive	70
More than 3.0[1]	___

[1] Remove and replace the lot with a mixture at the specified density. When acceptably replaced, the department will pay for the replaced work at the contract unit price. Alternatively the engineer may allow the nonconforming material to remain in place with a 50 percent payment factor.

(2) The department will not assess density disincentives for pavement placed in cold weather because of a department-caused delay as specified in 450.5.2(3).

460.5.2.3 Incentive for HMA Pavement Density

(1) If the lot density is greater than the minimum specified in table 460-3 and all individual air voids test results for that mixture placed during the same day are within 2.5 - 4.0 percent, the department will adjust pay for that lot as follows:

INCENTIVE PAY ADJUSTMENT FOR HMA PAVEMENT DENSITY

PERCENT LOT DENSITY ABOVE SPECIFIED MINIMUM	PAY ADJUSTMENT PER TON[1]
From -0.4 to 1.0 inclusive	$0
From 1.1 to 1.8 inclusive	$0.40
More than 1.8	$0.80

[1] The department will prorate the pay adjustment for a partial lot.

(2) The department will adjust pay under the Incentive Density HMA Pavement bid item. Adjustment under this item is not limited, either up or down, to the bid amount the schedule of items shows.

(3) For shoulders paved integrally with the traffic lane, if the traffic lane does not meet incentive requirements, the department will not pay incentive on the integrally paved shoulder.

Section 465 Asphaltic Surface

465.1 Description

(1) This section describes constructing asphaltic surface for new construction including pavement, safety islands, curb, rumble strip, and flumes. This section also describes using asphaltic surface for patching, detours, and temporary construction. The department will designate work under the bid items in this section only if the QMP provisions specified for HMA pavements under 460 are not required.

465.2 Materials

(1) Under the Asphaltic Surface, Asphaltic Surface Detours, and Asphaltic Surface Patching bid items; submit a mix design. Furnish asphaltic mixture meeting the requirements specified for either type LT or MT mix under 460.2; except the engineer will not require the contractor to conform to the quality management program specified under 460.2.8.

(2) Under the other 465 bid items, the contractor need not submit a mix design. Furnish aggregates mixed with a type AC asphaltic material. Use coarse and fine mineral aggregates uniformly coated and mixed with the asphaltic material in an engineer-approved mixing plant. The contractor may include reclaimed asphaltic pavement materials in the mixture.

465.3 Construction

465.3.1 General

(1) Prepare the foundation as specified for asphaltic surfacing in 211.

(2) Place using engineer-approved machine methods wherever practicable. Except for the surfacing bid items, the contractor may place material by engineer-approved hand methods. Regardless of the placement technique, spread and shape the material to the required contour without segregation.

(3) Immediately after placement, compact the mixture to produce a dense smooth surface using ordinary compaction procedures as specified in 450.3.2.6 except as follows:

- Compact safety islands as the engineer directs.
- Compact flumes using compactors, tampers, or rollers.
- Compact curb as specified in 465.3.2.

(4) Ensure that the finished surface is smooth and contoured as the plans show or engineer directs.

(5) Under the Asphaltic Surface, Asphaltic Surface Detours, and Asphaltic Surface Temporary bid items; straightedge the surface. Provide a finished surface with no variation greater than 1/4 inch in 10 feet. Remove and replace out-of-tolerance material or correct the surface using engineer-approved methods.

465.3.2 Asphaltic Curb

(1) Construct asphaltic curb in one layer on a prepared asphaltic pavement or base foundation. Clean the pavement surface area the curb will occupy to ensure a good bond. Apply a tack coat to the area as the engineer directs.

(2) The contractor may place the curb by one of the following methods:

- With an engineer-approved curb laying machine that places and compacts the mixture and finishes the curb to the required shape, grade, and dimensions.
- In forms fabricated to the curb shape. Place and thoroughly compact the mixture with vibratory compactors or mechanical tampers and screed to a smooth finish.
- For small quantities, by hand placing and shaping. Form the back of the curb. Place, tamp, and shape with hand tools. Provide a smooth-finished surface on the curb face and top.

465.3.3 Rumble Strips

(1) Construct asphaltic rumble strips by milling the asphaltic surface. Use a rotary head milling machine with a cutting tip pattern that will produce a relatively smooth cut of the size, shape, spacing, and smoothness the plans show. Cutting heads shall be on a suspension independent from the power unit to allow the heads to self-align with slopes and irregularities. The machine shall have a guidance system that consistently provides the plan alignment of the rumble strips.

(2) Before beginning the work, demonstrate to the engineer that the operation achieves the desired surface inside each depression without tearing or snagging the asphaltic pavement or surfacing. Place rumble strips in the pattern and shape the plans show. For shoulders carrying temporary traffic during construction, do not install rumble strips until after routing traffic back to the mainline.

(3) At the end of each work day, move equipment and material out of the clear zone and sweep or vacuum the traveled way pavement and shoulder areas. Sweep away or vacuum up milling debris

before opening adjacent lanes to traffic. Dispose of waste material as specified in 203.3.4; do not place on the finished shoulder surface.

465.3.4 Maintenance

(1) Maintain work done under the Asphaltic Surface Temporary bid item for the time the contract specifies.

465.4 Measurement

(1) The department will measure the Asphaltic Surface bid items by the ton acceptably completed using the methods specified in 450.4. The department will not measure asphaltic materials separately.

(2) The department will measure Asphaltic Curb by the linear foot acceptably completed, measured along the base of the curb face.

(3) The department will measure Asphaltic Flumes and Asphaltic Intersection Rumble Strips by the square yard acceptably completed.

(4) The department will measure the Asphaltic Shoulder Rumble Strips bid items and Asphaltic Centerline Rumble Strips 2-Lane Rural by the linear foot acceptably completed, measured as the length along each side of the traveled way, from the center of the first groove in a segment to the center of the last groove in that segment. A segment is a series of grooves including 50-foot and shorter gaps as well as skips the plans show. Gaps greater than 50 feet define a new segment. The department will deduct for skips greater than the plans show.

465.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
465.0105	Asphaltic Surface	TON
465.0110	Asphaltic Surface Patching	TON
465.0115	Asphaltic Surface Detours	TON
465.0120	Asphaltic Surface Driveways and Field Entrances	TON
465.0125	Asphaltic Surface Temporary	TON
465.0305	Asphaltic Surface Safety Islands	TON
465.0310	Asphaltic Curb	LF
465.0315	Asphaltic Flumes	SY
465.0400	Asphaltic Shoulder Rumble Strips	LF
465.0425	Asphaltic Shoulder Rumble Strips 2-Lane Rural	LF
465.0450	Asphaltic Intersection Rumble Strips	SY
465.0475	Asphaltic Centerline Rumble Strips 2-Lane Rural	LF

(2) Payment for the Asphaltic Surface bid items is full compensation for submitting an asphaltic mixture design; for preparing the foundation; for providing the asphaltic mixture, including asphaltic material and reclaimed asphaltic pavement materials; and for compacting the mixture.

(3) Payment for Asphaltic Surface Temporary is also full compensation for maintenance during the time the contract specifies.

(4) Payment for Asphaltic Curb is full compensation for providing the asphaltic mixture, including asphaltic material and reclaimed asphaltic pavement materials; for compacting the mixture; and for forming the curb.

(5) Payment for Asphaltic Flumes is full compensation for preparing the foundation; for providing the asphaltic mixture, including asphaltic material and reclaimed asphaltic pavement materials; and for compacting the mixture.

(6) Payment for the Asphaltic Shoulder Rumble Strips bid items, Asphaltic Centerline Rumble Strips 2-Lane Rural, and Asphaltic Intersection Rumble Strips is full compensation for milling; for sweeping or vacuuming; and for disposing of waste materials.

Section 475 Seal Coat

475.1 Description

(1) This section describes applying asphaltic material and an aggregate cover on a previously completed surface.

475.2 Materials

(1) Furnish asphaltic materials for seal coat conforming to 455.

(2) Furnish aggregates conforming to 460 except as follows:

1. Aggregate retained on the No. 4 sieve shall have 10 percent, by weight, or less flat & elongated pieces based on a 5:1 ratio.
2. The percent wear, measured according to AASHTO T96, shall not exceed 40 after 500 revolutions.
3. At least 60 percent, by count, of the aggregate retained on the No. 4 sieve shall have one or more fractured face.
4. Conform to the following gradation requirements:

SIEVE	PERCENT PASSING BY WEIGHT
1/2-inch	100
No. 4	0-60
No. 16	0-5

475.3 Construction

475.3.1 General

(1) Construct seal coat to the full width of the existing surface unless the contract or engineer specify otherwise. Use asphaltic material of the type and grade the special provisions designate. Apply at the plan rate.

(2) Apply asphaltic material only if the air temperature is 60 F or more, and the surface is clean and dry. Do not apply before impending rains if rain might damage the material before placing and rolling the cover aggregates. Limit the surface area treated with asphaltic material in a single day to what can be covered with aggregate and rolled during daylight hours.

475.3.2 Equipment

(1) Provide equipment to heat and distribute asphaltic material as specified for applying tack coat in 455.3.2.2.

(2) Provide additional equipment as follows:

- Power broom.
- Mechanical spreader capable of applying aggregate uniformly at the plan rate.
- Self-propelled steel-wheel roller weighing between 6 and 9 tons.
- Self-propelled, pneumatic-tire roller.

(3) Use pneumatic-tire rollers with tires on one axle arranged to cover the spaces between tires on the other axle. Ensure that all tires are the same size and uniformly inflated. During roller operation, ensure that the wheel load and tire contact pressure is 30 psi or greater, unless the contract specifies otherwise. If the engineer requests, furnish manufacturer documentation showing the contact areas and contact pressures for various wheel loadings and tire inflation pressures.

(4) Ensure rollers are in good mechanical condition, capable of operating both forwards and backwards, and the operating mechanism allows for starting, stopping, or reversing direction in a smooth manner, without loosening or distorting the surface being rolled.

(5) Equip rollers with a drum or tire lubricator. Do not lubricate with petroleum or tar products.

475.3.3 Preparing the Surface

(1) Immediately before applying the asphaltic material, clean the existing surface with a power broom or other suitable equipment to remove dirt, clay, or other objectionable matter.

475.3.4 Heating and Applying Asphaltic Material

(1) Heat and distribute asphaltic material as specified for applying tack coat in 455.3.2. Cover previously applied material as required to create transverse joints without overlapping. Close treated areas to traffic until after applying the cover aggregate.

475.3.5 Applying and Rolling Aggregate

(1) After the asphaltic material develops sufficient tackiness, spread aggregate uniformly over the treated surface. Dry or moisten the aggregate to ensure that it is damp to surface dry. If the engineer directs, moisten the aggregate to control dust. The engineer will determine the appropriate application rate to

completely cover the treated surface but limit the application to what is easily embedded in and bonded by the asphaltic material.

(2) Roll the surface immediately after spreading the aggregate with a steel-wheel roller. Begin at the edges and continue to the center, lapping 1/2 the roller width on each successive pass. After this initial rolling, perform subsequent rolling using both steel-wheel rollers and pneumatic-tire rollers until thoroughly embedding the aggregate and the surface is smooth and uniform in texture. Regulate the speed and take care when reversing roller direction to avoid displacing or loosening the cover aggregate, or damaging the asphaltic material.

(3) If the engineer directs, lightly broom the surface to remove excess loose material.

475.3.6 Maintenance

(1) Maintain the work until acceptance. Repair damage and correct areas with excess or deficient asphaltic material or aggregate cover during this maintenance period.

475.4 Measurement

(1) The department will measure Seal Coat by the cubic yard or by the ton acceptably completed, measured as the quantity of seal coat aggregate. The department will measure volume or weight in the vehicle and deduct for material wasted or not actually incorporated in the work.

475.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
475.0100	Seal Coat	CY
475.0105	Seal Coat	TON

(2) Payment for Seal Coat is full compensation for preparing the surface; for heating and applying asphaltic material; for drying or moistening, applying, and rolling the cover aggregate; and for brooming, finishing, and maintaining the surface.

(3) The department will pay for asphaltic materials separately under the Asphaltic Material Seal Coat bid item as specified in 455.5.

Part 5 Structures

Section 501 Concrete

501.1 Description

(1) This section describes proportioning, mixing, placing, and protecting concrete mixtures.

501.2 Materials

501.2.1 Portland Cement

(1) Use cement conforming to ASTM specifications as follows:

- Type I portland cement; ASTM C150.
- Type II portland cement; ASTM C150.
- Type III portland cement; ASTM C150, for high early strength.
- Type IP portland-pozzolan cement; ASTM C595, except maximum loss on ignition is 2.0 percent and maximum pozzolan content is 30 percent.
- Type IS portland blast-furnace slag cement; ASTM C595, except maximum slag content is 30 percent.
- Type IL portland-limestone cement; ASTM C595, except maximum nominal limestone content is 10 percent with no individual test result exceeding 12.0 percent.
- Type IT ternary blended cement; ASTM C595, except maximum limestone content is 10 percent and maximum pozzolan and slag combined content is 30 percent.

(2) Store cement of different types, brands, and sources separately. Keep batches of concrete made from different types, brands, and sources from becoming intermixed in the work, unless the engineer approves otherwise.

(3) The engineer will reject cement that is partially set or that contains lumps.

(4) The engineer may reject cement if, the temperature at the time of delivery to the mixer exceeds 165 F. To avoid this, store it until it cools to at least 165 F before incorporating into the batch.

501.2.1.1 Testing

(1) Test according to AASHTO standard methods.

(2) Determine fineness by the air permeability test method performed according to AASHTO T153.

(3) If testing for setting time, base results on the Gillmore test method according to AASHTO T154.

501.2.1.2 Certification

(1) Obtain cement from manufacturers whose products comply with the department's certification method of acceptance for cement, unless the engineer agrees to accept cement under alternate procedures allowed in the department's certification method.

(2) Provide a manufacturer's written certification for blended cements stating the source, quantity, and composition of essential constituents and the composition of the final cement provided under the contract.

501.2.2 Air-Entraining Admixtures

(1) If using an air-entraining admixture, the contractor must submit evidence based on tests made in a recognized laboratory to show that the material conforms to AASHTO M154 for 7- and 28-day compressive and flexural strengths and resistance to freezing and thawing, except as specified in 501.2.2(2). The engineer will not require tests for bleeding and setting time. Within 501, a recognized laboratory is any state department of transportation, FHWA, or any cement and concrete laboratory regularly inspected by the Cement and Concrete Reference Laboratory. The department may test samples taken from a quantity that the contractor submits for use on the project, or it may test samples the manufacturer submits and certifies as representative of the admixture it is supplying.

(2) Admixtures manufactured by neutralizing vinsol resin with caustic soda (sodium hydroxide) are an exception to the requirements in the above paragraph. If the contractor plans to use this admixture, then it must submit a certification of the admixture in the following form:

> "This is to certify that the product (trade name) as manufactured and sold by the (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 221 F is (number). No other additive or chemical agent is present in this solution."

(3) If the contractor offers to use an admixture that is essentially the same, with only minor differences in concentration, as another previously department-approved material, the department will require a certification stating it is essentially the same as the department-approved admixture, and that it contains no other admixture or chemical agent.

(4) The department will not require a certification for admixtures on the department's APL.

(5) Either before, or at any time during construction the engineer may require further testing on the admixture the contractor selects to determine its effect on the strength of the concrete. If tested, the 7-day compressive strength of the concrete sample made with enough of the admixture to produce the specified percent, +/- the specified tolerance percent, of entrained air in the plastic concrete shall not be less than 88 percent of the concrete strength made with the same materials, cement content, and consistency but without the admixture.

(6) Calculate the percentage reduction in strength from the average strength of at least five standard 6-inch by 12-inch cylinders of each type of concrete. Make and cure these specimens in the laboratory according to AASHTO T126 and test according to AASHTO T22. Determine the percentage of entrained air according to AASHTO T152.

(7) The department will reject admixtures failing to conform to the above requirements.

501.2.3 Retarding, Water-Reducing, and Non-Chloride Accelerating Admixtures

501.2.3.1 General

(1) Do not use retarding or water-reducing admixtures not on the department's APL without the engineer's approval.

(2) The engineer will base approval of retarding and water-reducing admixtures on tests made in the department's laboratory, or evaluation of results of tests made in a recognized laboratory as defined in 501.2.2(1). The manufacturer shall furnish test result data. Provide to the engineer a manufacturer's certification that the materials it is furnishing are essentially identical to those used in the performance testing.

(3) The department will maintain an APL for admixtures. The contractor may use admixtures included in the department's APL, provided they produce the required properties in the concrete.

(4) Based on manufacturer-furnished data, the indicated relationships between temperature of mix, quantity of admixture, and time of initial set must satisfy the engineer.

(5) The contractor shall provide the laboratory and the engineer with manufacturer's data required for evaluations indicated above and for determining quantities of admixture for job conditions.

(6) Retarding and water-reducing admixtures, as specified in this section, may or may not increase the quantity of air entrained in the mix. If using admixtures in air-entrained concrete, ensure the concrete mix air content is within the range specified for air-entrained concrete under 501.3.2.4.

501.2.3.2 Retarding Admixtures

(1) All admixtures used to retard concrete setting as specified for set retarder under 501.3.2.4.3 shall conform to AASHTO M194, type D.

501.2.3.3 Water-Reducing Admixtures

(1) If using water-reducing admixtures in concrete, conform to AASHTO M194, type A or type D, except that if adding a retarding admixture as specified for set retarder under 501.3.2.4.3, do not use type A.

501.2.3.4 Non-Chloride Accelerating Admixtures

(1) Conform to AASHTO M194, type C or type E.

501.2.4 Water

501.2.4.1 General

(1) Use water with cement in concrete, mortar, neat cement paste, or wash, and in other cement mixing operations conforming to 501.2.4.

501.2.4.2 Requirements

(1) The contractor may use drinking water from municipal water supplies for cement, except the engineer may test this water for compliance with the requirements specified below.

(2) Water from other sources shall comply with the following:

Acidity, maximum of 0.1N NaOH to neutralize 200 mL of water	2 mL
Alkalinity, maximum of 0.1N HCL to neutralize 200 mL of water	15 mL
Maximum sulphate ($S0_4$)	0.05 percent
Maximum chloride	0.10 percent
Maximum total solids:	
Organic	0.04 percent
Inorganic	0.15 percent

(3) Use water that is not brackish and is clean and free of injurious quantities of sugar, oil, or other deleterious substances.

(4) Use water that causes no indication of unsoundness, no significant change in the time of setting, and varies no more than 10 percent in the strength of standard 1:3 mortar briquettes from strengths obtained with mixtures containing distilled water and the same cement and sand.

501.2.4.3 Sampling and Testing

(1) Submit samples that each consist of at least 2 quarts of water, obtained and shipped in clean plastic or glass containers, carefully packed and labeled. The engineer will supervise sampling. Test according to AASHTO T26.

501.2.4.4 Source

(1) Do not use water from shallow, muddy, or marshy sources. The contractor shall not use water from suspected sources until the engineer tests and approves it. If supply sources are relatively shallow, enclose the suction pipe intake to keep out silt, mud, grass, and other foreign materials. Position the suction pipe to provide at least 2 feet of water beneath the pipe intake.

501.2.5 Aggregates

501.2.5.1 General

(1) Furnish material conforming to the individual component requirements of 501.2.5.3 for fine aggregates and 501.2.5.4 for coarse aggregates except as follows:

1. If testing for gradation during concrete production, the department will accept material based on the combined properties as batched. The department will determine combined values and combined spec limits for both size and deleterious substances mathematically. The department will use the actual batch percentages for component aggregates in this calculation.
2. If the contractor is using a QMP paving or structures mix for other work on the project, the department will accept the aggregate for the affected mixes as specified in the applicable QMP provisions.

(2) The engineer may prohibit using aggregates from any source, plant, pit, quarry, or deposit if the character of the material or method of operation makes it unlikely to furnish aggregates conforming to specified requirements; or from deposits or formations known to produce unsound materials.

(3) Before use, furnish samples of materials from previously untested sources and from previously tested sources if the engineer requires.

(4) If procuring aggregates from pits or quarries, conform to 104.9 for final cleanup.

501.2.5.2 Definitions

(1) Use the definitions in 301.2, 450.2.1, and the following:

Fine aggregates Those aggregates that entirely pass the 3/8-inch sieve, almost entirely pass the No. 4 sieve and are predominantly retained on the No. 200 sieve.

Coarse aggregates Those aggregates predominantly retained on the No. 4 sieve.

501.2.5.3 Fine Aggregates

(1) Fine aggregate consists of a combination of sand with fine gravel, crushed gravel, or crushed stone consisting of hard, strong, durable particles.

501.2.5.3.1 Deleterious Substances

(1) Do not exceed the following percentages:

SUBSTANCE	PERCENT BY WEIGHT
Material passing the No. 200 sieve	3.5[1]
Coal	1.0
Clay lumps	1.0
Shale	1.0
Other local deleterious substances like alkali, mica, coated grains, soft and flaky particles	1.0

[1] Reduce to 2.3 percent if used in grade E concrete.

(2) The total percentage of coal, clay lumps, shale, and other deleterious substances shall not exceed 3.0 percent by weight. There is no requirement to wash fine aggregate for concrete if produced otherwise to conform to all specified requirements. When used, the fine aggregate shall not contain any of the following: frozen material, and foreign material like wood, hay, burlap, paper, or dirt.

501.2.5.3.2 Organic Impurities

(1) Fine aggregate shall not contain harmful quantities of organic impurities. The engineer will reject aggregates, subjected to the colorimetric test for organic impurities, producing a darker than standard color, unless they pass the mortar strength test.

501.2.5.3.3 Mortar Strength

(1) Fine aggregates, if tested for the effects of organic impurities on strength of mortar, using type I portland cement, must produce a relative strength at 7 days, calculated according to section 8 of AASHTO T71, of not less than 95 percent.

501.2.5.3.4 Size Requirements

(1) Use well-graded fine aggregate conforming to the following gradation requirements:

SIEVE	PERCENT PASSING BY WEIGHT
3/8-inch	100
No. 4	90 - 100
No. 16	45 - 85
No. 50	5 - 30
No. 100	0 - 10

501.2.5.4 Coarse Aggregates

501.2.5.4.1 General

(1) Provide coarse aggregates from a department-approved source as specified under 106.3.4.2.

(2) Use clean, hard, durable gravel, crushed gravel, crushed stone, or crushed concrete free of an excess of flat & elongated pieces, frozen lumps, vegetation, deleterious substances, or adherent coatings considered injurious. Do not use coarse aggregates obtained from crushing concrete in concrete for bridges, culverts, or retaining walls.

501.2.5.4.2 Deleterious Substances

Revise 501.2.5.4.2(1) to specify testing & limits on all lightweight materials including chert and correct inconsistencies.

(1) The quantity of deleterious substances shall not exceed the following percentages:

DELETERIOUS SUBSTANCE	PERCENT BY WEIGHT
Shale	1.0
Coal	1.0
Clay lumps	0.3
Soft fragments	5.0
Any combination of above	5.0
Flat & elongated pieces based on a 3:1 ratio[1]	15
Material passing the No. 200 sieve	1.5
Lightweight pieces[2] for concrete not for prestressed concrete members	5.0[3]
Lightweight pieces[2] for concrete for prestressed concrete members	2.0

[1] As modified in CMM 8-60.

[2] Material having a saturated surface-dry bulk specific gravity of less than 2.45, tested according to AASHTO T113. Determine the percentage of lightweight pieces by dividing the weight of lightweight pieces in the sample retained on a 3/8-inch sieve by the weight of the total sample.

[3] The engineer may accept aggregates exceeding this value if aggregates from the same deposit or from one of similar geological origin demonstrated a satisfactory service record, or tests the engineer select indicate no inferior behavior.

(2) If using 2 sizes of coarse aggregates, the engineer will determine the percentages of harmful substances based on one of the following: a sample consisting of 50 percent of size No. 1, and 50 percent of size No. 2; or a sample consisting of the actual percent of size No. 1 and No. 2 used in the work.

(3) The engineer will not require the contractor to wash coarse aggregate produced within specified gradations, free of coatings considered injurious, and conforming to the above limits for harmful substances.

501.2.5.4.3 Physical Properties

(1) The percent wear shall not exceed 50, the weighted soundness loss shall not exceed 12 percent, and the weighted freeze-thaw average loss shall not exceed 18 percent.

(2) The department may prohibit using crushed stone from limestone/dolomite deposits having thinly bedded strata, or strata of a shale nature; it may also prohibit using aggregates from deposits or formations known to produce unsound material.

(3) If all coarse aggregates used are produced from the same deposit or source, ensure that testing for wear, sodium sulfate soundness, and soundness by freezing and thawing uses a composite sample. This sample will contain equal percentages of each component coarse aggregate used. If the component coarse aggregates are produced from more than one deposit or source, ensure that testing for wear, sodium sulfate soundness, and soundness by freezing and thawing uses one sample from each deposit or source.

501.2.5.4.4 Alkali Silica Reactivity Testing and Mitigation Requirements

(1) If using coarse aggregate from sources containing significant amounts of fine-grained granitic rocks including felsic-volcanics, felsic-metavolcanics, rhyolite, diorite, gneiss, or quartzite; test coarse aggregate according to ASTM C1260 for alkali silica reactivity. Gravel aggregates are exempt from this requirement.

(2) If ASTM C1260 tests indicate a 14-day expansion of 0.15 percent or greater, perform additional testing according to ASTM C1567. Test mortar bars made with coarse aggregate and the blend of cementitious materials proposed for concrete placed under the contract. The department will reject the aggregate if ASTM C1567 tests confirm mortar bar expansion of 0.15 percent or greater at 14 days.

501.2.5.4.5 Size Requirements

(1) Use well graded coarse aggregate conforming to the following gradation requirements:

	PERCENT PASSING BY WEIGHT	
SIEVE	SIZE NO. 1 AASHTO No. 67[1]	SIZE NO. 2 AASHTO No. 4[1]
2-inch	-	100
1 1/2-inch	-	90-100
1-inch	100	20-55
3/4-inch	90-100	0-15
3/8-inch	20-55	0-5
No. 4	0-10	-
No. 8	0-5	-

[1] Size No. according to AASHTO M43.

(2) Furnish coarse aggregates in the separate sizes indicated, and store each size separately to prevent mixture until proportioned into each batch. The engineer will allow the contractor to combine 2 aggregate fractions to produce a gradation within the limits specified for size No. 1 or size No. 2, provided they are proportioned separately by weight into the batch in proportions the engineer approves.

(3) Except as provided below, furnish coarse aggregate conforming to size No. 1 and size No. 2, combined in the proportions specified for the pertinent grade of concrete under 501.3.2.2.

(4) The contractor may provide coarse aggregate consisting entirely of size No. 1 as follows:

1. If the engineer approves, for grade A, A2, A3, A-FA, A-S, A-S2, A-T, A-IS, A-IP, or A-IT concrete.
2. Except for concrete pavement repair and replacement and if substituting grade C for grade A or A2 air-entrained high early strength concrete as specified in 710.4(6).
3. For curb, curb and gutter, sidewalk and steps.
4. Except for concrete pavement repair and replacement, for grade E concrete.
5. For concrete in prestressed concrete members.
6. For concrete in foundations for soldier pile walls and noise walls.

501.2.5.5 Sampling and Testing

(1) Sample and test aggregates for concrete according to the following:

Sampling aggregates[1] ..... AASHTO T2
Lightweight pieces in aggregate ..... AASHTO T113
Material finer than No. 200 sieve[1] ..... AASHTO T11
Unit weight of aggregate ..... AASHTO T19
Organic impurities in sands ..... AASHTO T21
Sieve analysis of aggregates ..... AASHTO T27

Effect of organic impurities in fine aggregate ..... AASHTO T71
Los Angeles abrasion of coarse aggregate ..... AASHTO T96
Alkali Silica Reactivity of Aggregates ..... ASTM C1260
Alkali Silica Reactivity of Combinations of Cementitious Materials and Aggregates ..... ASTM C1567
Freeze-thaw soundness of coarse aggregate ..... AASHTO T103
Sodium sulfate soundness of coarse aggregates (R-4, 5 cycles) ..... AASHTO T104
Specific gravity and absorption of fine aggregate ..... AASHTO T84
Specific gravity and absorption of coarse aggregate[1] ..... AASHTO T85
Flat & elongated pieces based on a 3:1 ratio[1] ..... ASTM D4791
Sampling fresh concrete ..... AASHTO R60
Making and curing concrete compressive strength test specimens ..... AASHTO T23
Compressive strength of molded concrete cylinders ..... AASHTO T22

[1] As modified in CMM 8-60.

(2) Test for soft or non-durable particles conforming to department laboratory methods. The engineer will field evaluate or laboratory test to determine aggregate acceptability relative to excessive clay lump quantities.

501.2.6 Fly Ash

501.2.6.1 General

(1) Fly ash is defined as a finely divided residue resulting from the combustion of coal in a base loaded electric generating plant, transported from the boiler by flue gases, and later collected, generally by precipitators. Use fly ash in concrete manufactured by facilities and processes known to provide satisfactory material.

(2) Test fly ash using a recognized laboratory, as defined in 501.2.2(1), starting at least 30 days before its proposed use, and continuing at ASTM-required frequencies as the work progresses. The manufacturer shall test the chemical and physical properties listed in tables 1 and 2 of ASTM C618 at the frequencies and by the test methods prescribed in ASTM C311.

(3) Use only one source of fly ash for a bid item of work under the contract, unless the engineer directs or allows otherwise in writing.

(4) Prequalify any proposed fly ash source as follows: The contractor shall obtain a copy of the certified report of tests or analysis made by a qualified independent laboratory, recognized by the department under 501.2.2, showing full and complete compliance with the above specification from the fly ash manufacturer and furnish it to the engineer. Provide this report to the engineer at least 14 calendar days before using the fly ash.

(5) The manufacturer shall retain test records for at least 5 years after completing the work, and provide these records upon request.

501.2.6.2 Class C Ash

(1) Conform to ASTM C618 class C except limit the loss on ignition to a maximum of 2 percent.

501.2.6.3 Class F Ash

(2) Furnish a class F fly ash from a source listed on the department's approved product list, and conform to ASTM C618 class F except limit the loss on ignition to a maximum of 2 percent.

501.2.7 Slag

(1) For grade A-S, A-T, A-S2, B-S, and C-S concrete, provide ground granulated blast furnace slag conforming to ASTM C989, grade 100 or 120.

501.2.8 Pozzolans

(1) The contractor may use pozzolans as a direct replacement for fly ash in concrete mixes. Conform to the replacement limits specified under 501.3.2.2 for fly ash. Use only as a complete replacement for fly ash. Do not combine pozzolans or use pozzolans with fly ash in the same mix.

(2) Furnish pozzolans conforming to the physical, chemical, and performance requirements specified for Class C fly ash in ASTM C618, except the definition of origin of the material does not apply. Obtain material from a manufacturer on the department's APL with an in-place quality management program that includes the following daily uniformity tests:

- Specific gravity.
- Percent retained on the No. 325 sieve.
- Loss on ignition.

- Moisture content.
- Activity index with cement.

501.2.9 Concrete Curing Materials.

(1) Furnish type 2, class A liquid curing compound conforming to ASTM C309, except the department will conduct water retention tests as follows:

1. The department will not seal the edges of the specimen.
2. The department will apply the curing compound at one gallon per 200 square feet of surface or at the manufacturer's recommended rate whichever is greater.

(2) Furnish sheeting conforming to ASTM C171 for white opaque polyethylene film, except that the contractor may use clear or black polyethylene for cold weather protection.

(3) Furnish burlap conforming to AASHTO M182, class 3 or 4. The contractor may use 2 layers of class 1 or class 2 instead of one layer of class 3 or class 4.

(4) Furnish polyethylene-coated burlap conforming to ASTM C171 for white burlap-polyethylene sheets.

501.3 Construction

501.3.1 Concrete Grades

501.3.1.1 General

(1) Unless the contract specifies otherwise, and except as allowed for prestressed girders in 503.2.2, use air-entrained concrete for all concrete in the work.

(2) The contractor may use high early strength concrete for bridge substructures and in other structures if the contract requires, or at the contractor's option, if the engineer approves, but the contractor shall not use it for bridge superstructures.

(3) Prepare air-entrained concrete with type I, IL, IS, IP, IT or II cement and sufficient air-entraining admixture to produce concrete with the air content specified in 501.3.2.4. Prepare air-entrained high early strength concrete as specified in 710.4.

501.3.1.2 (Vacant)

501.3.1.3 Concrete Grades

501.3.1.3.1 General

(1) Unless the contract specifies otherwise, and except as specified for pre-stressed concrete members in 503 and for special high early strength concrete pavement repair and replacement in 416.2.5, provide the grade of concrete specified below in 501.3.1.3.2 or 501.3.1.3.3. If the contractor selects and uses a specific grade of concrete for an item of work, then use that grade throughout the entire construction of the item, except as specified in 501.3.1.3.3, or as the engineer approves.

501.3.1.3.2 Special Restrictions

(1) If using coarse aggregate composed primarily of igneous or metamorphic materials, provide concrete for concrete pavement, approach slabs, barrier, surface drains, driveways, alleys, sidewalks, curb, gutter, and curb & gutter as follows:

Grade A, A-FA, A-S, and A-T:	If using type II portland cement, or if using Type IL blended cement where the base portland cement meets Type II chemical requirements.
Grade A-IS, A-IP, and A-IT:	If using type I/II blended portland cement.
Grade A-S2:	If placing by a slip-formed process and using type II portland cement.
Grade C, C-FA, C-S, C-IS, C-IP, and C-IT:	If using types I or III portland cement.

501.3.1.3.3 General Use

(1) If using concrete not covered in 501.3.1.3.2, use the grade of concrete as follows:

Grade A, A-FA, A-S, A-T, A-IS, A-IP, and A-IT:	For concrete pavement, incidental construction, and concrete in structures not designated as using other grades. Also use these grades, as modified in 502.3.5.3, for concrete placed underwater.
Grade A-FA, A-S, A-T, A-IS, A-IP, and A-IT:	For concrete for structures if used in decks, parapets, medians, and sidewalks.
Grade A2 and A-S2:	For concrete pavement, curb, gutter, curb & gutter, barrier, or sidewalk if placing by a slip-formed process.
Grade A3:	For concrete pavement and incidental construction on low volume State Trunk Highways and other roads under municipal or local jurisdiction in areas that a proven performance record exists for

similar mixes. Use only in locations and applications specifically delineated in the contract.

Grade B, B-FA, B-S, B-IS, B-IP, and B-IT: For concrete base.

Grade C, C-FA, C-S, C-IS, C-IP, and C-IT: For concrete pavement repair and replacement, and other uses if required in the contract.

Grade E: For overlays and repairs on decks of structures and approaches.

501.3.2 Concrete Composition

501.3.2.1 General

(1) Except as required for prestressed concrete members and for special high early strength concrete pavement repair and replacement, or unless the contract specifies otherwise, use the values tabulated for the grades of concrete in 501.3.2.2 as the master limits of the job mix governing material proportions incorporated in the batch. The engineer will designate, within these limits, the exact proportional weights of fine and coarse aggregates, the maximum quantity of water to use, and the batch weights of the remaining mix ingredients.

(2) Incorporate into each batch the quantity of cement; admixture; slag, or fly ash if necessary; water; and fine and coarse aggregates the engineer designates for the concrete grade produced.

501.3.2.2 Concrete Proportions

(1) The following table specifies the master limits of the job mix for the several grades of concrete, and designates the quantities of materials and relative proportions for each grade of concrete. Use the proportions given in the table for high early strength concrete, as required or allowed if using high early strength cement.

(2) The quantities of aggregates specified in the tabulations are for oven-dry materials with a bulk specific gravity of 2.65. For aggregates with a different specific gravity, adjust the weights in the ratio so that the specific gravity of the material used relates to 2.65. The tabulated design water and maximum water quantities are for total free water in the mix and do not include water absorbed in the aggregate.

QUANTITIES FOR A NOMINAL CUBIC YARD[1]

CONCRETE GRADE [2][3]	CEMENT[4][5][6] (lb)	CLASS C FLY ASH (lb)	SLAG[7] (lb)	WEIGHT TOTAL AGG (lb)	PERCENT FINE AGG[8] (% total agg)	DESIGN WATER (gals)	MAXIMUM WATER (gals)
A	565	-	-	3120	30-40	27	32
A2	530	-	-	3190	"	25	30
A3	517	-	-	3210	"	25	30
A-FA[9][10]	395	170	-	3080	"	27	32
A-S[9][10]	395	-	170	3100	"	27	32
A-S2[10]	285	-	285	3090	"	27	32
A-T[9][11]	395	Total fly ash and slag of 170[11]		3090	“	27	32
A-IP[9]	565	-	-	3100	"	27	32
A-IS[9]	565	-	-	3090	"	27	32
A-IT[9]	565	-	-	3100	"	27	32
B	400	-	-	3300	"	25	31
B-FA[10]	280	120	-	3270	"	25	31
B-S[10]	280	-	120	3280	"	25	31
B-IP	400	-	-	3280	"	25	31
B-IS	400	-	-	3280	"	25	31
B-IT	400	-	-	3280	"	25	31
C	660	-	-	2980	"	30	36
C-FA	560	100	-	2960	"	30	36
C-S	560	-	100	2970	"	30	36
C-IP	660	-	-	2970	"	30	36
C-IS	660	-	-	2950	"	30	36
C-IT	660	-	-	2970	"	30	36
E	823	-	-	2810	50	32	35

[1] A nominal cubic yard has the tabulated weights of cement and aggregate, design mix water, and 6.0% air.

[2] For all grades, use a water-reducing admixture conforming to 501.2.3.3 and 501.3.2.4.4.

[3] For all grades, provide air entrainment as specified in 501.3.2.4.2.

[4] For grades A-IP, B-IP, and C-IP, use only type IP cement.

[5] For grades A-IS, B-IS, and C-IS, use only type IS cement.

[6] For grades A-IT, B-IT, and C-IT, use only type IT cement.

[7] For grade C-S concrete, use only grade 120 slag.

[8] If using crushed stone or crushed concrete coarse aggregate, the engineer may allow up to 45% fine aggregate.

[9] For bridge substructures, the contractor may use a non-chloride accelerating admixture conforming to 501.2.3.4.

[10] If using less than the tabulated maximum quantities of fly ash or slag, calculate the cement content by reducing the base cement content for the grade A or B mix by the weight of fly ash or slag added.

[11] For ternary mixes containing cement, fly ash, and slag, if using less than the tabulated maximum combined quantity of fly ash and slag, calculate the cement content by reducing the base cement content for the grade A mix by the combined weight of fly ash and slag added.

(3) The total coarse aggregate quantity equals the difference between the total aggregate and the fine aggregate. Proportion this total quantity between the 2 sizes as necessary to secure suitable workability and ensure that it is within the range of 35-65 percent of size No. 1, with size No. 2 comprising the remainder, except if only one size is allowed as specified for size requirements in 501.2.5.4.5.

501.3.2.3 Job Mix

(1) From the master limits of the job mix, adjusted as necessary for the specific gravities of the aggregate furnished, the engineer will determine the job mix, using the lowest quantity or percentage of fine aggregate within the range shown that, without exceeding the maximum quantity of water allowed, yields a mix of the necessary workability.

(2) The difference between the quantity of fine aggregate determined above and the total quantity of aggregate equals the coarse aggregate proportioned between the 2 sizes within the limits set, except

if only one size is required. If the character of the proposed aggregates prohibits producing a workable mix within the maximum fine aggregate and water limits, then reduce the total quantity of aggregates sufficiently and re-proportion the mix to produce a workable mix without exceeding the maximum water allowed. The quantity of water allowed includes the free moisture in the aggregates, minus the absorbed moisture determined according to AASHTO T84 and T85. Use just the quantity of water needed, without exceeding the maximum that in the engineer's judgment produces a mixture of the consistency, plasticity, and workability required for the work. The engineer will designate, as the work progresses, the quantity of water to use for each batch and will either make or direct adjustments. The engineer will determine the stockpile moisture of the aggregates, or the absorption of moisture by aggregate during mixing and handling throughout construction as job conditions warrant; and the engineer will make any corrections in aggregate weights for moisture as necessary. Within the designated limits, the contractor may vary relative proportions of fine and coarse aggregate from the initial determination, as the characteristics of the aggregate necessitate, maintaining workability.

(3) These requirements do not guarantee yield.

501.3.2.4 Concrete Admixtures

501.3.2.4.1 General

(1) Dispense admixtures in liquid form only. Incorporate non-liquid admixtures in an aqueous solution according to the manufacturer's instructions before dispensing. Maintain admixtures at uniform concentration. The contractor is responsible for the uniform operation of the admixture and for its compatibility with other mix components and any other admixture used.

501.3.2.4.2 Air Entrainment

(1) Use an admixture conforming to 501.2.2 with non-air-entrained cement to produce air-entrained concrete. Ensure that concrete air content conforms to the following:

- Grade E concrete contains 6.0 percent air, +/- 1.0 percent.
- Slip-formed concrete contains 7.0 percent air, +/- 1.5 percent.
- Other concrete contains 6.0 percent air, +/- 1.5 percent.

(2) Test fresh concrete according to AASHTO T152 at the contract-required frequency and as the engineer directs. Test concrete placed by pumping or belting at the point of discharge from the pump line or belt.

(3) The engineer may verify air content using a method that measures air volume directly. The contractor may request a check test performed according to AASHTO T152 to validate the engineer's method.

501.3.2.4.3 Set Retarder

501.3.2.4.3.1 General

(1) Use admixtures to retard concrete setting conforming to 501.2.3.

501.3.2.4.3.2 Bridge Superstructures

(1) If required, add a retarding admixture conforming to 501.2.3 to the concrete mix used for the superstructures of cast in place reinforced concrete slab, concrete floor slabs, sidewalks, and parapets of other types of structures, including the top slab of concrete for box girder bridges according to the following:

(2) Add the department-approved retarding admixture, to the concrete mix, as the engineer directs, if the air temperature when placing the concrete is 70 F or above; or if it is 50 F or above and it is expected to take 4 or more hours to place the concrete in any one span or pour. Add the retarding admixture in the proportions the manufacturer recommends for the anticipated temperature.

501.3.2.4.3.3 Extended Delivery Time

(1) If the contractor elects to use a retarder to extend delivery time for ready-mixed concrete, as specified for delivery in 501.3.5.2, add it to the concrete mix if the concrete temperature when placing the concrete is 60 F or above.

(2) Add the retarding admixture according to the manufacturer's instructions to obtain at least a one-hour delay in the initial set, as defined in AASHTO T197, at the temperature during placement.

501.3.2.4.4 Water Reducer

(1) Add a water-reducing admixture conforming to 501.2.3. Determine the specific type and dosage based on the atmospheric conditions, the desired properties of the finished concrete, and the manufacturer's recommended dosage. The actual dosage shall at least equal the manufacturer's recommended dosage. Both the type and dosage used require the engineer's approval before use.

501.3.3 Handling Materials

501.3.3.1 Aggregates

(1) Keep materials required to manufacture concrete clean and free from contamination. The department will not accept aggregates mixed with foreign matter. Keep the fine aggregate and the coarse aggregates separate until measuring and placing in the batch. If mixing or storing aggregates from different supply sources in the same pile, the engineer will reject the entire pile. The engineer may approve use of aggregates from different sources alternately in the same class of construction or mix; this permission is contingent on amending the job mix and batch weights as necessary to protect the concrete quality produced.

(2) If using a composite material from 2 or more sources for any aggregate for a job mix, proportion material from the respective sources separately into the batch by weight in the proportions the engineer approves.

(3) Store aggregates in stockpiles. The aggregates shall not go directly from the washing plant to the proportioning bins. After washing, drain fine aggregate in stockpiles for at least 12 hours before weighing for the batch, unless the engineer reduces this waiting period. After washing and before placing in the proportioning plant, allow coarse aggregates to drain for periods that ensure reasonable uniformity in the moisture content.

(4) Choose reasonably smooth, firm, and well-drained sites for aggregate stockpiles cleared of vegetable matter and foreign material that might contaminate the aggregates. If necessary, build adequate bulkheads or partitions for keeping the fine and the several sizes of coarse aggregates separated. If the aggregates become intermixed, then do not use them.

(5) Construct coarse aggregate stockpiles in a way that minimizes segregation of the coarse and fine fractions.

(6) Exercise care in removing aggregates near the bottom of stockpiles, to avoid incorporating foreign materials, and use of material removed from near the bottom of drainage stockpiles at production plants and batching plants is prohibited unless tests indicate the material is satisfactory.

501.3.3.2 Cement

(1) Handle bulk cement in a way that precludes contamination and avoids loss.

(2) If using packaged cement, deposit it directly from the containers, as shipped, into the mixer when placing the aggregates into the mixer, or dump it directly on the batch aggregates just before placing the batch aggregates into the mixer, except as required otherwise to conform to 415.3.13 and 502.3.9.2 for mixing concrete under cold weather conditions. Take care to place the container's full contents into the batch.

501.3.3.3 Fly Ash or Slag

(1) Use separate facilities equal to those used for cement for handling, storing, transporting, and conveying the fly ash or slag.

501.3.4 Proportioning

501.3.4.1 Aggregates

(1) Measure the specified quantities of each size of fine and coarse aggregates by weight into each batch, except as specified for volumetric plant and mixer in 501.3.6.4.

501.3.4.2 Cement

(1) Measure the specified quantity of cement accurately into each batch.

(2) The contractor may proportion cement in sacks by volume if the operations allow the engineer to accurately determine the quantity of cement proportioned into each batch. Do not use batches requiring a fractional part of a sack of cement, unless the contractor elects to weigh the fractional part required for each batch.

(3) Proportion cement in bulk by weight, except as specified for volumetric plant and mixer in 501.3.6.4.

501.3.4.3 Water

(1) Measure water by volume or by weight. Use water-measuring equipment capable of accurately measuring to within one percent of the quantity required for each batch. Ensure that the measurement accuracy is uniform under all construction conditions and that variations in pressure in the water supply line do not affect it.

(2) Use water-measuring equipment with preset controls that enable the operator to automatically cut off the flow after discharging the required quantity of water. Use equipment that has an accurately

calibrated and easily read indicator showing the quantity of water used in each batch. Arrange this measuring equipment to facilitate checking the calibration accuracy.

501.3.4.4 Admixtures

501.3.4.4.1 General

(1) The contractor may proportion admixtures by volume or by weight. Follow a department-approved procedure for adding the specified quantity of each admixture. Add admixtures during initial batching of the concrete except as specified in 501.3.4.4.2.

(2) If using more than one admixture, add each admixture in a way that prevents intermixing the admixtures before incorporating into the mixture. The contractor may introduce the admixture into the water line, directly into the mixer when adding the water, or uniformly dispense it into the fine aggregate just before incorporating into the mix.

501.3.4.4.2 Adding Air-Entraining Admixtures in the Field

(1) The department will allow re-tempering with air-entraining admixtures at the work site for concrete delivered in truck mixers.

(2) If additional air-entraining admixture is needed at the work site to raise the air content of the concrete above the lower spec limit, measure it in a calibrated container and then add to the mixer in a dilute solution with water. Mix the concrete at mixing speed for at least 30 revolutions before discharge.

501.3.4.5 Weighing Equipment for Aggregates

501.3.4.5.1 General

(1) The contractor may use manual, automatic, or semi-automatic batching plants for weighing fine and coarse aggregates.

(2) Ensure each plant has bins for holding each aggregate weighed, and batchers, and scales for weighing the aggregates, and conforms to the requirements specified below.

(3) The contractor may use batching plants that are a complete unit with bins, batchers, and scales mounted on a rigid framework for direct discharge of the aggregate from the bin to the batcher; or plants with the bins mounted separately from the batchers and provided with appropriate means for conveying the aggregate from the bin to the batcher. Ensure the framework supporting bins and batchers is rigidly constructed and mounted on firm foundations.

(4) After erection, test each batching plant before use. Fully load aggregate bins, batchers, and scales with aggregate for not less than 5 hours before testing, in order to allow for settlement and adjustment under working conditions.

(5) Provide each batching plant with at least 10 standard 50 pound weights accurate to within 0.1 percent.

(6) When the engineer is observing the testing, furnish any accessories and assistance required to test the weighing and metering equipment. If difficulties occur in calibrating and testing the weighing or metering equipment, or if discrepancies occur during use, the engineer may require an authorized testing firm or agency test the scales or meters. If testing weighing equipment, ensure the material bins are fully loaded at the time.

(7) The contractor may batch aggregates, both fine and coarse, in separate or accumulative weigh batchers.

501.3.4.5.2 Scales

(1) Use either the beam, digital, or springless dial-type scales suitable for supporting the batcher and of a simple rugged design with a minimum number of adjustments, consistent with the accuracy required. Use scales designed and constructed to prevent displacement of scale parts and that provide a means for readily checking the proper position and alignment of scale levers. Ensure pivots are constructed of material that satisfactorily resists wear under repeated weighing and are set accurately in substantial mountings to ensure a permanent spacing of the knife edges under all loading and use conditions.

(2) If provided beam scales, they must have a separate beam, or separate beam and fractional beam for each aggregate weighed. Provide each beam with a sliding poise and locking device to firmly hold it in position. Provide a means to display to the scale operator that the required load weight is approaching, for example, a springless dial indicator or tare beam. If using a graduated dial, provide it with a separate movable pointer or marker for each aggregate weighed. Set these pointers or markers to indicate the load of each aggregate as required. Provide a moisture resistant dial face.

(3) If using digital scales, conform to NIST handbook 44.

(4) Design, build, and maintain the scales to an accuracy within 0.4 percent of the net load in the hopper. Arrange the scales or indicating devices so the operator can maintain full view of them.

(5) Use graduated dials, beams, or other indicators to allow readings or settings made to within 0.1 percent of the capacity of the scale.

(6) Ensure accessibility to the scale working parts for inspection and cleaning, and protect working parts against contamination. Provide full and complete instructions for setting up and adjusting the scale.

501.3.4.5.3 Manually Operated Batching Plants

(1) Bins shall have: suitable size and shape, no leakage, compartments or separate bins for each size of aggregate, rigid framework that, if mounted on a suitable foundation, holds them in the correct position.

(2) Multiple compartment bins shall have partitions that extend above the top of the bins to prevent intermixing of the separate sizes of aggregates if heaped above the top of the bins.

(3) Weigh batchers shall: have suitable size and shape, not leak, rest entirely upon the scales, and hang free. Provide clearance between the batcher top and bin discharge gates, or charging facilities, to house a full batch without hand raking, and sufficient clearance to remove any overload of aggregate. Provide a means to tightly close the batcher discharge gate during the batching interval. Ensure the design, construction, and operation of the batcher and its appurtenances does not retain varying tare materials on any of its parts, and completely and quickly discharges without shaking or jarring the scales.

501.3.4.5.4 Automatic and Semi-Automatic Batching Plants

(1) Use automatic and semi-automatic plants with bins, batchers, and scales conforming to the requirements specified above for manually operated batchers.

(2) Provide a means to protect the device for setting the batch weights against tampering by unauthorized personnel.

(3) Provide an audible signal device activated by the discharge of any batch whose weight is outside the specified tolerance. Ensure a loud enough signal to hear throughout the plant area under normal operating conditions.

(4) Provide automatic and semi-automatic batching plants with a device to indicate any underweight or overweight material.

(5) Provide automatic batching equipment with batching devices that if activated by a single starting mechanism, automatically batches or measures any given material, and automatically stops the flow of material after attaining the desired quantity, within the allowable tolerance.

(6) Use an interlocking batcher charging mechanism on automatic plants that guards against opening until the batcher entirely discharges and the scale balances within +/- 0.3 percent of the scale capacity, and against opening if the batcher discharge gate is open. Also, it should interlock to ensure against opening if the batcher charging mechanism is open, and against opening if the batch is either over or underweight by more than 1.5 percent of the specified batch weight in individual batchers or 1.5 percent of the specified intermediate and final accumulative batch weight in accumulative batchers.

(7) Provide semi-automatic batching equipment with suitable batching devices that open or start separately, if actuated by individual starting mechanisms, to allow weighing or measuring the material, and close or stop automatically after attaining the desired quantity, within the allowable tolerance.

(8) Use an interlocking batcher discharge mechanism for semi-automatic plants to ensure against opening if the batch is either over or underweight by more than 1.5 percent of the specified batch weight in individual batchers, or 1.5 percent of the specified intermediate and final accumulative batch weights in accumulative batchers.

(9) Ensure that the batcher discharge mechanisms of automatic or semi-automatic plants interlock against opening until aggregate batchers and the cement batcher are charged with the correct weights.

(10) Equip the batching system with automatic controls to stop the cycle in the underweight check position and the overweight check position for each material to allow tolerance limit checking.

(11) The contractor may use a batching system consisting of a combination of automatic and semi-automatic batchers provided it furnishes the appropriate controls and interlocks.

(12) If the control system of automatic or semi-automatic batching plants breaks down, the contractor may manually operate plants for up to 72 hours while making repairs.

501.3.4.6 Weighing Equipment for Cement, Fly Ash, and Slag

(1) The contractor may use manual, automatic, or semi-automatic batchers for batching cement. If using a combination of bin, batcher, and scales to proportion cement in bulk, conform to 501.3.4.5 for batching plants, with the following additions and exceptions:

(2) Use a separate batcher and scales.

(3) If using a beam scale, provide a tare beam and a weigh beam or beams capable of being lifted out of weighing position to allow checking the batcher's tare weight to determine if it discharges all the cement into the batch, unless there are other positive means to determine if complete discharge took place.

(4) Mechanically operate the batcher discharge gate in a way that does not affect the scale balance.

(5) Ensure that the batcher charging mechanism of automatic batchers interlock against opening until the batcher entirely discharges and the scale balances within +/- 0.3 percent of scale capacity, and against opening if the batcher discharge gate is open. Also, it should interlock against opening if the batcher charging mechanism is open; and against opening if the batch is either over or underweight by more than one percent of the specified batch weight.

(6) If using semi-automatic batchers, ensure the batcher discharge mechanism interlocks against opening if the batch is either over or underweight by more than one percent of the specified batch weight.

(7) Ensure that the batcher discharge mechanisms of automatic or semi-automatic plants interlock against opening until charging the cement batcher and aggregate batchers with the correct weight.

(8) The contractor may weigh and batch fly ash or slag along with the cement, but if this occurs, weigh the cement into the batcher first, and then add the fly ash or slag to the top of the batch of cement to the appropriate accumulative weight.

(9) For separate scales, bins, and hoppers used to batch fly ash or slag conform to the requirements specified above for cement-weighing equipment.

501.3.4.7 Dispensing Equipment for Admixtures

(1) Use accurate, volumetric, mechanical measuring dispensers, capable of presetting to deliver a specified quantity of admixture, or engineer-approved scales. Furnish a separate volumetric dispenser or scale for each admixture. Use a dispensing system with a device that either detects and indicates the presence or absence of flow of the admixture, or provides a convenient way to visually observing the admixture during batching or discharging. Ensure that the dispenser piping is free from leaks and properly valved to prevent back flow or siphoning.

(2) Interlock admixture-dispensing systems used in conjunction with semi-automatic plants, automatic plants, or on-site mixers of 21 cubic feet or more with the batching operations. Ensure that the system is capable of dispensing the admixture within +/- 3.0 percent of the required volume or weight of admixture, or the minimum dosage rate per 100 pounds of cement, whichever is greater.

501.3.5 Ready-Mixed Concrete

501.3.5.1 General

(1) The contractor may use ready-mixed concrete instead of site-mixed concrete, except for grade E concrete. Do not use ready-mixed concrete to produce grade E concrete.

(2) Interpret ready-mixed concrete to include central-mixed, transit-mixed, and shrink-mixed concrete, defined as follows:

Central-mixed concrete	Concrete completely mixed in a stationary mixer and transported to the point of delivery with or without mechanical agitation in the transporting vehicle.
Transit-mixed concrete	Concrete completely mixed in a truck mixer.
Shrink-mixed concrete	Concrete mixed partially in a stationary mixer with the mixing completed in a truck mixer.

501.3.5.2 Delivery

(1) Deliver ready-mixed concrete at a rate that ensures reasonably continuous progress in the placing and finishing operations. If the time intervals between successive loads or batches causes a partial drying of previously placed concrete provide additional equipment of the kind necessary to preclude these delays. Failing in this, discontinue use of ready-mixed concrete and use site-mixed concrete.

(2) Provide sufficient facilities for the production and delivery of ready-mixed concrete for concrete pavement to ensure placement at a uniform rate of not less than 80 cubic yards per hour, unless performing single-lane construction.

(3) Deliver and completely discharge the concrete within the following limits, beginning when adding water to the cement, or when adding cement to the aggregates.

Delivered in Agitating Vehicles:

- 60 minutes if the concrete temperature is 60 F or higher at placement, and the contractor does not use a department-approved retarder.

- 90 minutes if the concrete temperature is less than 60 F at placement.
- 90 minutes if the concrete temperature is 60 F or higher at placement, and the contractor uses a department-approved retarder.

Delivered in Non-Agitating Vehicles:

- 30 minutes if the concrete temperature is 85 F or higher at placement, and the contractor does not use a department-approved retarder.
- 45 minutes if the concrete temperature is 60 to less than 85 F at placement, and the contractor does not use a department-approved retarder.
- 60 minutes if the concrete temperature is less than 60 F at placement.
- 60 minutes if the concrete temperature is 60 F or higher at placement, and the contractor uses a department-approved retarder.

(4) The engineer or inspector may reduce these times under conditions contributing to quick stiffening of the mix, or during cold weather when loss of heat occurs to the extent that the concrete temperature is not correct at placement.

(5) Except during the mixing revolutions, operate the drum or agitator of the vehicle at agitating speed until discharging the mix. Ensure the concrete's uniform composition, required consistency, and required air content at time of delivery.

(6) The contractor may deliver central-mixed concrete to the work site by equipment with non-agitating body types. These body types are smooth, mortar-tight, metal containers capable of discharging the concrete at a satisfactorily controlled rate. Do not use aluminum bodies. Provide watertight covers for protection against the weather if necessary. The concrete in these vehicles should show no appreciable water gain at the surface. The concrete should freely and readily discharge from the vehicle, be free of excessive segregation of the fine and coarse aggregates, and have an air content within the required range at the point of discharge. Slump tests made during discharge should not differ by more than 2 inches. Remove foreign material and accumulated concrete before batching concrete into those vehicles.

501.3.5.3 Mixers and Mixing

(1) The contractor may use stationary mixers, or truck mixers of the revolving drum type or, with the engineer's written approval, other types specifically designed for mixing. For agitators, use truck mixers or truck agitators. The manufacturer shall attach in a prominent place, to each stationary mixer, truck mixer, or truck agitator a metal plate plainly marked with the various uses of the equipment, the drum or container capacity in volume of mixed concrete, and the rotation speed of the mixing drum or blades.

(2) If using a stationary mixer to mix concrete, mix at least one minute, provided that plant operating procedures are reasonably stabilized and controlled, and that it achieves visible blending of materials during charging to the engineer's satisfaction. If this mix time does not achieve proper stabilization, control, and blending, the engineer may increase the mixing time to 75 seconds.

(3) Exceptions to the minimum mixing time for stationary mixers specified above are contained in an approved list, the department's bureau of technical services maintains, of reduced minimum mixing times for specific makes and models of stationary mixers. If these department-approved reduced minimum mixing times do not produce satisfactory stabilization, control, and blending the engineer may increase the mixing time as needed.

(4) Blending implies a uniform volume of flow of all batch ingredients throughout the charging time interval, except for the brief introduction of water and coarse aggregate. Charge the batch into the mixer so that:

1. Some water enters shortly before the solid material, and all water is in the drum by the time mixing begins.
2. Introduce admixtures uniformly throughout the charging time interval.
3. Introduce some coarse aggregate before other solid materials.
4. For the remaining solid material charging time, introduce the large and small sizes of the coarse aggregate, sand, and cement in an acceptably uniform rate of flow, as determined by visual inspection.
5. Start mixing time after all solid materials are in the mixer.

(5) The maximum mixing time for stationary mixers shall not exceed the minimum specified above, by more than 60 seconds.

(6) Consider transfer time in multiple drum mixers as part of the mixing time.

(7) For stationary mixers, compute the total mixed concrete volume based on nominal cubic yard of concrete as specified in 501.3.2.2 and this volume shall not exceed the manufacturer's rated

maximum mixing capacity, for the type and volume of mixer used, in the concrete plant mixer standards of the Concrete Plant Manufacturer's Bureau.

(8) Equip stationary mixers with a timing device that automatically locks the discharge mechanism during the full mixing time and releases it at the end of the mixing period.

(9) If mixing concrete in a truck mixer, mix each batch for 70 or more revolutions at the manufacturer-designated mixing speed. Do not exceed 300 total revolutions per batch, the sum of the revolutions at mixing and agitating speeds. Begin mixer revolutions only after all materials, including mixing water are in the mixer.

(10) Add the mixing water at the batching plant, but if obtaining the specified slump requires more water, add it in the field with the engineer's permission. Do not exceed the maximum water specified in 501.3.2.2. Calculate the maximum water as the sum of free water added with the aggregates and all added mixing water. If adding more water at the work site, perform an additional 20 revolutions of the truck mixer at mixing speed before discharging any concrete. The process of adding more water and additional mixing must happen within 45 minutes of introducing the mixing water to the cement or the cement to the aggregates. The engineer may extend the time limit for adding water and additional mixing to 75 minutes for those grades of concrete mixed under the conditions described in 501.3.5.2 whose delivery time limit is 1 1/2 hours. If additional mixing revolutions are necessary because of added water at the site, the total revolutions at mixing and agitating speeds shall not exceed 300.

(11) If using a truck mixer or agitator to transport concrete completely mixed in a stationary mixer, rotate the drum or agitator at the agitating speed during transportation and until discharge.

(12) Equip truck mixers with an engineer-approved revolution counter. Unless equipped to control and count revolutions at mixing speed, perform mixing at the batching plant or job site with the mixer operated at agitating speed while in transit.

(13) For truck mixers operating from plants erected to supply concrete to highway projects, if the delivery time is short enough that the truck cannot exceed the maximum number of revolutions at mixing speed in transit, then mixer may operate at mixing speed in transit.

(14) If using a stationary mixer for partial mixing of the concrete, the contractor may reduce the mixing time in the stationary mixer to the minimum required to blend the ingredients, about 30 seconds.

(15) If using a truck mixer to finish the partial mixing done in a stationary mixer, mix each batch for 50 or more revolutions at the manufacturer-recommended speed. No batch shall exceed 300 total revolutions, the total revolutions at mixing and agitating speeds.

(16) For truck mixers, compute the total concrete volume mixed per batch based on the nominal cubic yard of concrete as specified in 501.3.2.2 and shall not exceed the manufacturer's rated capacity, or the following percentages of the drum's gross volume:

- For complete mixing, 63 percent.
- For partial mixing, initial (shrink) mixing done in stationary mixer, 70 percent.

(17) The engineer may obtain representative samples from approximately the 1/6 and 5/6 discharge points of the concrete load of any truck mixer or truck agitator. If the slump of the 2 samples differs by more than one inch, or the entrained air content in them differs by more than one percent, correct the condition before using the load.

(18) For central-mixed or shrink-mixed concrete, if using more than one batch to make up a load, properly proportion each batch using all the ingredients, including admixtures, fly ash, or slag.

(19) The contractor shall not incorporate water used to clean mixing equipment and accessories into the mix.

(20) Replace the pick-up and throw-over blades of truck mixers or agitators if any part or section is worn one inch or more below the their original height. Provide a copy of the manufacturer's design, showing dimensions and blade arrangement, upon the engineer's request.

501.3.5.4 Inspection

(1) Notify the engineer at least 24 hours before the contractor requires delivery of ready-mixed concrete, so the engineer can make the necessary arrangements to inspect and calibrate equipment at the plant.

(2) With each load of ready-mixed concrete, provide a computer-printed batch ticket which includes load and truck identification, the actual batch weights of all materials in that load, the mixing time for central plant-mixed concrete or the start of the batch life as specified in 501.3.5.2(3) for transit-mixed concrete, and other pertinent data. Give batch tickets to the inspector upon arrival at the work site. The department will only accept loads that arrive in satisfactory condition and have a batch ticket. The

engineer will only accept hand written batch tickets in remote locations where no computerized plant is available within deliverable distance of the work site.

(3) Instead of requiring a batch ticket for each load, the engineer may accept central-mixed concrete used in pavement and associated bid items based on daily production records from a computer-controlled plant erected specifically for work under the contract. Submit a complete load-by-load written record that ties the truck IDs to the batch quantities and batch times for each day's production to the engineer at the end of each day's production. During concrete production, operate under a plan acceptable to the engineer that ties the truck ID to the batch quantities and batch time for each load. In that plan describe how that information will be made available to the engineer immediately upon request. The engineer may also require batch tickets to address short-term operational difficulties.

(4) The engineer may accept minor quantities of ready-mixed concrete used in miscellaneous bid items without batch tickets.

501.3.6 Site-Mixed Concrete

501.3.6.1 General

(1) Site-mixed concrete is concrete manufactured in standard batch or volumetric type portable mixers at the work site. Use volumetric mixers only for work that specifically allows volumetric proportioning.

501.3.6.2 Batch Mixer

(1) Use a powered revolving drum type mixer conforming to the following requirements, unless the engineer allows another type.

(2) Maintain the mixer in good working order and operate it in a way that does not combine the mixed batch with the following dry batch, and so that the ingredients of only one batch are intermixed with each charge of the mixer. Keep charging devices, the throat, and drum interior free of accumulated materials. If charged with the batch, revolve the mixer drum at a speed that does not exceed the manufacturer’s specified speed for the mixer, provided the drum makes between 14 and 20 revolutions per minute. Replace pick-up and throw-over blades showing a wear in excess of 3/4 inch from their original factory depth. Mixers must have a rated capacity of at least 5 cubic feet of mixed concrete per batch.

(3) Equip mixers with an engineer-approved automatic timing device, in proper working order, designed and constructed so that it starts when the charging skip is raised and dumped. The timing mechanism shall have a device that transmits an audible or visible signal when mixing is complete.

(4) Equip mixers, with a rated capacity of 21 cubic feet or more of mixed concrete, with an engineer-approved discharge-locking device, in good working order, and automatically controlled by the timing device.

(5) Keep the box or compartment containing the timing device closed and locked at all times except for adjustment or repairs. Only the contractor or an authorized representative shall make adjustments under the direct supervision of the engineer or inspector.

(6) Compute the total volume of concrete mixed per batch based on the nominal cubic yard as specified in 501.3.2.2 and shall not exceed the mixer’s rated capacity by more than 10 percent as established by the Mixer Manufacturer's Bureau of the Associated General Contractors of America. The capacities above are contingent on the mixer drum retaining the batch without segregating, spilling, or leaking during charging, mixing, and discharging; and upon adequate methods of handling, placing and finishing the resultant concrete.

(7) Stop using and repair or replace with a satisfactory mixer, any concrete mixer that is not adequate or suitable for the work, has insufficient power, inefficient mixing action, or has auxiliary units that do not function properly.

501.3.6.3 Batch Mixing Time

(1) Mix each batch for at least 50 seconds but not more than 90 seconds. During this time, the drum revolves at the rate specified above. Start the mixing time after all solid materials are in the drum.

(2) Introduce the mixing water to the drum ahead of the other materials and continue to discharge for a short time after all solid materials are in the drum.

501.3.6.4 Volumetric Plant and Mixer

(1) Use a truck-mounted mobile concrete plant and mixer, designed for automatic volume proportioning of concrete materials, and for mixing concrete for immediate use at the work site, for grade E concrete, and the engineer may allow its use for bid items from other grades. This machine shall produce a thoroughly mixed and uniform concrete.

(2) Calibrate the plant on a weight-volume relationship according to the manufacturer's recommended procedures. Recalibrate the plant if changing aggregates and, as the engineer deems necessary.

(3) Volumetric proportioning equipment and procedures are subject to the engineer's approval. Equip the plant with either a water flowmeter or a recording water meter.

501.3.7 Concrete Consistency

(1) Concrete shall have a uniform consistency, with all ingredients uniformly distributed throughout the weight, and so that the mortar clings to the coarse aggregate. Concrete shall not have a consistency sufficiently wet so it flows and segregates, or a mealy, dry consistency.

(2) Use the minimum quantity of water that achieves the desired workability, as the engineer determines. Obtain the engineer's approval of any changes in this quantity.

501.3.7.1 Slump

(1) Use a 1-inch to 4-inch slump for concrete used in structures or placed in forms, except as follows:

- Do not exceed a slump of 2 inches for grade E concrete.
- Increase slump as specified in 502.3.5.3 for concrete placed underwater.

(2) Use the applicable slump specified in 415.2.1 for concrete pavements.

(3) Perform the slump tests for concrete according to AASHTO T119.

501.3.8 Placing

501.3.8.1 General

(1) Except as specified in 501.3.5.2 for ready-mixed concrete, place the concrete within 30 minutes of first adding water to the batch. Use placement techniques that minimize segregation. Batch, mix, place, and finish concrete within a monolithic unit as continuously as practicable.

501.3.8.2 Hot Weather Concreting

501.3.8.2.1 General

(1) The contractor is responsible for the quality of the concrete placed in hot weather. For concrete placed under the bid items enumerated in 501.3.8.2.1(2), submit a written temperature control plan at or before the pre-pour meeting. In that plan, outline the actions the contractor will take to control concrete temperature if the concrete temperature at the point of placement exceeds 80 F. Do not place concrete under these bid items without the engineer's written acceptance of that temperature control plan. Perform the work as outlined in the temperature control plan.

(2) If the concrete temperature at the point of placement exceeds 90 F, do not place concrete under the following bid items:

Concrete Masonry Bridges	Concrete Masonry Retaining Walls
Concrete Masonry Bridges HES	Concrete Masonry Retaining Walls HES
Concrete Masonry Culverts	Concrete Masonry Endwalls
Concrete Masonry Culverts HES	Concrete Masonry Overlay Decks

(3) The department will pay $0.75 per pound for the quantity of ice required to reach a target concrete temperature of 80 F if the following conditions are met:

1. The un-iced concrete temperature exceeds 85 F.
2. The contractor has performed the actions outlined in the contractor's accepted temperature control plan.
3. The contractor elects to use ice.

(4) If the engineer directs the contractor to use ice when the un-iced concrete temperature is 85 F or less, the department will pay $0.75 per pound for that ice.

(5) Notify the engineer whenever conditions exist that might cause the temperature at the point of placement to exceed 80 F. If project information is not available, the contractor should obtain information from similar mixes placed for other nearby work.

501.3.8.2.2 Bridge Decks

(1) For concrete placed in bridge decks under the bid items enumerated in 501.3.8.2.2(2), submit a written evaporation control plan at or before the pre-pour meeting. In that plan, outline the actions the contractor will take to maintain concrete surface evaporation at or 0.2 pounds per square foot per hour. Do not place concrete under these bid items without the engineer's written acceptance of that evaporation control plan. If the engineer accepts an evaporation control plan calling for ice, the department will pay $0.75 per pound for that ice. Perform the work as outlined in the evaporation control plan.

(2) If predicting a concrete surface moisture evaporation rate exceeding 0.2 pounds per square foot per hour, do not place bridge deck concrete under the following bid items:

Concrete Masonry Bridges
Concrete Masonry Overlay Decks
Concrete Masonry Bridges HES

(3) Provide evaporation rate predictions to the engineer under one or more of the following conditions:

1. Conditions exist that might cause concrete surface evaporation to exceed 0.2 pounds per square foot per hour.
2. The concrete temperature at the point of placement exceeds 80 F.
3. The engineer requests that information.

(4) Compute the evaporation rate from the predicted ambient conditions at the time and place of the pour using the nomograph provided in CMM 5-25 figure 1, or using a computerized equivalent. Use weather information from the nearest national weather service station. The engineer will use this information to determine if the pour will proceed as scheduled.

(5) On the day before the pour, the engineer will notify the contractor in writing whether or not to proceed with the pour as scheduled. If the actual computed evaporation rate during the pour exceeds 0.2 pounds per square foot per hour, the engineer may allow the contractor to complete the pour. If the engineer allows placement to continue, the department will pay $0.75 per pound for the quantity of ice required to maintain concrete surface evaporation at or below 0.2 pounds per square foot per hour. If ice is not available the department will pay for any actions, beyond those described in the contractor's evaporation plan, required to complete the pour as the engineer directs.

501.3.9 Mixing and Protecting During Cold Weather

(1) Mix, place, and protect concrete according to the method specified below, applicable to its use.

(2) Mix, place, and protect concrete for pavement, pavement repair and replacement, pavement widening, pavement gaps, driveways, alleys, headers, surface drains, pavement approach slabs, base, base widening or patching, curb, gutter, curb & gutter, ditch checks, sidewalks, steps not a part of a structure, loading zones, safety islands and other concrete of a similar nature as specified in 415.3.13.

(3) Mix, place, and protect concrete for bridges, culverts, retaining walls, end walls, or any other structure consisting, wholly or in part, of concrete, if placed during cold weather, as specified in 502.3.9.

501.3.10 Test Specimens

(1) The engineer may cast the number of cylinders required to make tests for determining the compressive strength of the concrete. Make test cylinders 6 inches in diameter and 12 inches in height, unless the engineer directs otherwise.

(2) The engineer will either perform or supervise the sampling, making, curing, and testing of concrete cylinders.

(3) Make the test specimens from concrete actually used. If the engineer directs, the contractor shall transport the specimens from the work site to the field laboratory or other location the engineer designates. During transportation, embed the specimens in straw, burlap, or other acceptable material to protect them, in a manner the engineer approves. Take care to avoid sudden impacts during hauling and handling that might cause fractures.

(4) The contractor shall furnish the concrete for test specimens including all materials, except molds; a suitable vehicle the engineer approves, for transporting specimens, if required; materials necessary to properly transport and cure; and labor incidental to preparing, transporting, storing, and curing.

501.4 (Vacant)

501.5 Payment

(1) The department will not pay directly for the concrete specified under this section. Concrete is incidental to the various bid items using it. Payment under those bid items includes providing materials, including aggregates and associated aggregate source testing, cement, fly ash, slag, and admixtures; for preparing, transporting, storing, protecting and curing concrete; and for contractor requirements related to testing specified in 501.3.10.

(2) If required to remove and replace any concrete damaged by lack of proper protection. Perform this work at no expense to the department.

(3) The department will pay for ice used to cool concrete in hot weather as specified in 501.3.8.2 under the Ice Hot Weather Concreting administrative item.

Section 502 Concrete Bridges

502.1 Description

(1) This section describes constructing concrete bridges and concrete parts of other bridges.

502.2 Materials

502.2.1 General

(1) Furnish grade A-FA, A-S, A-T, A-IS, A-IP, or A-IT, air-entrained concrete conforming to 501 as modified for class I structure concrete in 715. Provide QMP for class I structure concrete as specified in 715.

(2) For other materials, conform to the following:

Steel reinforcement.....505
Structural steel and miscellaneous metals.....506
Waterproofing.....516

(3) Except for form ties, use hot-dipped galvanized or epoxy-coated steel, stainless steel, or non-metallic materials for hardware incorporated into the structure. Repair cuts and other damage to galvanized or epoxy coatings according to ASTM A780. Do not use galvanized hardware where it is in contact with weathering steel.

502.2.2 Concrete Composition

(1) Furnish concrete for bridges conforming to 501. If the contract specifies, or the engineer allows, use high early strength concrete.

(2) Do not use high early strength concrete in cast in place bridge superstructures.

(3) Do not use high early strength concrete in bridge substructures or in other structures unless the contract requires it, or if the engineer allows the contractor, in writing, to use high early strength concrete to expedite the work.

(4) Provide the concrete grade specified in 501.3.1.3.3.

(5) Use the coarse aggregate sizes specified in 501.2.5.4.5 and 501.3.2.2.

502.2.3 Falsework

(1) The engineer will not require the contractor to use new or unused materials in falsework.

(2) Use timber and piling in falsework of adequate strength and shape, suitable for the purpose intended. Use material that is in good condition, sound, and free from defects that might impair its strength. Use reasonably straight piling capable of withstanding pile driving.

(3) Use straight steel members, of adequate strength and shape suitable for the purpose intended.

502.2.4 Forms

(1) The contractor may use wood or metal, or, with the engineer's approval, composite construction. The engineer will not require the use of new, unused material. Use material in good condition, of adequate strength, and of a shape suitable for the purpose intended.

502.2.5 Waterstops

(1) If not specified in the contract, the contractor may furnish and use either polyvinyl chloride (PVC) or rubberized membrane waterstops. Use polyvinyl chloride waterstops that are a dense, homogeneous material, free from holes and other imperfections, extruded from an elastomeric plastic compound. If using PVC waterstops, conform to the Corps of Engineers' Specification CRD-C 572.

(2) Select the rubberized membrane, primer, and mastic from the department's list of engineer-approved waterstop products. Use membrane with a minimum thickness of 60 mils.

502.2.6 Concrete Curing Compound

(1) Use liquid curing compound conforming to ASTM C309, type 1-D, clear or translucent with fugitive dye, except as modified in 501.2.9 for testing.

502.2.7 Preformed Joint Filler

Revise 502.2.7(1) to include foam expansion joint materials. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Use preformed joint filler conforming to AASHTO M153, AASHTO M213, or ASTM D8139.

502.2.8 Preformed Elastomeric Compression Joint Sealer

(1) Use preformed elastomeric compression joint sealer conforming to AASHTO M297.

(2) If installing the preformed joint sealer, use a lubricant-adhesive that is a one-part moisture curing polyurethane and hydrocarbon solvent mixture with the following physical properties:

Average weight per gallon ..... 7.2 to 8.8 pounds
Solids content percent ..... 72 to 74% by weight
Adhesive to remain fluid from ..... 5 F to 120 F
Film strength (ASTM D412) ..... 1200 psi
Elongation 350%

(3) Ensure the viscosity of the lubricant-adhesive performs suitably with the application equipment. The engineer will reject any lubricant-adhesive not used within 9 months of manufacture.

(4) Ensure the lubricant-adhesive consistency works well at the temperatures the seals are installed, is compatible with the seals and the concrete, and is relatively unaffected by the normal moisture in the concrete.

(5) Deliver the lubricant-adhesive in containers plainly marked with the manufacturer's name or trademark, lot number, and manufacture date.

(6) Use a joint sealer compatible with concrete, or steel and resistant to abrasion, oxidation, oils, gasoline, salt, and other materials spilled on or applied to the surface.

(7) Shape the sealer so that in its compressed condition the top center of the exposed surface is depressed below the edges of the installed sealer. At the joints maximum opening, the minimum unit pressure on the sides of the joint sealer shall be 3 psi.

(8) Mark the top surface of the seal at one-foot intervals clearly, in a manner durable enough to make length determinations of the seal after installing in the pavement joints.

(9) Mark shipping containers for seals clearly, with the manufacturer’s name, the size of the seal, the lot number, and the manufacture date.

502.2.9 Non-Bituminous Joint Sealer

(1) Furnish gray sealant complying with ASTM C920 for non-sagging grade NS, class 25, traffic area use T, and either single-component type S, or multi-component type M.

502.2.10 Hot-Poured Elastic Joint Sealer

(1) Furnish material conforming to ASTM D6690.

502.2.11 Crack and Surface Sealers

(1) Furnish crack and surface sealers from the department's APL as follows:

- Crack sealer: Low Viscosity Crack Sealers for Bridge Decks list.
- Protective surface treatment: Concrete Protective Surface Treatment list.
- Pigmented surface sealer: Cure and Seal Compound for Non-trafficked Surfaces for Structural Masonry list.

502.2.12 Adhesive Anchors

(1) Unless the plans show stainless steel, furnish either stainless steel or galvanized anchors, bolts, studs, nuts, and washers. Ensure that galvanized materials are either hot dipped according to ASTM A153 supplemented by ASTM F2329 or mechanically zinc coated according to ASTM B695. If the plans show using reinforcing bars, use grade 60 bars conforming to AASHTO M31 and to 505.2.

(2) Furnish adhesive from the department's APL.

(3) Do not substitute adhesive anchors for anchors the plans show unless the plans allow adhesive anchors. Do not use adhesive anchors in overhead applications with sustained tensile loads.

502.2.13 Clear Protective Coating

(1) Furnish clear protective coating composed of the following:

MATERIAL — MINIMUM PERCENT BY WEIGHT
Vinyl resin[1] 25.0
Methyl ethyl ketone solvent 37.0
Toluene solvent 37.0

[1] Use resin of an engineer-approved vinyl chloride-acetate copolymer containing 86 percent vinyl chloride and 14 percent vinyl acetate. Ensure a viscosity of 250-500 centipoises for a 22 percent by weight solution or resin in a solvent, consisting of equal parts of methyl iso-butyl ketone and toluene at 77 F.

COATING PROPERTY
Weight per gallon at 77 F ..... 7.6 pounds minimum
Viscosity at 77 F ..... 60-70 Krebs units
Color ..... Clear and colorless
Drying time ..... 1/2 hour maximum

502.3 Construction

502.3.1 General

(1) Use construction methods conforming to the specifications for the several parts of the structure. Do not slip-form parapets unless the department explicitly allows by special provision.

502.3.2 Falsework

502.3.2.1 Detailed Plans

(1) At the engineer's request, the contractor shall submit one copy of signed and sealed detailed plans and computations for falsework, as specified in 105.2, and place on file. If the engineer requests, submit 2 additional copies of plans for review. Revise the plans as the engineer directs. Understand that whether or not the engineer requests submission of these plans or concurs in the use of the submitted or corrected plans, the contractor is responsible for obtaining satisfactory results.

502.3.2.2 Design

(1) Design falsework to support a weight of 160 pounds per cubic foot for concrete plus a live load allowance of not less than 10 pounds per square foot of horizontal projection of forms; and must also provide the necessary rigidity and support for the loads without appreciable settlement or deformation. Consider the potential effects of high wind and high water in the design.

502.3.2.3 Erection

(1) Build falsework on foundations adequate to support the load without appreciable settlement. Drive an ample quantity of falsework piling to support the falsework unless there is firm foundation material for the support of mud sills that is not subject to undermining or softening. Construct mud sills of a size and thickness to support the load at the soil's safe bearing value. Generally, found mud sills only on rock, firm sand, gravel, or very firm, silty, sands or clays in their natural beds. Place mud sills founded on well-compacted slopes of berm fills or natural slopes on benches, with the edge of the sill not closer than one foot from the intersection of the bench and the surface of the slope, except if the engineer allows placing sills on slope paving. The safe design bearing value for foundation material, other than rock, under mud sills shall not exceed 2 tons per square foot. Unless supporting the excavation for footings adequately with sheeting, place the edge of the falsework sill no closer than 4 feet from the excavation edge.

(2) If supporting falsework by mud sills placed on paved, well-compacted slopes of berm fills, then the contractor shall not strut the falsework to columns, unless founding the column on rock or supporting by piling.

(3) Set falsework at the proper elevation to produce, in conjunction with engineer-approved wedges, shims, or jacks, the specified permanent camber plus a construction camber covering allowance for settlement. Construct slabs and girder spans to provide a permanent camber as the plans show.

(4) If extending existing concrete bridges, then extend the falsework and forms for the new construction one foot under the edge of the existing structure and make the existing structure bear on the falsework by driving wedges between the falsework and the forms.

(5) If the plans show, brace and tie the exterior girders supporting bridge decks to the interior girders as necessary to preclude rotation of the exterior girders if supporting the deck overhang by knee braces bearing against the exterior girders.

(6) If the plans do not show the above requirement, the contractor shall determine the need for any bracing or stabilization necessary to prevent girder rotation and overhang settlement.

(7) The contractor's responsibility includes obtaining satisfactory results whether or not the plans show a requirement for bracing or stabilizing the exterior girders.

(8) If building falsework over a stream or lake subject to boating use, construct it to provide ample horizontal and vertical clearance for rowboats and small powerboats to pass. If building falsework over a highway or street used by traffic provide a minimum clearance, unless the plans show otherwise or special provisions specify otherwise, of 22 feet horizontal and 13 1/2 feet vertical. Ensure that no part of the falsework protrudes into the clear areas reserved for water or highway traffic. For signing, conform to plan details or contract provision requirements.

502.3.3 Forms

502.3.3.1 Detailed Plans

(1) The engineer reviews the details for formwork, bracing, tying, etc., and will not give permission to place concrete until all this work is complete. If the engineer directs, submit detailed plans and computations for forms to the engineer for examination. Revise the plans as the engineer directs.

Understand that whether or not the engineer requests submission of these plans or concurs in the use of the submitted or corrected plans, the contractor is responsible for obtaining satisfactory results.

502.3.3.2 Design

(1) Design forms to sustain the pressures resulting from considering concrete without initial set as a liquid weighing 160 pounds per cubic foot plus a live load allowance of not less than 10 pounds per square foot of horizontal projection of forms. Use substantial and unyielding forms designed so that the finished concrete conforms to the proper dimensions and contours. Design forms to account for vibration forces.

502.3.3.3 Erection

(1) Build forms mortar-tight and sufficiently rigid to prevent distortion from concrete pressure and other loads that occur due to construction operations. Construct and maintain forms to prevent warping and joint openings due to lumber shrinkage, and so they remain true to the lines designated until the concrete hardens sufficiently. Forms shall remain in place for the periods specified below in 502.3.4.

(2) If forms appear unsatisfactory in any way, before or during concrete placement, the engineer will order the work stopped until correction of the defects. If the engineer orders, the contractor shall remove and replace the concrete within the defective area at no expense to the department.

502.3.3.4 Timber Forms

(1) Use forms for exposed surfaces made of dressed lumber, of uniform thickness and make mortar-tight.

(2) Fillet the forms with triangular molding chamfer strips at exposed, sharp corners and at the edges of the concrete. Unless specified otherwise, use triangular molding that measures 3/4 inch on the sides.

(3) Construct forms for railing, copings, and ornamental work to standards equivalent to first-class millwork. Make moldings, panel work, and bevel strips, straight and true, with neatly mitered joints, and design so that the finished work is true, sharp, and clean cut. Exercise special care to secure smooth and tight fitting forms, hold the forms rigidly to line and grade, and remove without injuring the concrete.

(4) In forming copings, offsets, and recesses, give the forms sufficient taper to allow removal without damaging the concrete. The maximum draft shall equal one inch per foot.

(5) Use bolts or rods to hold forms in place. Construct metal appliances used inside forms to hold them to correct alignment and location so that, after removing the forms, removal of the metal to a depth of at least one inch from the surface of the concrete does not injure the surface. Hold bolts or rods in place by attaching devices to the wales that develop the strength of the rod. Fill cavities left by removing bolts and rods with cement mortar conforming to 502.3.7.1 and leave a sound, smooth, and even surface uniform in color. If exposing the completed concrete, use tie rods of a diameter, or fitted with cones, or other means to provide cavities large enough to allow filling and finishing with cement mortar.

(6) The contractor shall not use spreaders for metal pipe, precast concrete, or rolled sections unless it removes them while placing the concrete.

(7) Secure forms for exposed surfaces to the studs or uprights with true horizontal joints.

(8) If reusing forms or form lumber maintain them in clean and good condition as to accuracy, shape, strength, rigidity, tightness, and smoothness of surface. Do not reuse any split, warped, bulged, or marred lumber, or use lumber with defects that may produce inferior work.

(9) If possible, daylight columnar forms at vertical intervals and with sufficient openings to allow free access to forms for inspecting and working the concrete.

502.3.3.5 Metal Forms

(1) Apply the above specifications for forms, if they are applicable, to metal forms carrying an equivalent loading. Use metal forms thick enough so they remain true to shape. Countersink bolt and rivet heads in the form face. Use clamps, pins, or other connection devices designed to hold the forms rigidly together and to allow removal without injuring the concrete. The contractor shall not use metal forms that do not present a smooth surface or line up properly. Exercise special care to keep metal forms free from rust, grease, or other foreign matter that tends to discolor concrete.

502.3.3.6 Clean Outs

(1) For narrow walls and other locations where no reasonable access to the bottom of the forms exists, provide adequate clean-out openings. Ensure forms are clean and entirely free from chips, dirt, sawdust, nails, wire, and other extraneous matter during concrete placement.

502.3.3.7 Oiling and Wetting

(1) Oil the inside of forms used for exposed concrete surfaces with a light, clear, paraffin base oil, or treat with other engineer-approved bond-inhibiting materials that will not discolor or injuriously affect the concrete surface. Perform oiling before placing the reinforcement. Thoroughly wet forms with water immediately before placing concrete.

502.3.3.8 Lined Forms

(1) Use lined forms for the exposed surfaces of endwalls, substructure units, retaining walls, rigid frames, underside surfaces of superstructures, except slabs between beams or girders, the outside surfaces of superstructures, and all railing and parapet surfaces.

(2) Ensure lined form surfaces completely contact the concrete faced with metal, plywood, composition, or other engineer-approved material to the engineer's satisfaction. Submit samples, specifications, and other pertinent information on these forms to the engineer if requested and secure the engineer's permission to use the contemplated form lining.

(3) Form lining material shall not bulge, warp or blister, or stain the concrete. Keep the number of pieces of material used line forms to a minimum. Make splices in form lining material neatly and break joints with the form material.

(4) The contractor may use forms constructed of metal, plywood, or other engineer-approved material that satisfactorily produces the desired surface finish for the concrete instead of lined forms.

502.3.3.9 Cylindrical Column Forms

(1) If forming cylindrical columns with fiber pulpboard tubes, use truly cylindrical tubes of uniform diameter and with adequate strength to support the concrete. Ensure that the surfaces of the tube are waterproof with a treated interior surface that prevents adhesion of the tube to the concrete and after finishing, does not leave protruding seams or fins. The tube shall provide a smooth and true column surface, free from discoloration.

502.3.4 Removing Forms and Falsework

502.3.4.1 Removing Forms

(1) If removing forms under slabs, beams, girders, brackets, and supports, conform to the removal requirements for falsework specified below in 502.3.4.2. The contractor may remove all other forms 12 hours after casting concrete if the concrete is sufficiently set to be self-supporting.

(2) If forms are an integral part of the falsework, keep them in place until falsework removal. During hot weather, use water, as the engineer directs, to cool the concrete within the forms.

(3) Remove forms in a manner causing no injury to the concrete.

502.3.4.2 Removing Falsework

(1) Do not remove falsework and form supports without the engineer's approval. Remove supports in a way that allows the concrete to uniformly and gradually take the stresses due to its own mass.

(2) In determining the removal time of falsework, consider the location and character of the structure, the weather, the materials used in the mix, and other conditions influencing the concrete setting.

(3) The engineer may determine when to remove falsework or form supports by using test cylinders or by using the minimum requirements specified below:

1. If not controlling field operations by cylinder tests, keep falsework supporting concrete in bridges, including slabs, beams, girders, arches, or concrete slabs on steel or concrete girders in place according to the minimum requirements for equivalent curing days specified in 502.3.10.1. Except do not remove falsework from cast in place bridge slab decks or box girder spans until at least 7 days elapse, for deflection control, exclude days that the concrete surface was subjected to temperatures below 40 F.
2. If controlling field operations by cylinder tests, remove falsework or form supports, with the engineer's approval, when the tests of cylinders show a concrete compressive strength of not less than 2000 psi for spans 12 feet or less; and not less than 2500 psi for spans over 12 feet. Except, do not remove falsework from cast-in-place bridge slab decks or box girder spans until at least 7 days elapse, for deflection control; exclude days that the concrete surface was subjected to temperatures below 40 F.

(4) Double the length of the horizontal projection of cantilevered portions of piers, abutments, and similar sections for determining span length for falsework removal.

(5) Test at least 2 cylinders to determine the attained strength of concrete for falsework removal. Use the average test results for the 2 cylinders to determine compliance, except that both cylinders must be no less than 10 percent below the required strength. Cure the cylinders under conditions that at best equal the most unfavorable conditions for concrete sampled that the cylinders represent.

(6) Remove falsework piles down to at least 24 inches below streambed or finished ground line. Remove temporary mud sills and footings.

(7) For multiple concrete spans of continuous design, do not remove the falsework from any one span until the concrete in an entire unit of continuous span cures for the required time. If providing a longitudinal joint in the roadway of any one span, do not remove the falsework from any portion of the span until the entire span cures for the required time.

502.3.5 Handling and Placing Concrete

502.3.5.1 General

(1) Notify the engineer before placing concrete to allow inspection of the forms, reinforcement, and placement preparations.

(2) Before placing any concrete in a given pour, have sufficient labor, material, and equipment at the work site to complete the pour. Use equipment that is adequate for the work and in first-class working order.

(3) Complete the forming and placing reinforcement before placing the concrete in any unit. Place and rigidly support in the correct position all bar steel reinforcement extending into a subsequent pour before placing the first concrete in a given pour, unless the plans show otherwise. Complete adjacent pile driving and other operations detrimental to freshly placed concrete before placing concrete.

(4) Before placing concrete, remove sawdust, chips, nails, wire, other construction debris, and extraneous matter from the forms interior. Clean the contact surfaces of structural steel members embedded in the placed concrete to ensure they are free from oil, grease, loose rust scale, or other materials that would affect the bond between the concrete and the steel.

(5) The contractor shall not support construction equipment on reinforcement steel or bar chairs.

(6) Place the concrete in a way that avoids segregating the aggregate or displacing the reinforcement. If the engineer finds any defective concrete section, remove and replace it, as the engineer directs, at no expense to the department.

(7) Arrange and use chutes, troughs, belts, and pipes as aids in placing concrete so no separation of the concrete ingredients occur. Provide enough chutes, troughs, or pipes to carry the concrete up at a uniform level without shifting them. Keep chutes, troughs, belts, and pipes clean and free from coatings of hardened concrete. Discharge water used for flushing away from the concrete in place.

(8) If placing concrete in structures, the distance from the discharge ends to the point of deposit for chutes, troughs, pipes, belts, and buckets shall not exceed 4 feet.

(9) If using conveyor belt systems, equip the belts with suitable hoods or chutes to control the discharge.

(10) If conveying or placing concrete by pumping, use suitable equipment with adequate capacity for the work. Arrange the equipment so that any resulting vibrations do not damage freshly placed concrete. Operate the pump in a way that produces a continuous stream of concrete without air pockets. After pumping is complete, if using the concrete remaining in the pipeline, eject it so there is no concrete contamination or ingredients separation. After this operation, thoroughly clean the equipment.

(11) If placing concrete by pumping, take measures to minimize entrained air loss. The point of discharge from the flexible hose at the end of the boom shall be higher than the lowest point of the flexible hose. If using an extended boom, the contractor may lay part of the flexible hose on the deck. If completely suspending the flexible hose from the boom, tie the discharge end of the flexible hose back toward the end of the rigid boom to form a partial loop. The engineer may approve alternate methods if the contractor can demonstrate that the air loss in the concrete created by the pumping process does not exceed 1.0 percent in any boom orientation.

(12) The contractor shall not use aluminum pipes, chutes, troughs, spouts, or tremies for pumping, conveying, or placing concrete.

(13) If placing operations involve placing concrete through the completed forms, as for, piers, columns, and retaining walls over 5 feet in height, with the exception of cast in place concrete piles and walls less than 10 inches thick, deposit concrete through sheet metal or other engineer-approved pipes. Assemble these pipes in sections to facilitate adjusting outlets to proper heights during pouring operations. The distance from the bottom of these pipes to the point of deposit shall not exceed 4 feet at any time.

(14) If using troughs or chutes, extend them down inside the forms, or through holes left in the forms, to within 2 feet of the point of deposit unless they end in vertical downspouts that extend to within 4 feet of the point of deposit. Equip steep chutes with baffle boards or assemble them in short lengths that reverse the direction of movement. The contractor shall not use long chutes for conveying concrete from the mixing plant to the forms.

(15) Place concrete in continuous horizontal layers approximately 12 inches thick, except that the engineer may allow increasing this thickness to 24 inches. Place each layer in a continuous pour and consolidate before the concrete in the preceding layer takes initial set.

(16) Make construction joints only at locations the plans show, unless the engineer directs otherwise. In case of an emergency, place construction joints at the engineer's direction. Use shear keys or inclined reinforcement at necessary points to transmit shear, or bond the 2 sections together.

(17) Regulate placing the concrete so that the pressure of the concrete does not exceed that of the form design.

(18) Take special care to fill each part of the forms by depositing concrete directly as near the final position as possible, to work the coarse aggregate back from the face, and to force the concrete under and around the reinforcement bars without displacing them. Also, try to prevent spattering the forms or reinforcement bars so that the spattered concrete does not dry or harden before incorporating into the mix. Clean foreign material from reinforcement bars before the succeeding pour.

(19) Remove all removable form spreaders before placing concrete at the spreader elevation.

(20) Take care to avoid accumulating laitance or foreign matter inside forms, recesses, or corners. Provide openings in forms for removing any accumulations, as the engineer directs.

(21) After the concrete takes initial set, avoid jarring the forms or placing any strain on the ends of projecting reinforcement.

(22) Use mechanical vibration to consolidate the concrete for superstructures. Consolidate other concrete for structures by vibrating unless using other methods the engineer finds satisfactory. Use vibrators capable of operating at frequencies sufficient to achieve thorough and uniform consolidation, but at not less than 7000 impulses per minute. Make available at least one spare vibrator, in working order and of sufficient frequency, on the work site before pouring concrete.

(23) Apply vibration to the freshly deposited concrete by slowly inserting and withdrawing the vibrator. Perform this procedure at enough locations and for as long as necessary to uniformly and thoroughly consolidate the entire weight of fresh concrete without causing aggregate segregation, or forming localized areas of mortar.

(24) Consolidate each concrete layer thoroughly before placing the next layer on top. Ensure that the vibrator penetrates through each successive layer and sufficiently into the preceding layer to uniformly blend the 2 concrete layers together.

(25) The contractor shall not perform vibration directly to or through the reinforcement of sections or layers that harden so that they are no longer plastic under vibration. The contractor shall not use the vibrator to transport, or to flow, the concrete within the forms to the extent of causing segregation.

(26) Supplement vibration with as much spading as necessary, to ensure smooth surfaces and dense concrete, along form surfaces and in corners and locations impossible to reach with the vibrator.

(27) If required to continue mixing, placing, or finishing concrete after daylight hours, employ artificial light at the work site to the engineer's satisfaction.

502.3.5.2 Substructures

(1) If possible, place concrete for substructures in unwatered foundation pits. The contractor may omit the forms and fill the entire excavation with concrete, if the material type encountered in excavation for structures allows placing concrete for footings wholly or in part without forms, and if the engineer approves.

(2) Place concrete in columns in one continuous operation unless the engineer specifies or the plans show otherwise. Allow the concrete to set at least 12 hours before placing the concrete in the cap, cross girder, or superstructure.

(3) If the plans show, ensure the thorough and effective drainage of the filling material behind culverts, retaining walls, and abutments by placing weep holes in conjunction with the construction specified in 206.3.12. Discharge the drainage water through the abutment, the wall of the culvert, or through the retaining wall in a manner and at locations that do not cause discoloration of exposed masonry surfaces. Form weep holes and, if necessary, fit with suitable screens or gratings to protect the intake against clogging. Constructing weep holes the plans show is incidental to the work.

(4) The contractor shall not place concrete on a frozen foundation.

502.3.5.3 Depositing Concrete Underwater

(1) Deposit concrete underwater only if the engineer orders, the plans show, or the contract specifies.

(2) Provide concrete as specified in 501, except increase the slump to 5 - 9 inches without exceeding the maximum mix water allowed for that grade.

(3) For concrete deposited underwater, place it carefully in a compacted weight in its final position using a tremie. The tremie consists of a tube that has a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie support shall allow free movement of the discharge end over the entire work surface and allow its rapid lowering if necessary to choke off or retard the flow. Keep the discharge end sealed at all times and the tremie tube full to the bottom of the hopper. If dumping a batch into the hopper, raise the tremie slightly, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. Then stop the flow by lowering the tremie. Ensure a continuous uninterrupted flow until the work is complete. The contractor may use a tremie equipped with a suitable mechanical seal or valve at the discharge point instead of the open tube tremie, if the engineer approves of the design, method of operation, and control of the device.

(4) Exercise special care not to disturb concrete deposited underwater and to maintain still water at the deposit point. The contractor shall not place concrete in running water. Ensure watertight formwork.

(5) Place the concrete in a way that precludes developing a cold joint between successive layers or placement stages. Accomplish this by either placing the concrete layers deep enough to accommodate satisfactory tremie operation, while ensuring that the previously layer does not take initial set by pouring at a rate sufficient to raise the concrete level between 1 1/2 to 2 feet per hour; or by placing the concrete full depth in one continuous operation and completing the work to grade progressively from one end of the cofferdam to the other.

(6) Design cofferdams to accommodate appropriate and planned pour rates. The contractor may place underwater concrete by pumping, if the engineer approves.

(7) The contractor shall not dewater the cofferdam until at least 3 days pass from the time placed and not before the concrete hardens and is strong enough to withstand the hydrostatic pressure.

(8) After dewatering, remove laitance or other unsatisfactory material on the top of seals and underlying proposed substructure units by scraping, chipping, or other means.

502.3.5.4 Superstructures

(1) Except for parapets or similar pours, the contractor shall not place concrete in bridge decks if housing is required at time of placement, unless the engineer specifically allows or requires in writing. Except for rigid frame bridges, remove the forms for the substructure units that support any proposed superstructure before placing the superstructure.

(2) Ensure continuous concrete placement in superstructures between joints the plans show.

(3) Exercise care to minimize honeycombed concrete. The engineer may require the removal and replacement of honeycombed concrete at no expense to the department.

(4) Do not place concrete parapets, sidewalks, and medians on cast in place structures until the falsework is released for that superstructure unit. The contractor may place those portions of the railings directly attached to substructure units while the falsework is in place.

(5) The contractor may form and place concrete parapets, sidewalks and medians on steel girder, I-beam, or pre-stressed girder structures after 48 hours following deck placement, provided it uses no heavy equipment on the deck and it properly cures the deck adjacent to the pours.

(6) Place floor drains, conduits, expansion joints, and other fittings as the plans show. Place and securely fastened them before placing the concrete.

(7) Before placing concrete floors on steel superstructures, release the falsework and swing the span free on its supports.

502.3.6 Joints

502.3.6.1 General

(1) Construction joints are those joints that do not provide for movement of abutting surfaces. Expansion joints are those joints that provide for movement by sliding or by deflection. Contraction joints are those joints that provide for accommodating movement resulting from contraction, and control cracking.

(2) Place joints only at the locations that the plans show. The contractor shall not omit any joints the plans show, except upon the engineer's written authorization. If constructing joints not as the plans show, but required due to emergency, use shear keys or inclined reinforcement at locations necessary to transmit shear, or to bond the 2 sections together.

(3) The contractor shall not edge joints that have reinforcing steel carried through.

(4) Conform to the plans for constructing construction, expansion, and contraction joints. Unless the plans show otherwise, make joints normal to the forms. Provide bulkheads for all except horizontal joints. Ensure that joints are true to alignment and uniform in width.

(5) If the plans show, seal expansion joints with a hot-poured elastic joint sealer, conforming to 502.2.10. Seal contraction joints with a non-bituminous joint sealer conforming to 502.2.9.

502.3.6.2 Construction Joints

(1) Form keyed construction joints by inserting and subsequently removing a template. Use a method to insert and remove the template that avoids chipping, breaking, or damaging the concrete.

(2) If joining fresh concrete to concrete previously set, remove loose material, laitance, dirt, and foreign matter from the previously set concrete surface and keep the surface saturated with water until the new concrete is placed. Immediately before placing the new concrete, draw forms tightly against the previously set concrete.

502.3.6.3 Expansion Joints

502.3.6.3.1 Preformed Joint Filler

(1) Use preformed joint filler conforming to 502.2.7, carefully placed, and accurately fit to the adjacent concrete. Take special care to prevent displacing the joint filler during concrete placing and to prevent forming concrete fins under or between the sections of material. Do not assemble a series of small pieces of joint filler to produce a shape that could be cut from a single piece. Edge or chamfer exposed concrete edges adjacent to preformed fillers, as the plans show.

502.3.6.3.2 Preformed Elastomeric Compression Joint Sealer

(1) Use preformed elastomeric compression joint sealer conforming to 502.2.8 and install in the joint with a lubricant-adhesive.

(2) Clean joint faces to ensure they are free of laitance, oils, greases, dirt, free water, and other foreign matter immediately before installing the seal. The engineer will direct the method of cleaning the joints.

(3) Install the seals, in the properly prepared joint, using tools designed for installing joint seals. Remove and replace any seal damaged during installation with an undamaged seal. Remove and reinstall any seal improperly positioned in the joint at the proper elevation.

(4) Before placement, cut the seals to the lengths of the joints or as much longer as needed for proper installation. Measure each seal before and after installing as a check against stretch. Remove and reinstall any installed seal showing more than 5 percent stretch.

(5) Install the seals so they are secure and free from any objectionable curling or twisting in the joint groove. Use a lubricant to facilitate installation and to cover both sides of the seal over the full area in contact with the sides of the joint. The contractor may apply the lubricant to the joint faces, or the seal, or both. Install the seals in a highly compressed state and ensure the top of the seal is below the pavement surface by approximately 1/8 inch but not more than 3/8 inch. Install the seal in one piece, without field or factory splicing, for the full length of each transverse joint.

(6) Observe the manufacturer-specified temperature limitations.

502.3.6.3.3 Expansion Device

(1) Use an expansion device conforming to one of the models the special provisions show.

(2) Install the steel extrusions with field splices located to match the stage construction. The department will not allow welding in the steel extrusion's internal section where the neoprene extrusion is located. Weld splices conforming to the following:

For steel: AWS D 1.5, Bridge Welding Code.

For stainless steel: AWS D 1.6, Structural Welding Code - Stainless Steel.

Revise 502.3.6.3.3(3) to require an inspector from the contractor's current field welding plan described in (DT2337).

(3) Visually inspect and certify the quality of field welds as follows:

1. Designate an inspector listed in the current contractor field welding plan described in department form DT2337.
2. Have the designated inspector complete department form DT2320 and submit to the engineer for inclusion in the permanent project record.

(4) Blast clean the steel extrusion's internal section that comes in contact with the neoprene extrusion so that all surfaces are dry, free from dirt, grease, and contaminants before installing the neoprene extrusion and cover or fill this internal section before placing concrete, to prevent concrete from entering.

502.3.6.4 Waterstops

(1) Waterproof construction and expansion joints, if the plans show, by installing rubberized membrane or polyvinyl chloride waterstops. Make the field splices for rubberized membrane or polyvinyl chloride

waterstops watertight. Install rubberized membrane waterstops as specified for rubberized membrane in 516.3.3. Install polyvinyl waterstops as the plans show.

(2) Install waterstops so they do not transfer forces into the concrete embedded in until the concrete is sufficiently strong to withstand that force.

502.3.7 Surface Finish of Concrete

502.3.7.1 General

(1) After removing forms, remove metal devices used to tie forms together in a way that leaves no metal within less than one inch of the concrete surface and does not injure the concrete surface. The contractor shall not burn off rods, bolts, or other metal devices. After removing the ties, roughen the opening and remove concrete containing any oil.

(2) Immediately after removing forms, saturate cavities produced, and other holes, depressions, and honeycomb spots with water and carefully point with a cement and fine aggregate mortar mixed in the same proportions as the concrete being treated and of as dry a consistency as possible to use. For exposed surfaces, add as much white cement as necessary to provide a mortar the approximate color of the concrete. Use mortar in pointing that is not more than one hour old.

(3) Clean open joints in the completed work to make them free of mortar and concrete.

(4) If using insulated forms or if allowed to leave forms in place more than 72 hours, point holes, cavities, depressions, and honeycomb areas and apply a sack rubbed or rubbed surface finish as soon after removing the forms as weather and curing conditions allow.

502.3.7.2 Ordinary Surface Finish

(1) Unless specified otherwise, provide an ordinary surface finish on formed surfaces.

(2) Work the concrete up against formed surfaces during placement by using engineer-approved concrete vibrators or spading implements. Force coarse aggregate from the surface, and thoroughly work the mortar against the forms to produce as smooth a finish as possible, free from water pockets, air bubbles, and honeycomb.

(3) Immediately after form removal, point tie rod holes, pits, or defects and remove or correct fins and irregularities. If the engineer determines the final surface is not satisfactory and that an ordinary surface finish was not provided, apply a rubbed surface finish conforming to 502.3.7.3 to the affected exposed areas. There is no requirement to extend the rubbed surface finish into nondefective areas solely to obtain a uniform texture.

502.3.7.3 Rubbed Surface Finish

(1) Apply a rubbed surface finish by carefully rubbing the ordinary surface finish with a fine carborundum brick immediately after removing the forms. Begin by moistening the surface with water and then immediately rubbing it with the carborundum brick, using light pressure and a circular motion. Continue rubbing until filling air holes and small depressions and a thin, uniform coating of mortar is on the surface and until obtaining a smooth surface, free from lumber marks and irregularities.

(2) The contractor may employ machine methods to produce the rubbed surface finish if the engineer approves.

(3) Keep rubbed surfaces wet and covered for at least 4 days or cure by applying membrane curing material as specified in 502.3.8.

(4) Before acceptance, remove lather, powder, and dust on rubbed surfaces.

502.3.7.4 Float Surface Finish

(1) Unless specified otherwise, apply a float surface finish to all unformed upper surfaces.

(2) To provide a float surface finish, place excess material in the forms and remove or strike off the excess with a wooden template, forcing the coarse aggregate below the mortar surface. After striking off the concrete, work the surface thoroughly with a wooden float. Before this last finish sets, lightly stripe surfaces finished this way and exposed in the finished work with a fine brush to remove the surface cement film and leave a fine-grained, smooth, but sanded texture.

(3) The contractor shall not mortar top surfaces that will receive a float surface finish.

502.3.7.5 Sack Rubbed Surface Finish

(1) If the plans show, or specifications indicate, provide a sack rubbed finish on concrete surfaces.

(2) Before applying the sack-rubbed finish fill tie rod holes and large cavities and remove or correct fins and irregularities as specified in 502.3.7.1 and 502.3.7.2.

(3) Produce a sack rubbed surface finish by rubbing the concrete surface with a clean rubber float or wad of burlap and mortar. Use mortar made of one part cement and 2 parts, by volume, sand passing a

No. 16 sieve, mixed with sufficient water to provide a consistency equal to that of thick cream. Use the same type and brand cement as used in the concrete. If necessary, blend white cement into the cement to match the surrounding concrete surface.

(4) Thoroughly wet the surface of the concrete and then perform sack rubbing while the surface is damp but not wet. Thoroughly rub the mortar over the area with a rubber float or wad of burlap, filling pits. While the mortar is still plastic in the pits, rub the surface with the rubber float or burlap using a dry mix of the above proportions, removing excess plastic material and placing enough dry material in the pits to stiffen and solidify the mortar, then finish the mortar fillings flush with the surface. At the end of the rubbing, no mortar or material shall remain on the surface other than that within the pits.

(5) Ensure the completed surface is free of surface voids and blemishes, and is uniform in appearance and texture, except for the difference in texture between the filled voids and the remainder of the surface.

502.3.7.6 Substructures

(1) Provide an ordinary surface finish for formed faces of substructure units. Except, give exposed formed surfaces of parapets built integrally with substructure units the same surface finish specified for similar work on superstructures in 502.3.7.7. Rubbed or special surface finish is not required for any formed faces of substructure units unless the plans or special provisions require, or as specified in 502.3.7.2 for applying a rubbed surface finish.

(2) Strike off and float bent caps, bridge seats, tops of parapet walls supporting a superimposed load, and tops of piers with a wooden float as specified for float surface finish. Before this last finish sets, steel trowel the entire area. If finishing areas to receive bearing plates, secure a true plane at the correct elevation.

502.3.7.7 Superstructures

(1) Apply a sack rubbed surface finish to exposed formed surfaces of parapets, posts, and sidewalks as well as to exposed side surfaces of superstructures, including the outer face of outside pre-stressed girders as specified in 503.3.3.4, unless the special provisions specify otherwise.

(2) There is no requirement to provide a rubbed surface finish for any formed surface of superstructures, unless the plans or special provisions require it, except if, the engineer determines the sack rubbed finish provided is unsatisfactory, then the contractor shall apply a rubbed surface finish conforming to 502.3.7.3 to the affected exposed areas.

(3) Strike off and float the tops of safety curbs, sidewalks, or copings that serve as sidewalks in the completed structure with a wooden float as specified for float surface finish. Before this last finish sets, steel trowel these areas and then brush them.

502.3.7.8 Floors

(1) Prepare the concrete for bridge floors, if and as required in 501.3.2.4.3, with a retarding admixture. Deliver the mixed concrete at a uniform rate to provide a continuous placing operation for each pour section. Handle and place the concrete by methods and equipment that minimize segregating the ingredients. Deposit it as closely as possible to its final position without forming piles and so that it requires a minimum of rehandling.

(2) Immediately after depositing the concrete, consolidate, strike off, screed, and finish it to the required grade, section, and surface tolerance. Uniformly consolidate the concrete by internal vibratory methods as specified in 502.3.5.1, except that, the contractor may use a vibratory screed for consolidating and finishing in conjunction with internal vibration. Operate the internal vibrators or the vibratory screed, or both, in a way that avoids over-vibration.

(3) Unless the contract specifies otherwise, construct concrete bridge floors with self-propelled machine finishers.

(4) Use a machine finisher designed for finishing bridge floors. It shall consist of a rigid supporting frame mounted on wheels that ride on removable tracks or rails and is equipped with the necessary screeding apparatus to strike off and finish the concrete to required crown and grade. It shall have one or more power-driven oscillating, rotating or vibratory screeds. The screeds may suspend from the machine either transversely or longitudinally with the bridge centerline, except as required for skew angles of 20 degrees or greater. Use a finishing machine capable of propelling itself both forward and backward to allow repeated passes of the screed in order to correct surface irregularities. Adjust its screed or screeds and operate in manner that finishes the concrete to required grade and crown and requires a minimum of cutting or filling in any subsequent float-finishing operations.

(5) The contractor shall set the rails or tracks, that the machine finisher rides on, to the required elevation; and ensure they adjust to allow for settlement under load. If the rail supports are located in the

concrete, ensure their removal without disturbing the concrete, or partially remove so that no piece remains less than 2 inches below the finished concrete surface. Remove these supports, fill the resulting holes with concrete, and finish flush with the deck concrete before it hardens.

(6) Ensure the rails or tracks extend beyond each end of the floor or deck sufficiently to support the finishing machine at the correct grade and entirely free of the floor or deck area.

(7) Finish floor areas inaccessible to machine operation by hand methods.

(8) On bridge decks supported on prestressed concrete or steel girders and having skew angles of 20 degrees or greater, operate the finishing machine so that its longitudinal axis is within 20 degrees of the centerline of bearing of the substructure units. Make transverse screeds parallel to the longitudinal axis of the machine.

(9) If using hand-operated strike-off screeds, design, construct, and operate them to provide the required crown and grade in the finished floor. The contractor may use vibratory or nonvibratory type screeds that operate on forms or temporary guides set and maintained at the required elevation. Use sectioned, temporary guides that remain rigid and unyielding under screed operation and, if located within the pour limits, can be removed as the work progresses. If using vibratory screeds to supplement required internal vibration, operate them so they do not over vibrate the concrete.

(10) Hand finish gutter lines and areas around floor drains not reached by the templates and finishing equipment to the grade and section needed to insure proper drainage.

(11) Strike off and remove the laitance from floor areas that will receive concrete for sidewalks or similar items.

(12) Following screeding, unless obtaining a satisfactory surface with a self-propelled finishing machine, float the surface as needed to produce a uniform surface.

(13) While the concrete is still plastic and following screeding operations, and float finishing if performed, work laitance, surplus water, and inert material off the floor and make it smooth. Test for smoothness by dragging the entire floor surface with a 10-foot straightedge as specified in 415.3.6.1 for straightedging concrete pavement. Use bridges to facilitate straightedge operations on pour sections wider than 2 lanes.

Revise 502.3.7.8(14) to require transverse tining for bridge decks unless specified otherwise. This change was implemented in ASP 6 effective with the December 2017 letting.

(14) Unless specified otherwise, transversely tine finish the floors of structures with approach pavements designed for speeds of 40 mph or greater as specified in 415.3.8.3, except make the tining 1/8 inch in depth and do not perform tining within 12 inches of gutters. The contractor may apply a broom finish, described below, instead of the artificial turf drag finish required before tining. The contractor may perform tining manually, if it obtains a finish satisfactory to the engineer. Perform tining within 20 degrees of the centerline of bearing of the substructure units on bridge decks having skew angles of 20 degrees or greater.

(15) Unless specified otherwise, provide a turf drag finish on floors of structures with approach pavements designed for speeds of less than 40 mph as specified in 415.3.8.2 or provide a broom finish. If providing a broom finish, draw the broom transversely across the full width of the pavement with adjacent strokes slightly overlapping. Perform brooming to produce uniform corrugations and approximately 1/8 inch in depth. Complete brooming before the concrete hardens and this operation tears or roughens the surface. Brooming shall provide a surface free from rough or porous areas, irregularities, and depressions that result from improper broom handling. Furnish brooms of a sufficient quality, size, and construction, and operate them to produce a surface finish the engineer approves. Provided the contractor obtains satisfactory results, the engineer will allow manual brooming instead of mechanical brooming.

(16) The finished bridge floor shall conform to the surface test specified in 415.3.10. The engineer will not direct corrective grinding without authorization from the department's bureau of structures.

(17) Make available suitable platforms to use, as required, over steel reinforcement projecting from previously placed concrete, during the period necessary for the concrete to achieve sufficient strength to preclude damage from contractor's operations on the unprotected reinforcement.

(18) Make available adequate bridges, if and as the engineer requires, for inspecting and testing the placed concrete, and furnish bridges, if necessary, to perform work operations that follow the screeding operations.

502.3.8 Curing

502.3.8.1 General

(1) Maintain adequate moisture throughout the concrete mass to support hydration until the concrete develops sufficient strength to open it to service. Cure concrete by one or a combination of the following methods:

1. Impervious coating.
2. Impervious sheeting.
3. Continuous wet cure.
4. Alternate method the engineer approves.

(2) If the contractor fails to cure concrete as specified here in 502.3.8, the engineer may suspend concrete placement operations.

502.3.8.1.1 Impervious Coating Method

(1) After finishing operations, and as soon as the free water disappears, spray the concrete surface with a uniform coating of curing compound conforming to 502.2.6. Seal moisture in the concrete by applying a continuous water-impermeable film on exposed concrete surfaces.

(2) Provide sufficient agitation of pigment within the curing compound during spraying to ensure uniform consistency and dispersion as applied.

(3) Apply the curing compound with spraying equipment that produces a continuous, uniform film that does not run or sag.

(4) Apply the curing compound uniformly at a minimum rate of one gallon per 150 square feet. Apply the membrane curing material in 2 applications at the rate of not less than one gallon per 300 square feet.

(5) If damage to the curing compound coating occurs before the concrete conforms to the opening criteria specified in 502.3.10, recoat the affected area immediately. If removing forms before the concrete conforms to the opening criteria specified in 502.3.10, coat newly exposed surfaces within 30 minutes after form removal.

502.3.8.1.2 Impervious Sheeting Method

(1) As soon as the concrete receives a finish and hardens sufficiently to prevent excessive marring, cover exposed concrete surfaces with one or a combination of the following impervious sheeting materials:

1. Polyethylene sheeting conforming to the curing materials specified in 501.2.9.
2. Polyethylene-coated burlap conforming to the curing materials specified in 501.2.9. Pre-wet the polyethylene-coated burlap and place with the uncoated side against the concrete.
3. Insulated curing blankets with an impervious coating, with the engineer's approval.
4. Alternate impervious sheeting materials, with the engineer's approval.

(2) Provide sheeting material sufficient to cover exposed surfaces and edges, with enough excess to hold the material securely in place by weighting or an alternate anchoring method. Provide a minimum of 12 inches overlap between adjacent pieces of sheeting. Place the sheeting material so that it is in direct contact with exposed concrete surfaces.

(3) Maintain the sheeting material in place until the concrete conforms to the opening criteria specified in 502.3.10. If temporary removal is required, to remove forms or perform other necessary work, re-cover exposed concrete as quickly as practicable, or as the engineer directs.

(4) If the engineer approves, the contractor may reuse sheeting materials in serviceable condition.

502.3.8.1.3 Continuous Wet Cure Method

(1) As soon as the concrete receives a finish and hardens sufficiently to prevent excessive marring, spray or fog the exposed surfaces of the concrete to keep it moist until the concrete conforms to the opening criteria specified in 502.3.10. Apply a layer of thoroughly wetted burlap to protect the surface from the mechanical impact of the spray.

(2) If the concrete surface shows evidence of erosion by the curing water, the engineer will immediately suspend the spraying or fogging. Remedy the conditions causing erosion or switch to another cure method that does not involve continuous wet cure.

(3) If ambient temperatures are predicted to fall below 32 F within the next 24 hours, suspend continuous wet curing and switch to another curing method.

502.3.8.1.4 Alternate Curing Methods

(1) If the contractor requests, the engineer may approve using alternate materials or curing methods. Supply technical specifications, test results, or performance records to support its proposed alternative method, if the engineer requests.

502.3.8.2 Curing Requirements

502.3.8.2.1 General

(1) Do not use reinforcing steel to support or attach covering materials.

(2) If curing formed concrete by the impervious coating method, apply the first application immediately after form removal and surface finish application. If the surface is dry, wet the concrete thoroughly with water and apply the curing compound just as the surface film of water disappears. Apply the second application as soon as the first application sets.

(3) Do not apply impervious coating curing material to construction joints, or to surfaces being bonded to other concrete, or to surfaces being waterproofed, or to which applying sealants. Ensure that steel reinforcement, anchors, waterstops, and similar devices are free of compound before placing concrete.

(4) Do not use the impervious coating method on concrete before applying the required surface finish. Use other allowed curing procedures before applying the surface finish.

(5) The contractor may delay applying the required surface finish, if the engineer approves, until after completing curing with wetted burlap or polyethylene-coated burlap, in order to allow uniform and continuous finish application. Provide at least 4 hours of an engineer-approved moisture cure to prevent the finish from sanding-out.

(6) If the structure or any portion of it is enclosed, and artificial heat is provided for protection, this does not waive the above requirements for moisture for curing. The contractor may use steam for heating and to produce an adequate supply of moisture within the enclosure.

(7) The contractor may leave forms in place instead of using burlap or membrane curing.

502.3.8.2.2 Substructures

(1) Cure concrete footings, not backfilled upon form removal, and the exposed surfaces of backfilled footings as specified in 502.3.8.1 or by submersion, if the engineer approves. If necessary to remove wetted burlap to allow form setting, keep the exposed concrete surface thoroughly damp.

502.3.8.2.3 Decks

(1) For structures under 100 feet in length, cure the concrete in decks, medians, and sidewalks for at least 7 days with polyethylene-coated burlap or other coated material conforming to 501.2.9. As soon as the concrete sets sufficiently to support the covering, place the coated burlap with the coated side up; or perform an initial cure of the concrete by using wetted burlap for at least 12 hours and then apply the coated burlap to a thoroughly wetted concrete surface. Place each strip or sheet of coated burlap so that it overlaps the preceding sheet by at least 12 inches. Secure the coated burlap covering in place. Ensure adequate moisture is present on the surface of the floor, wearing surfaces, or sidewalks beneath the curing material for the 7-day curing period.

(2) For Structures 100 feet or greater in length, cure the concrete in decks, medians, and sidewalks by the following method. Begin curing the horizontal concrete surfaces by fogging within 15 minutes of finishing and tining. Apply the fog or fine water spray so that no water marks result and no mortar washes from the concrete surface. Keep the concrete surface continuously wet by fogging until applying the burlap strips to the finished concrete. Wet the burlap immediately after placement. During the first day, until placing the soaker hose system, keep the burlap continuously wet. Through the remainder of the curing period, keep the burlap continuously wet with soaker hoses hooked up to a continuous water source. Inspect the burlap on a daily basis to ensure that the entire surface is moist. If necessary, alter the soaker hose system as needed to ensure the entire surface is moist. Do not use white polyethylene sheeting or plastic coated burlap blankets. Continue moist curing at least 7 days.

502.3.8.2.4 Parapets

(1) Cure concrete in the inside faces of railings and parapets by covering with wetted burlap immediately after form removal and surface finish application. Keep the burlap thoroughly wet for at least 4 days; or by covering for the same period with thoroughly wetted polyethylene-coated burlap conforming to 501.2.9.

(2) Cure concrete in the outside faces of railings, parapets, exterior girders, and similar parts of the structure by one of the following methods:

1. Apply impervious coating curing material immediately after removing the forms and applying the required surface finish.
2. Cover with wetted burlap immediately after form removal and applying the required surface finish and keeping the burlap thoroughly wet for at least 4 days.
3. Cover for at least 4 days with thoroughly wetted polyethylene-coated burlap conforming to 501.2.9.

(3) Secure coverings along all edges to prevent moisture loss.

502.3.9 Cold Weather Protection

502.3.9.1 General

(1) Maintain the quality of the concrete placed in cold weather. Provide the protection necessary to prevent concrete freezing until it develops sufficient strength to conform to the opening criteria specified in 502.3.10. Remove and replace frozen or frost damaged concrete at no expense to the department.

(2) Unless the engineer directs otherwise, protect concrete under both of the following conditions:

1. The air temperature is 40 F or less.
2. The air temperature is predicted to be 40 F or less within 24 hours.

(3) Ensure that forms, reinforcement, base, and subgrade are free of ice, snow, and frost during pouring. If the atmospheric temperature is below 40 F, preheat the interior surfaces of forms, all reinforcement, and the concrete surface adjacent to the pour to 40 F or higher.

(4) Adjust forms or insulation, as necessary, to control the temperature of the concrete. Unless the engineer allows otherwise, ensure the temperature of the concrete does not exceed 120 F, or fall below 40 F during the protection period.

502.3.9.2 Mixing

(1) Heat the mixing water, aggregates, or both under both of the following conditions:

1. The air temperature is 40 F or less at the time of mixing or placement.
2. The air temperature is predicted to be 40 F or less within 24 hours following placement.

(2) During concrete placement, ensure the mixed concrete temperature is not less than 50 F or more than 80 F, unless otherwise directed.

(3) Do not heat the cement, or add salt or other chemicals to the mix to prevent freezing.

502.3.9.3 Heating

(1) Protect exposed concrete surfaces within a heated housing from drying and carbonation throughout the curing period by the impervious coating method or the impervious sheeting method specified in 502.3.8.

(2) If heated housing is required before placing concrete, heat the housing sufficiently before placing the concrete to ensure a temperature of the forms and reinforcing steel of not less than 40 F. Ensure a reasonably uniform temperature throughout the enclosure.

(3) If the engineer allows, the contractor may protect footings by completely and continuously submerging in water inside the cofferdam.

502.3.9.4 Temperature Records

(1) Take temperature readings within the enclosure at necessary times to show the true temperature conditions that the concrete is subjected to. At a minimum, provide high/low thermometers that retain the minimum and maximum temperature readings for each measurement period. Provide facilities suitable to the engineer to verify the temperature inside and outside the insulation, and within the mass of the concrete at various locations in the unit. Make temperature recordings at least every 24 hours. Make outside air temperature recordings at the same time making the recordings within the enclosure. Provide a copy of the temperature record to the engineer at the close of each day's work.

502.3.9.5 Cessation of Heating or Cold Weather Protection

(1) At the end of the heating or cold weather protection period, gradually reduce the temperature within the enclosure to avoid a sudden temperature change of the new concrete. Make this decrease by loosening the forms and other insulating layers in a manner to allow the whole mass of concrete to gradually approach the outside air temperature at the end of the curing period. Ensure the average rate of decrease does not exceed 5 F in any hour, or 40 F in any 24-hours, until reaching the outside air temperature. Allow the concrete surface to dry while equalizing the temperatures.

502.3.9.6 Bridge Decks

(1) Protect concrete in bridge decks as specified for structural masonry, and except for parapets and similar pours, according to the following requirements:

1. Do not place concrete for bridge decks or other superstructure elements when the national weather service forecast for the construction area predicts temperatures to fall below 32 F within 24 hours, unless the engineer specifically allows or requires in writing.
2. Protect the underside of the deck by housing and heating when the national weather service forecast for the construction area predicts temperatures to fall below 20 F during the cold weather protection period.

502.3.10 Applying Loads to Concrete

502.3.10.1 Opening to Service

502.3.10.1.1 General

(1) Maintain moisture, temperature, and physical protection for concrete until it develops sufficient strength to open it to service. The engineer will use the same criteria to allow the opening of structural masonry concrete items to service as is used to allow the opening of bridge superstructures to traffic.

(2) The engineer will allow the contractor to open bridge superstructures or other structural masonry items to construction and public traffic when the concrete attains a verified compressive strength of 3500 psi. Without compressive strength information, the engineer may allow the contractor to open the affected structural masonry after the following minimum times as adjusted for concrete surface temperature.

APPLICATION	EQUIVALENT CURING DAYS
High early strength concrete	4
General purpose concrete: grade A	5
General purpose concrete: grades A-FA, A-S, A-T, A-IS, A-IP, and A-IT	7

(3) The equivalent curing day is based on a daily average concrete surface temperature of 60 F. Calculate the daily average concrete surface temperature by taking the average of the high and low temperatures at the least favorable location of the affected concrete unit, as verified by the engineer, for each day. If this daily average concrete surface temperature falls below 60 F, then equivalent curing days accumulate at a reduced rate. Use the following guidelines to calculate equivalent curing days; for a daily average concrete surface temperature of:

1. 60 F or more; accumulate one equivalent curing day per calendar day.
2. 40 to less than 60 F; accumulate 0.6 equivalent curing day per calendar day.
3. Less than 40 F; no curing credit is accumulated.

502.3.10.1.2 Exceptions

502.3.10.1.2.1 General

(1) If the contract prescribes a specific wet curing period, do not open to service until after wet curing is complete and the strength or equivalent curing day requirements are met.

(2) The contractor may conduct construction operations on concrete not conforming to these opening criteria as specified in 502.3.10.1.2.2 and 502.3.10.1.2.3. The engineer may suspend or delay operations that injure the surface or otherwise damage the concrete. Clean the surface before allowing any traffic to use the structure.

502.3.10.1.2.2 Substructures

(1) If placing footings on seals, the contractor may set the footing forms and place the concrete immediately after dewatering the cofferdam and preparing the surface of the seal. Unless the engineer directs otherwise, the contractor may set the column and wall forms on the day after placing the concrete in the footing; and may place the concrete in columns and walls after the concrete footing for the column or wall cures for at least 24 hours over 40 F.

(2) Do not apply any load of the superstructure, or any dead load, except as specified in 502.3.10.1.2.2(1), to concrete substructure units until the concrete in the unit cures for at least 48 hours. Do not apply loads to the beams of open-type substructure units until after the required falsework support period.

502.3.10.1.2.3 Superstructures

(1) After the concrete cures sufficiently, the contractor may, with the engineer's approval, apply loads to decks that result from storing small articles, and operating concrete buggies and other necessary light equipment, if applied in a way that causes no injury to the concrete.

(2) If the deck concrete conforms to 502.3.10.1.1(2) the contractor may operate hauling equipment as necessary to perform subsequent pours on that structure. Do not operate or park hauling equipment outside of the centerline of an exterior girder until at least 24 hours after placing the parapet.

502.3.10.1.3 Opening Strength

502.3.10.1.3.1 General

(1) Determine opening strength and provide the engineer with the information required to verify that strength by one or a combination of the following methods:

1. Compressive strength testing of cylinders.
2. Maturity method.

(2) The resulting opening strength, when the engineer verifies, will apply to concrete on the same project conforming to the following criteria:

1. Of the same mix design as the test location.
2. Cured under similar or more desirable conditions.
3. Placed on or before the test location.

(3) If both direct compressive strength test results and maturity data are not available, the engineer may estimate compressive strength based on test results of concrete of the same mix design placed adjacent to and under similar conditions on the same project.

502.3.10.1.3.2 Compressive Strength Testing of Cylinders

(1) Submit the compressive strength test results to the engineer for verification. Compute the opening strength as the average of compressive strength test results for 2 cylinders. If the strength of a cylinder is less than 90 percent of the required strength, the engineer will reject the resulting average. Field cure cylinders under conditions similar to those prevailing for the structural masonry unit they represent. Fabricate cylinders according to AASHTO T23 and test the cylinders according to AASHTO T22.

502.3.10.1.3.3 Maturity Method

(1) Develop a strength/maturity relationship for each concrete mix design. Base that relationship on the strength of cylinders from concrete incorporated into the work. Submit the maturity data to the engineer for approval before placing more concrete using that mix design. Develop a new strength/maturity relationship every time the mix changes or if engineer verification cylinder strength varies more than 10 percent from the required opening strength when tested at the calibrated opening maturity.

(2) Conform to CMM 8-70 for strength/maturity relationship development, field verification of the resulting curves, and maturity testing. Use a default datum temperature of 32 F or use a mix-specific datum temperature determined according to Annex A1 of ASTM C1074. Develop data points for the strength/maturity relationship up to 120 percent of the required opening strength.

Revise 502.3.10.1.3.3(3) to allow contractor determination of maturity probe placement based on their operations.

(3) Place sensors based on contractor operations for concrete pavement bid items and one sensor for each 100 cubic yards of concrete placed under non-pavement bid items. The resulting maturity, after engineer verification, will apply to concrete on the same project conforming to the following:

1. Of the same mix design as the test location.
2. Cured under conditions similar to or more favorable than that of the test location.
3. Placed on or before the time the test location was placed.

(4) Each work week provide a set of 3 verification cylinders to the engineer for each strength/maturity field calibration curve currently in use on the project. The engineer will designate the sampling location for these verification cylinders. Provide 2 cylinders for compressive strength testing and one with a data-encrypted sensor embedded in its center for maturity evaluation. Cast and cure these cylinders on-site as the engineer directs and conforming to the requirements of ASTM C31 for field curing. Deliver the 2 compressive strength cylinders to the engineer after attaining 50 percent of their opening maturity. Notify the engineer promptly when the instrumented cylinder reaches the opening maturity so the engineer can perform verification testing as closely as possible to that opening maturity level.

502.3.11 Name Plates

(1) Install nameplates conforming to 506.2.4 at the locations the plans show. Embed or epoxy the plate lugs in the concrete. Except for survey benchmarks, do not attach other permanent plates or markers to a structure.

502.3.12 Bridge Seat Protection

(1) Unless the contract specifies otherwise, apply a mopping of epoxy to the top surfaces of all abutments and any piers beneath transverse joints.

(2) Use the type of epoxy resin the manufacturer recommends for sealing exterior concrete surfaces, subject to the engineer's approval.

(3) Apply the epoxy before placing bearing pads or plates and before erecting the superstructure, unless the engineer directs otherwise.

(4) The contractor shall not apply resin in wet weather, or if the surface temperature of the concrete is below 60 F unless the engineer specifically allows.

(5) If applying resin, ensure the concrete surface is dry, thoroughly clean, and free from dust or other loose material.

(6) Furnish a 2-part epoxy resin system. Combine immediately before use and apply according to the manufacturer's written instructions. If no application rate is recommended, apply the epoxy at approximately one gallon per 100 square feet.

502.3.13 Concrete Crack and Surface Sealing

502.3.13.1 Crack Sealing

(1) For newly constructed bridge decks, seal cracks visible during dry weather conditions with low-viscosity crack sealer. Conduct an initial crack survey with the engineer within 7 days after wet curing is complete, or when the deck dries enough to expose cracks requiring sealing. Seal the cracks identified in the survey. Seal crack areas only. Do not flood seal the deck unless the engineer allows as a part of overseeding with aggregate.

(2) Prepare the deck by water blasting and apply crack sealer as the sealer manufacturer recommends except as follows:

1. The contractor need only wait 7 days after completing moist curing before sealing.
2. Seal only if drying conditions have existed for the preceding 48 hours.
3. Immediately before applying sealer, direct an air blast over the surface to remove dust and any loose particles.
4. Seal before opening to public traffic.

(3) Conduct a follow-up crack survey as late as possible, but allowing time for sealing additional cracks and subsequently applying surface sealer, before opening to public traffic. Seal additional cracks identified in the follow-up survey before applying protective surface treatment.

502.3.13.2 Protective Surface Treatment

(1) Apply protective surface treatment conforming to 502.2.11 to concrete decks, deck overlays, medians, and sidewalks After deck crack sealing is completed, apply surface treatment to the top of new bridge decks. Do not apply to surfaces where the contract requires staining or other treatment.

(2) Clean and dry surfaces before applying surface treatment. Immediately before application, direct an air blast over the surface to remove dust and any loose particles. Ensure that application equipment is clean inside before filling and that the equipment is functioning properly.

(3) Apply surface treatment no less than 7 days, but preferably a minimum of 21 days, after the curing period has expired. Apply according to manufacturer recommendations, except ensure the concrete is surface dry for a minimum of 2 consecutive days before applying. Ensure that the crack sealer is dry to the touch before applying surface treatment. Apply at the manufacturer's recommended rate. If application in a single coat causes ponding, use two lighter coats allowed to dry between coats.

(4) Complete surface treatment before opening to traffic and before suspending work for the winter. Do not open the bridge deck to traffic until the surface treatment is dry enough to sustain traffic without causing damage to the surface treatment or creating a hazard to traffic.

502.3.13.3 Pigmented Surface Sealer

(1) Apply pigmented surface sealer conforming to 502.2.11 to the inside and top faces of parapets, including parapets on abutment wings. Use gray sealer unless the contract specifies a different color. Do not seal surfaces where the contract requires staining or other treatment.

(2) Clean and dry surfaces before sealing. Immediately before sealing, direct an air blast over the surface to remove dust and any loose particles. Ensure that application equipment is clean inside before filling and that the equipment is functioning properly.

(3) Seal after providing the required surface finish under 502.3.7. Conform to sealer manufacturer recommended application procedures and coverage rate. If application in a single coat causes running, use two lighter coats allowed to dry between coats.

(4) Complete sealing before opening to traffic and before suspending work for the winter.

502.3.14 Adhesive Anchors

502.3.14.1 General

(1) Notify the engineer and provide the adhesive manufacturer's installation instructions to the engineer before installing anchors. Do not install anchors before 21 days after concrete placement. Notify the engineer if reinforcement is encountered during drilling.

(2) Clean holes by flushing with water followed by blowing with air until the hole is dry and dust-free. Follow additional cleaning procedures and temperature restrictions the adhesive manufacturer recommends.

(3) Place adhesive and install reinforcing bars to the depth and of the length and bar size the plans show following the adhesive manufacturer's installation recommendations. Fill holes completely with adhesive.

(4) Ensure proper installation by one or both of the following:

- Installation by or under the direct supervision of an ACI/CRSI certified installer.
- Field-verified by non-destructive pullout testing according to ASTM E488.

502.3.14.2 ACI/CRSI Certified Installer

(1) Have an ACI/CRSI certified installer install or directly supervise anchor installation. Direct supervision is directly viewing installation of 2 or more anchors per installer. Submit department form DT1641 to the engineer certifying that anchor installation conforms to the contract.

(2) The engineer will verify anchor installation by periodically observing the contractor's installation procedures and may direct the contractor to perform pull-out testing conforming to 502.3.14.3.

502.3.14.3 Non-Destructive Pullout Testing

(1) Demonstrate anchor installation and perform both installation and static tension testing according to ASTM E488 for the first 3 anchors of each rebar size installed under the contract. Do not proceed with production installation without the engineer's approval. Do not test before 28 days after concrete placement.

(2) Do not allow any portion of the pull-out testing device to bear on the concrete within a distance equal to the embedment depth the plans show. Test anchors to a proof load of 80 percent of the anchor yield strength unless the plans show otherwise. If an anchor fails, modify installation procedures or use a different anchor system and retest.

(3) In addition to tests performed on the first 3 anchors of each size, test one or 5 percent of the anchors placed during production installation whichever is greater. Provide an approximate installation schedule to the engineer and immediately notify the engineer if a test fails. The engineer will increase testing frequency by one percent for each failed anchor. Submit test reports and specification sheets prescribed under ASTM E488 to the engineer upon request.

(4) The engineer will verify anchor installation by periodically observing the contractor's installation and testing procedures and may direct the contractor to perform additional pull-out testing.

502.3.15 Clear Protective Coating

(1) Apply a clear protective coating to specified areas of the substructure.

(2) Apply the coating to the concrete surface before erecting structural steel. Do not apply coating at temperatures lower than the manufacturer recommends.

(3) Clean the exposed vertical surfaces of the piers, and the front face of the abutments including the backwalls and the ends of the body wall to remove dust and dirt.

(4) Apply the coating to these areas by brush or roller to give a smooth coating, completely covering the concrete. Apply the coating at the rate of one gallon per 200 square feet. If the coating runs or sags when applied in one coat, apply the material in 2 approximately equal coats of thickness. Apply the second coat within 10 minutes of the first.

(5) If, because of weather conditions, the contractor cannot apply coating to the substructure before starting steel erection, protect the above-mentioned areas from staining until applying the coating. Obtain the engineer's approval for the method of temporary protection.

502.4 Measurement

502.4.1 General

(1) The department will measure the quantities of the various bid items that constitute the completed and accepted structure according to the contract provision for those bid items, in the units provided. All work included in the scope of the contract, but not listed as bid items in the proposal are incidental to the cost of the work.

502.4.2 Concrete for Bridges

(1) The department will measure the Concrete Masonry Bridges bid items by the cubic yard acceptably completed. The department will not measure work or material for forms, falsework, cofferdams, unless specified otherwise, pumping, bracing, or other incidentals necessary to complete the work as required in these specifications.

(2) If measuring floor slabs, the department will deduct the volume of the flanges of I-beams and precast concrete beams projecting into concrete floor slabs from the volume of the floor slab.

(3) The department will deduct from the quantity of concrete, as computed above, the actual volume displaced by the projection of cast-in-place concrete piling into the footing, pile cap, or abutment; and 0.8 cubic foot of volume for each linear foot of timber piling projecting into the footing, pile cap, or abutment. The department will measure this net quantity for payment.

(4) If the contractor pours footings wholly, or in part without forms, the department will only measure material placed within the footing dimensions the plans show.

502.4.3 Concrete for Seals

(1) The department will measure Concrete Masonry Seal by cubic yard acceptably completed. The department will only measure material the engineer orders, the plans show, or the contract specifies.

(2) The department will base measurements and computations of quantity of accepted work on the dimensions of the area and thickness of the seal the plans show, or the engineer orders. The department will deduct the volume displaced by piles, if any, from this quantity and the department will measure this net quantity for payment. If using cast in place concrete piling, deduct the actual volume displaced by the piling; and in the case of timber piling, deduct the quantity based on 0.8 cubic foot of volume for each linear foot of piling projecting into or through the seal.

502.4.4 Preformed Elastomeric Compression Joint Sealers

(1) The department will measure the Compression Joint Sealer Preformed Elastomeric bid items by the linear foot acceptably completed, measured along the centerline of the joint.

502.4.5 Expansion Devices

(1) The department will measure the Expansion Device bid items as a single lump sum unit for each structure acceptably completed.

502.4.6 Surface Sealing

(1) The department will measure the Protective Surface Treatment and Pigmented Surface Sealer bid items by the square yard acceptably completed, measured as the net area treated with no additional area measured where re-sealing after applying pavement marking as required under 646.3.1.1.

502.4.7 Adhesive Anchors

(1) The department will measure the Adhesive Anchors bid items as each individual anchor acceptably completed.

502.4.8 Clear Protective Coatings

(1) The department will measure Protective Coating Clear by the gallon acceptably completed. The quantity measured equals the actual number of gallons used to treat the abutments and piers.

502.5 Payment

502.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
502.0100	Concrete Masonry Bridges	CY
502.0200	Concrete Masonry Bridges HES	CY
502.1100	Concrete Masonry Seal	CY
502.2000	Compression Joint Sealer Preformed Elastomeric (width)	LF
502.3100	Expansion Device (structure)	LS
502.3200	Protective Surface Treatment	SY
502.3210	Pigmented Surface Sealer	SY
502.4100 - 4199	Adhesive Anchors (inch)	EACH
502.4200 - 4299	Adhesive Anchors (bar)	EACH
502.6500	Protective Coating Clear	GAL

(2) Perform miscellaneous work that the plans show or the contract specifies, but not listed as bid items, as a part of and included in the contract price for other bid items.

502.5.2 Concrete for Bridges

(1) Payment for the Concrete Masonry Bridges bid items is full compensation for providing forms and falsework; for placing, finishing, curing, protecting, and heating concrete; for measuring concrete opening strength, including fabricating and testing cylinders, and evaluating maturity; for treating joints, including sealing, providing preformed joint filler and waterproofing; for sealing deck cracks identified in the initial crack survey; for providing bridge seat protection; and for providing nameplates.

(2) If the contractor pours footings wholly, or in part without forms, the department will only pay for material placed within the footing dimensions the plans show.

(3) If the engineer allows the contractor to substitute high early strength concrete to expedite the work as allowed under 502.2.2, the contractor will bear the additional costs associated with that substitution.

(4) The department will pay separately under the Follow-Up Deck Crack Sealing administrative item for sealing additional deck cracks identified in the follow-up crack survey at the fixed price of $3.00 per linear foot of crack acceptably sealed. The department will also pay separately for traffic control required for the follow-up sealing operations.

502.5.3 Concrete for Seals

(1) Payment for Concrete Masonry Seal is full compensation for providing concrete seals including forms, placing, curing, protecting, and pumping.

(2) If the contract does not contain the Concrete Masonry Seal bid item and the engineer orders this work, the department will pay for this work as extra work.

502.5.4 Preformed Elastomeric Compression Joint Sealers

(1) Payment for the Compression Joint Sealer Preformed Elastomeric bid items is full compensation for providing the seal, including lubricant-adhesive.

502.5.5 Expansion Devices

(1) Payment for the Expansion Device bid items is full compensation for providing devices.

502.5.6 Surface Sealing

(1) Payment for the Protective Surface Treatment and Pigmented Surface Sealer bid items is full compensation for treating and sealing surfaces including surface preparation and color-matching as required. Resealing after pavement marking is incidental to the applicable pavement marking bid item under 646.5.

502.5.7 Adhesive Anchors

(1) Payment for the Adhesive Anchors bid items is full compensation for providing adhesive anchors; and for pullout testing including additional engineer-directed verification testing.

(2) The department will pay separately for reinforcing bars under the appropriate Bar Steel Reinforcement HS bid item as specified in 505.5.

502.5.8 Clear Protective Coatings

(1) Payment for Protective Coating Clear is full compensation for providing the coating, including temporary protection, and surface preparation.

Section 503 Prestressed Concrete Members

503.1 Description

(1) This section describes fabricating, furnishing, transporting, and erecting prestressed concrete girders, or other prestressed concrete members.

(2) These specifications provide for prestressing concrete members by the pretensioning method. In this method, stress the reinforcing tendons initially, then place and cure the concrete and release the stress from the anchorages to the concrete after developing specified concrete strength.

503.2 Materials

503.2.1 General

(1) Furnish materials conforming to the following:

Bar steel reinforcement.....505

(2) Use galvanized or epoxy-coated steel, stainless steel, or non-metallic materials for hardware incorporated into the finished structure.

503.2.2 Concrete

(1) Furnish concrete as specified in 501. If the design ultimate stress, f'_c, the plans show is 8000 psi or higher for a prestressed concrete I-type girder, extend 28-day strength requirements within 503 for that girder to 56 days.

(2) Ensure concrete attains a minimum 28-day compressive strength of 6000 psi for prestressed I-type girders. Base tests on 6-inch by 12-inch cylinders, or 4-inch by 8-inch cylinders, provided the engineer develops and approves a correlation factor. Mold concrete cylinders in steel or plastic molds. Cure concrete cylinders according to AASHTO T23, except cure the cylinders with the member until release strength is obtained, then cure the cylinders according to AASHTO T23. Maintain laboratory facilities and equipment according to AASHTO M201. Make 3 cylinders for each line of prestressed members poured and test each cylinder according to AASHTO T22. Calibrate cylinder-testing equipment at least annually according to AASHTO T67. Average the strengths of the 2 cylinders with the highest test results for each line and use the average to determine compliance with the 28-day strength requirement. Ensure that neither of the 2 cylinders with the highest test results has a strength less than 10 percent below the required strength.

(3) Instead of the above acceptance procedure, the engineer will allow early acceptance of the prestressed units, before the 28-day test, if 2 successive laboratory tests on standard test specimens, cured continuously with and in the same manner as the units, indicate compressive strength in excess of the required 28-day strength. Test the 28-day strength cylinders and record the results to maintain continuity of the contractor's quality control records.

(4) Have an HTCP-certified PCC Technician I sample concrete, perform fresh concrete testing, and fabricate and cure cylinders. Have an HTCP-certified Concrete Strength Tester, working in a department-qualified laboratory, perform cylinder and core compression tests. Determine the compressive strength in psi for each cylinder according to AASHTO T22. Test each cylinder to failure. Use a compression machine that automatically records the date, time, rate of loading on a load vs. time plot, and maximum load for each cylinder. Include a printout of this information with the strength documentation for each cylinder tested. Notify the engineer immediately if concrete cylinder compressive strengths are less than the required 28-day strength. Keep neatly documented records of all cylinder testing on the day of the test and make them available to the engineer.

(5) Furnish prestressed concrete members cast from air-entrained concrete, except I-type girders may use non-air-entrained concrete. Use type I, IL, IS, IP, IT, II, or III cement. The contractor may replace up to 30 percent of type I, IL, II, or III cement with an equal weight of fly ash, slag, or a combination of fly ash and slag. Ensure that fly ash conforms to 501.2.6 and slag conforms to 501.2.7. Use only one source and replacement rate for work under a single bid item. Use a department-approved air-entraining admixture conforming to 501.2.2 for air-entrained concrete. Use only size No. 1 coarse aggregate conforming to 501.2.5.4.

(6) The contractor shall determine proportions for the mix within the following limitations:

Water cementitious material ratio, w/cm.....0.45 or less[1]

Cementitious material content.....610-800 pounds per cubic yard

Air content:

Prestressed I-type girders..... 6.0 percent maximum

Other components.....4.5 - 7.5 percent

Slump..... 8 inches maximum[2]

[1] The water cementitious material ratio is the weight of the total added water plus the aggregate free water, divided by the combined weight of the cement, fly ash, and slag.

[2] Proportion the mix to provide a concrete of uniform quality and consistency with a slump no greater than necessary for proper placement and consolidation.

(7) Incorporate a department-approved high range water-reducing admixture conforming to ASTM C494, type G. Instead of a type G admixture, the contractor may use type F and type D admixtures in combination to achieve equivalent results.

(8) Use a department-approved set retarding admixture as specified in 501.2.3.2 at the recommended rate if the ambient air temperature is 70 F or higher. The contractor may use it if the ambient air temperature is less than 70 F.

(9) The contractor shall not add more admixtures or water after mixing is complete.

(10) Use admixtures that do not have significant chlorides or chlorides added during manufacture.

(11) Use admixtures compatible with all ingredients of the concrete mixture.

503.2.3 Pretensioning Reinforcement

(1) Use high tensile strength, 7-wire strands of the nominal diameter the plans show and conforming to ASTM A416, grade 270.

503.2.4 Plant Certification

(1) Obtain prestressed concrete members from fabrication plants that comply with the department's plant certification program for fabrication of prestressed concrete members, unless the engineer agrees to accept these items according to the alternate procedures set forth in the department's plant certification program.

503.3 Construction

Revise 503.3 to require electronic submittal of shop drawings, a quality certification form, and a progress report form.

503.3.1 General

(1) Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting department form DT2328 with each set of shop drawings. Department review does not relieve the contractor from responsibility for errors or omissions on shop drawings.

(2) Ensure that the fabricator submits a fabrication progress report on department form DT2336 electronically to the department’s fabrication library. Update this form weekly for each structure in fabrication.

503.3.2 Stressing Procedure

(1) Ensure all the strands of a pretensioned girder are free from kinks or twists before starting tensioning operations. Ensure no strand unwinds more than one turn after starting tensioning operations. Tension all the strands 1500 pounds each before starting elongation readings, or as the contractor determines; however, the contractor shall not use an initial load greater than 4000 pounds. This initial tension in any strand shall not vary by more than 5 percent. Use equipment to produce the initial tensioning load that provides a way of accurately measuring the force. If applying the initial tensioning load by pressure jacks, equip them with a proper gaging system for the initial force.

(2) If tensioning draped pretensioned strands in a horizontal position, tension them to a less than required the design stress so that the increased strain from jacking the drape in the strands results in a stress equal to the required design stress.

(3) If tensioning the draped strands in their draped position, support them by rollers at points of change in direction. Ensure the hold-up rollers between girders and at the ends of the end girders have either bronze bushings or roller bearings, and are well lubricated. Use free running rollers at the hold-down points that produce minimal friction. If stressing from one end results in a difference of more than 5 percent between the load calculated from elongation and the gauge load then tension draped strands from both ends. The sum of elongation at both ends shall agree within 5 percent of that indicated by the jack gauges.

(4) Provide to the contractor's project file details showing number, spacing, and method of draping pretensioned strands.

(5) The department will allow one splice per pretensioning strand provided the splices are positioned so only one splice occurs within a member. Ensure that spliced strands have the same twist or lay. Make allowance for splice slippage in computing strand elongation.

(6) The engineer may accept failure of one wire in a 7-wire pretensioning strand if it attains 85 percent of the required tension load before failure, and the failed wire constitutes not more than 2 percent of the total area of strands in an individual beam or girder.

(7) If using a jacking system equipped with an automatic release valve that closes if the required prestressing force is reached, there is no requirement to measure strand elongation for all horizontal strands; however, this measurement is required for the first and last strand tensioned and for at least 10 percent of the remaining strands. If performing elongation computations, take into account strand anchorage slippage, horizontal movement of abutments, and any change in temperature of the prestressing steel between tensioning and when concrete takes its initial set, if this change is expected to exceed 30 F.

(8) Equip prestressing systems with accurately calibrated gauges for measuring the loads produced. Ensure gauges are accurate to within 2 percent and are equipped with a gauge dial read to the nearest 250 pounds of prestressing force. Use a department-approved testing laboratory to calibrate the gauge, and furnish a certified calibration curve for each gauge. If gauges do not read loads directly in pounds, provide a chart tabulated in increments of at least 250 pounds for converting the readings to pounds. Calibrate the gauges with the gauges in place on the jacking system, completely assembled in the manner used in the prestressing operation.

(9) For gaging, use loads between 1/4 and 3/4 of the total graduated capacity of the gauge, unless calibration data clearly establish consistent accuracy over a wider range.

(10) Re-calibrate gaging devices at least once a year; however, if the gaging system gives erratic results, or if the gauge and elongation measurements indicate significantly different stresses, then re-calibrate the jack and the gauges.

(11) Measure the stress induced in the prestressing element by both jacking gauge pressure and by elongation of the prestressing steel. If these measurements differ, use the gauge pressure to indicate the true stress in the prestressing steel. There is an allowable master tolerance of +/- 5 percent between the actual gauge pressure and elongation and the calculated value of each. Additionally, there is a more restrictive 5 percent tolerance for algebraic comparison of the variation of gauge pressures to the variation of elongations. If the difference between gauge pressure and elongation exceeds 5 percent, carefully check the entire operation, determine, and correct the source of error before proceeding further.

(12) Mark each anchor (dead, live, and splice) and visually check for slippage in excess of that assumed in the calculations. Perform random measured checks.

(13) During prestressing operations, provide the safety measures and means necessary to prevent accidents in the event the prestressing steel, hold down devices, abutments, and beds break, or the grips slip.

(14) Tension the prestressing elements to provide the required prestress the plans show.

(15) Perform transfer of prestress to concrete after the concrete develops the minimum required strength for transfer determined by the test cylinders.

(16) Use the minimum required concrete strength at transfer of prestress that the plans show.

503.3.2.1 Placing and Fastening Steel

(1) Place steel units in the position the plans show and hold firmly during concrete placing and setting as specified in 505.3.

(2) Maintain distances from the forms by using stays, ties, hangers, or other engineer-approved supports. Separate layers of units by suitable devices. The contractor shall not leave wood blocks in the concrete.

(3) Position wires, wire groups, parallel-lay cables, and any other prestressing elements, correctly in the enclosures. Provide suitable horizontal and vertical spacers, if required, to hold the wires in true position in the enclosures.

(4) Ensure that prestressing steel is free of dirt, grease, wax, scale, rust, oil, or other foreign material that may prevent bonding between the steel and the concrete.

503.3.3 Concrete Operations

503.3.3.1 Placing Concrete

(1) Handle and place the concrete as specified in 502, except as specified otherwise below.

(2) Place and consolidate concrete in lifts in a way that prevents segregation, provides uniform consolidation throughout the member, and minimizes visible lift lines and dried concrete deposits along formed surfaces. Ensure not more than one hour elapses between placing successive lifts.

(3) Consolidate the concrete in girders by internal, external, or both internal and external vibration. Avoid displacing reinforcing, conduits, or wires. Ensure that concrete is free from honeycombing throughout the member, free from voids around reinforcement and inserts, and free from excessive bug holing along formed surfaces.

503.3.3.1.1 Tolerances

(1) Cast prestressed concrete members to plan dimensions within the following applicable tolerances:

PRESTRESSED CONCRETE I-TYPE GIRDERS

Depth of the flange, web, and fillets	+/- 1/4"
Depth overall	+1/2" to -1/4"
Width of flanges and fillets	+3/8" to -1/4"
Width of web	+3/8" to -1/4"
Length of beam	+/- 1/8" per 10', up to a max of +/- 1 1/2"
Deviation from square of exposed beam ends	
Horizontally.	+/- 1/4"
Vertically.	+/- 1/8" per foot of beam depth
Side inserts, spacing between centers and from centers to beam ends	+/- 1/4"
Bearing plates, spacing between centers	the greater of +/- 1/8" per 10', or +/- 1/2"
Bearing plates, spacing from centers to beam ends	+/- 1/4"
Bearing plate or bearing area, deviation from plane	+/- 1/16"
Stirrup bars, projection above top of beam	+1/4" to -3/4"
Stirrup bars, longitudinal spacing	+/- 1"
End of stirrup bars from end of beam	2" or less
Horizontal alignment, deviation from a straight line, "sweep"	1/8" per 10' of member length
Camber, differential between adjacent beams	1/8" per 10' of span up to a max of 1"
Center of gravity of draped strand group	+/- 1/4"
Center of gravity of draped strand group at end of beam	+/- 1/2"
Position of hold-down points for draped strands	+/- 6"
Position of handling devices	+/- 6"

503.3.3.2 Curing

(1) Steam cure concrete members as specified below or cure by other methods identified by the contractor's fabrication quality control plan. Protect the surfaces of members exposed during curing from moisture loss until release strength is obtained. The contractor shall not use curing compound for this purpose.

503.3.3.2.1 Steam Curing

(1) If steam curing, enclose the concrete member in a chamber or enclosure, with at least 12 inches between the member and the enclosure. If using tarpaulins for enclosures, use at least 2 layers and arrange them to form a tight enclosure that leaks as little steam as possible. Use low-pressure steam and do not allow steam jets to spray directly on the concrete or on the forms. Maintain the relative humidity at approximately 100 percent within the enclosure.

(2) Maintain the concrete temperature at or near the pouring temperature until the initial set, according to AASHTO T197, before allowing the temperature to rise. The rate of temperature rise of the concrete shall not exceed 40 F per hour.

(3) During curing maintain the internal concrete temperature between 50 F and 160 F. Ensure that the temperature of the concrete in different locations within the housing does not vary more than 20 F at any time.

(4) Place a minimum of 3 engineer-approved continuous recording thermometers in each line. Provide the engineer with complete temperature record charts for the curing period, including the heat-up and cool-down times. If the temperature records indicate that steam control produces rates or temperatures that do not conform to those specified, modify procedures to obtain specified results.

(5) Continue steam curing until the concrete develops the required strength for transfer of prestress. The contractor may then discontinue steaming and uncover the beam. Cure the test specimens used to determine the above strength as specified in 503.3.3.3.

(6) If steam-curing girders, release the prestressing strands immediately after steam curing. Cut or release strands in a sequence that minimizes eccentricity of prestress force in the beam.

(7) If the contractor wants to remove the forms before completing the steaming, the contractor may uncover the beam one side at a time and for as much length as required to remove the form sections. Immediately replace the covering after removing each form section. During this operation, the contractor shall not expose the forms and beam surface for more than 30 minutes.

503.3.3.3 Test Cylinders for Release of Pretensioned Steel

(1) Make test cylinders for determining the time for releasing the pretensioned steel. Make 6-inch by 12-inch test cylinders and mold them in suitable steel or plastic molds. Cure the test cylinders with the represented concrete member until removal for capping and testing. Ensure that at least 2 cylinders have strengths above the minimum specified required strength, or average above the specified minimum with the lower not more than 5 percent below this strength, before releasing the tension. Make these test cylinders in addition to the cylinders designated in 503.2.2 for determining the 28-day strength.

503.3.3.4 Surface Finish

(1) The manufacturer of prestress concrete girders or other members shall notify the engineer of the following:

- All honeycomb deep enough to expose the prestressing steel.
- Defects that may affect bond length or transfer length.
- Any area that the manufacturer believes to be detrimental.

(2) The engineer responsible for inspection at the prestress concrete manufacturing plant will consult with the manufacturer to determine the corrective action required to repair the member. The prestress manufacturing plant is responsible for rejecting prestress members that cannot be effectively repaired. The engineer is responsible for acceptance.

(3) Provide a sack rubbed surface finish on the exposed surfaces of prestressed concrete girders as specified in 502.3.7.5 before shipping from the plant. Provide a wire brush or stiff broom finish on surfaces to be bonded. Provide a smooth trowelled finish on the top surface of the top flanges of bulb tee girders, except for the bonding region centered over the web.

(4) After the sack rubbed finish adequately cures, apply engineer-approved gray-pigmented concrete sealer for non-trafficked surfaces uniformly to sack rubbed and smooth trowelled surfaces using the manufacturer's recommended rate and procedures. Apply sealer and allow adequate time for sealer to dry before shipping prestressed concrete members from the plant.

Add 503.3.3.4(5) to specify filling precast voids created for transport, erection, or deck forming.

(5) Fill exposed voids created for transport, erection, or deck forming. For voids with a surface opening greater than 2 inches in diameter, dry and uniformly coat void surfaces with an epoxy bonding agent conforming to ASTM C881 type II and following the bonding agent manufacturer's recommendations. Epoxy bonding agent is not required for voids with a surface opening of 2 or less inches in diameter. Fill with an engineer-approved non-shrink grout immediately after applying the bonding agent, unless the grout manufacturer recommends otherwise.

503.3.4 Transportation, Storage, and Erection

(1) Transport, handle and store the prestressed girders in an upright position, and ensure that points of support, and direction of the reactions with respect to the girder are approximately the same during transportation, storage, and erection as when the girder is in its final position. The maximum overhang from the point of support to the end of girder during storage, handling, and transporting shall not exceed the depth of the girder unless the engineer allows a larger overhang.

(2) Handle, store and erect prestressed units in a way that prevents cracking or other damage to the unit. Discard and replace units damaged by improper handling or storing.

(3) Do not transport or erect prestressed girders before they attain a minimum 28-day compressive strength, determined from test cylinders made, cured, and tested as specified in 503.2.2. The engineer may allow delivery and erection of girders before their acceptance, pending strength tests, if the contractor provides in writing that it accepts responsibility for their removal and replacement in the event of rejection due to deficient strength.

(4) The contractor shall not place floors on girders until the specified tests made on representative test cylinders indicate they achieved their minimum 28-day strength.

(5) If, during the prestressed girders erection, the contractor elects to use a crane on the girders before placing and curing the concrete slab for the span, then the contractor shall submit details of the proposed temporary flooring, the strutting between the girders, and information about the crane used to the engineer for prior approval.

(6) Clean the exposed surface of stainless steel bearing plates on girders before setting the girder on the opposing bearing surface. Ensure that bearing surfaces are clean and free of materials that could adversely affect the function of the sliding bearing.

503.4 Measurement

(1) The department will measure the Prestressed Girder bid items by the linear foot acceptably completed.

503.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
503.0100 - 0199	Prestressed Girder (type) (inch)	LF

(2) Payment for the Prestressed Girder bid items is full compensation for providing girders, including concrete, grout, mortar, reinforcement steel, tie bars, anchor plates, and other embedded metal; for casting and curing concrete; for jacking and prestressing; for handling, hauling and erecting; and for discarding and replacing units damaged by improper handling or storage.

(3) The department will accept prestressed concrete members with 28-day concrete cylinder strengths below the required 28-day compressive strength, as specified in 503.2.2, based on a pay reduction, if the 28-day concrete cylinder strength provided is greater than the engineer-determined design strength of the individual member. The department will reduce payment for an accepted member with 28-day concrete cylinder strength less than the required 28-day compressive strength by the greater of $500, or 20 percent of the contract unit price applied to the measured length of the member.

(4) If the 28-day concrete cylinder strength for the prestressed concrete member falls below the engineer-determined design strength of the individual member, obtain cores from each member according to AASHTO T24, test according to AASHTO T22, and evaluate for strength comparison. Obtain the engineer's approval for the core sample locations. If the average of 3 core strengths per member satisfies the design strength, and if none of the core strengths are less than 10 percent below the design strength, the engineer will accept the member based on the pay reduction defined above for deficient 28-day concrete cylinder strengths. The contractor may perform coring and testing, or an independent testing agency that the engineer approves may perform coring and testing. The engineer will observe coring and testing done by the contractor. Costs associated with taking, analyzing, and testing cores are the contractor’s responsibility.

Section 504 Culverts, Retaining Walls, and Endwalls

504.1 Description

(1) This section describes providing culverts whether defined as a culvert or bridge under 101.3, retaining walls, and endwalls. This work does not include providing pipe culverts.

504.2 Materials

(1) Furnish steel reinforcement conforming to 505.

Revise 504.2 to specify different concrete material requirements for cast in place vs precast structures.

(2) For cast in place structures, furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT air-entrained concrete conforming to 501 as modified in part 7. Where the contract specifies or the engineer allows, the contractor may use high early strength concrete. Provide QMP for concrete as follows:

- For culverts and retaining walls as specified in 715 for class I structure concrete.
- For endwalls as specified in 716 for class III ancillary concrete.

(3) For precast structures, conform to ASTM C1577. Manufacture in a plant listed under precast concrete fabricators on the department's APL. Conform to the specified ASTM materials requirements for the structure specified except as follows:

- Use concrete with 565 pounds or more cementitious material per cubic yard.
- The contractor may use cement conforming to 501.2.1 or may substitute for portland cement at the time of batching conforming to 501.2.6 for fly ash, 501.2.7 for slag, or 501.2.8 for other pozzolans. In either case the maximum total supplementary cementitious content is limited to 30 percent of the total cementitious content by weight.
- For wet cast use air-entrained concrete with 7.0 percent +/- 1.5 percent air content.

504.3 Construction

504.3.1 General

(1) Construct culverts, retaining walls, and endwalls conforming to 502.3.

504.3.2 Placing Concrete

(1) For constructing concrete box culverts, unless specified otherwise, place the curtain walls, base slab, and the barrel sidewalls as a single unit to an approximate height of 6 inches and allow to set before constructing the remaining culvert. If constructing the sidewalls and top slab of box culverts as a monolith, allow not less than one hour or more than 3 hours to elapse between completing placement of the sidewalls and beginning placement of the top slab.

504.3.3 Removing Falsework and Applying Load

(1) For culvert spans less than 12 feet, the engineer may allow falsework removal based on one of the following:

- Absent compressive strength information, the minimum equivalent days specified in 502.3.10.1.
- With compressive strength information, a strength of 2000 psi or greater.

(2) For culvert spans of 12 feet and greater, the engineer may allow falsework removal after 7 equivalent days as defined in 502.3.10.1.

(3) The contractor may backfill culverts, retaining walls, and end walls that have attained the specified compressive strength or upon expiration of the minimum times as specified in 206.3.13. Do not apply additional loads on culverts until attaining a compressive strength of 3500 psi or, absent compressive strength information, for at least 21 days.

504.3.4 Name Plates

(1) Install nameplates on culverts and retaining walls conforming to 506.2.4 at the locations the plans show. Embed in concrete as specified in 502.3.11.

504.3.5 Curing

(1) Cure concrete in culverts, retaining walls, and end walls by any of the methods specified in 502.3.8.

(2) Cure retaining wall parapets with pigmented cure and seal conforming to 502.2.11. If applying architectural or other surface treatments, use a curing method compatible with those treatments.

504.4 Measurement

(1) The department will measure the several bid items that constitute the completed and accepted structure according to the provisions of the contract for those bid items and in the units the contract specifies. All work included within the scope of this contract but not listed as bid items in the proposal is incidental to the work.

(2) The department will measure the Concrete Masonry Culverts and the Concrete Masonry Retaining Walls bid items by the cubic yard acceptably completed. The department will not measure work or material for forms, falsework, cofferdams, unless specified otherwise. The department will not measure pumping, bracing, or other incidentals necessary to complete the work.

(3) The department will measure Concrete Masonry Endwalls by the cubic yard acceptably completed.

504.5 Payment

504.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
504.0100	Concrete Masonry Culverts	CY
504.0200	Concrete Masonry Culverts HES	CY
504.0500	Concrete Masonry Retaining Walls	CY
504.0600	Concrete Masonry Retaining Walls HES	CY
504.0900	Concrete Masonry Endwalls	CY

(2) Perform miscellaneous work the plans show, or the contract otherwise specifies but does not list as a bid item, as a part of and incidental to other contract bid items.

(3) Payment for the Concrete Masonry Culverts and the Concrete Masonry Retaining Walls bid items is full compensation for materials, forms, falsework, placing, finishing, curing, protecting, and heating; and for providing nameplates.

(4) Payment for Concrete Masonry Endwalls is full compensation for excavating; materials, including reinforcement; forms; placing, including reinforcement; finishing, curing, protecting and heating.

Section 505 Steel Reinforcement

505.1 Description

(1) This section describes furnishing and placing bar steel, high-strength bar steel or coated high-strength bar steel.

505.2 Materials

505.2.1 General

(1) Use deformed reinforcing bars unless the contract specifies otherwise.

(2) Unless the plans show otherwise or the special provisions specify otherwise, use the deformed type for all bar steel, all high-strength bar steel, and all coated high-strength bar steel reinforcement. If plain, round steel reinforcement is specified, conform to ASTM A675, grade 80.

(3) Use fabrication tolerances for straight and bent bars specified in Subsection 4.3, Tolerances, of the American Concrete Institute Committee 315, in the American Concrete Institute Detailing Manual.

(4) Unless the contract specifies otherwise, submit a manufacturer's certified report of test or analysis showing the reinforcement conforms to the specifications to the engineer before incorporating the reinforcement into the work.

505.2.2 Bar Steel Reinforcement

(1) Conform to AASHTO M31.

505.2.3 High-Strength Bar Steel Reinforcement

(1) Conform to AASHTO M31, grade 60.

505.2.4 Coated High-Strength Bar Steel Reinforcement

505.2.4.1 General

(1) Conform to AASHTO M31, grade 60. Ensure that the coating is applied in a CRSI certified epoxy coating plant. Bend bars that require bending before coating, unless the fabricator can bend the bar without damaging the coating.

(2) Do not weld epoxy-coated reinforcement except as the plans show.

505.2.4.2 Coating Material

(1) Coat reinforcement according to ASTM A775 with a fusion-bonded powder from the department's APL. Provide written certification from the resin manufacturer that the coating material is the same formulation and quality as submitted to the department for prequalification testing.

(2) Furnish a two-part epoxy resin that meets ASTM A775 for field repairs and patching.

505.2.4.3 Surface Preparation

(1) Ensure the bar surface is clean and free from rust, scale, oil, grease, and similar surface contamination, and slivers, scabs and other surface defects detrimental to proper coating.

(2) Blast the surface to a near white No. 10 finish according to SSPC-SP 10. Provide an anchor pattern with blast profile maximum roughness depth readings within the range of 1.6 mils to 4.0 mils. Determine the readings according to NACE RP-287, using replica tape.

(3) Remove all traces of grit and dust from the blasting before coating.

(4) Apply the coating to the cleaned surface as soon as possible after cleaning and before visible oxidation of the surface occurs. The contractor shall not wait to apply the coating more than 8 hours after cleaning, unless the engineer directs otherwise.

505.2.4.4 Coating Process

(1) Apply the coating as an electrostatically charged dry powder sprayed onto the grounded steel bars using an electrostatic spray gun. The contractor may apply the powder to either a hot or a cold bar. Give the coated bar the thermal treatment the epoxy resin manufacturer recommends to provide a fully cured finished coating.

(2) Cure, post-cure, or cure and post-cure the coating film to a fully cured condition. The coating applicator shall check a representative proportion of each production lot, using the method it finds most effective for measuring cure, to ensure the entire production lot of coating is fully cured.

505.2.4.5 Test Bar Conditioning

(1) Condition bars being tested for coating thickness, holidays (pinholes not visually discernible), coating adhesion, and abrasion resistance at a temperature range of 68 F to 86 F. If disputed, conduct tests at 73 F +/- 4 F and 50 +/- 5 percent relative humidity according to ASTM D3451 section 3.1.

505.2.4.6 Coating Thickness

(1) Ensure the coating is smooth and uniform in thickness. After curing is complete, ensure at least 90 percent of recorded thickness measurements of the coating are 7 mils +/- 2 mils. Thickness measurements below 5 mils are cause for rejection. The upper thickness limit does not apply to repaired areas of damaged coating. Measure the film thickness on a representative number of bars from each production lot according to ASTM D7091 for measuring film thickness of pipeline coatings on steel.

(2) Take an average of 3 individual readings on the body of a straight length of bar between 3 consecutive deformations to obtain a single recorded thickness measurement. Obtain a minimum of 5 recorded measurements, evenly spaced along 2 sides of the test bar for a minimum of 10 recorded measurements per bar.

(3) The contractor may use pull off and fixed probe gauges. Do not use pencil-type pull off gauges that require the operator to observe the reading at the instant the magnet is pulled from the surface. Follow the thickness gauge manufacturer's recommendations for its calibration and use.

505.2.4.7 Coating Continuity

(1) Check the coating on a representative number of bars selected from each production lot after cure for continuity of coating and ensure it is free from holes, voids, contamination, cracks, and damaged areas. Additionally, ensure that no more than an average of 2 holidays exist in any linear foot of coated bar. Base the average on the bar's full production length.

(2) Use a 67 1/2 volt holiday detector at the manufacturer's plant to check the coating.

505.2.4.8 Coating Flexibility

(1) Evaluate the coating flexibility based on a representative number of bars selected from each production lot. Evaluate coating adhesion according to ASTM A775.

505.2.4.9 Abrasion Resistance

(1) Determine the coating's resistance to abrasion on a representative number of bars selected from each production lot, according to ASTM D4060 using CS-10 wheels and a 1000 gram load per wheel, and ensure that the weight loss does not exceed 100 megagrams per 1000 cycles.

505.2.4.10 Inspection

(1) Furnish a certificate of compliance for the surface preparation, coating material, and process. The coating applicator shall retain test results and make them available for not less than 7 years.

505.2.4.11 Damage Repair and Rejection

(1) The contractor shall not repair epoxy-coated high-strength bar steel reinforcement that does not conform to the requirements for coating thickness, continuity of coating, coating cure, or flexibility of coating. Replace the reinforcement or strip, reclean, and recoat epoxy-coated high-strength bar steel reinforcement with one or more of these defects.

(2) If using coated high-strength bar steel reinforcement in bridges, the department requires patching on circumferential areas with damaged coating, on sheared or cut ends, on end areas left bare during the coating process, and on any areas that the entire coating is removed.

(3) If using coated high-strength bar steel reinforcement in concrete pavement and miscellaneous concrete construction bid items in 415 or 416, the department requires patching on circumferential areas with damaged coating or removed coating. The department will not require patching on sawed ends, cut ends, coated damaged ends, or end areas left bare during the coating process.

(4) Patch with the material specified in 505.2.4.2(2) according to ASTM D3963 and manufacturer instructions.

(5) Complete required repairs before visible oxidation of the steel surface occurs.

(6) The engineer will reject bars having total damage greater than 2 percent of the total circumferential area of the bar length. Consider the entire loss of the coating at the specific area on the bar as total damage.

505.2.5 Welded Steel Wire Fabric for Concrete Reinforcement

(1) Use a fabric of the weight and design the plans show and conform to ASTM A1064.

505.2.6 Dowel Bars and Tie Bars

Revise 505.2.6 to add subsections for tubular dowels and alternate high performance dowels. This change was implemented in ASP 6 effective with the March 2018 letting.

505.2.6.1 General

(1) Furnish bars coated in a plant certified by the Concrete Reinforcing Steel Institute. For dowel bars and straight tie bars, there is no requirement for bend tests. Ensure that the bars are the specified diameter and length the plans show.

(2) The contractor need not coat or patch sawed ends, sheared ends, cut ends, ends left bare during the coating process, or ends with damaged coating.

(3) The contractor need not repair circumferential coating damage from shipping, handling, or installation, if the following conditions are met:

1. The damaged area is 1/4 inch square or smaller.
2. The total damaged area in any one-foot length does not exceed 2 percent of the circumferential area in that length.

(4) Repair areas of damaged circumferential coating larger than 1/4 inch square. Reject bars with total damage greater than 2 percent of the bar's circumferential area.

505.2.6.2 Dowel Bars

505.2.6.2.1 General

(1) Ensure that the bars are straight, round, smooth, and free from burrs or other deformations detrimental to the free movement of the bar in the concrete.

(2) Saw bars to the required length. For solid bars, the department will allow shearing if no damage occurs to the coating and shearing distortions do not exceed the following:

1. No distorted diameter is more than 0.04 inches greater than the true diameter.
2. No distortion extends more than 0.40 inches from the sheared end.

(3) Apply a surface treatment to loose dowels, or furnish manufacturer-treated bars in dowel bar baskets, capable of preventing bond between the epoxy-coated bars and the concrete. Apply field surface treatments when loading bars in the dowel bar magazine.

505.2.6.2.2 Solid Dowel Bars

(1) Furnish coated bars conforming to AASHTO M31 grade 40 or 60. Alternatively the contractor may furnish dowel bars conforming to AASHTO M227 grade 70-80. Coat with a thermosetting epoxy conforming to AASHTO M254, type B.

505.2.6.2.3 Tubular Dowel Bars

(1) Furnish welded steel tubular bars conforming to ASTM A513 fabricated from plain carbon steel with a minimum tensile yield strength of 60 ksi and sized as follows:

SOLID BAR SPECIFIED DIAMETER	MINIMUM REQUIRED OUTSIDE DIAMETER	MINIMUM BASE METAL WALL THICKNESS
1 1/4-inch	1 5/16 inches	0.120 inch
1 1/2-inch	1 5/8 inches	0.120 inch

(2) Cap bar ends to prevent intrusion of concrete or other materials. Ensure that tubing is galvanized on the exterior and interior according to ASTM A653 with a G40 zinc coating and apply 7-13 mils of epoxy to the galvanized exterior according to AASHTO M254, Type B.

505.2.6.2.4 High Performance Dowel Bars

(1) As an alternate the contractor may furnish high performance dowel bars from the department's APL.

505.2.6.3 Tie Bars

(1) Furnish coated bars conforming to AASHTO M31 grade 40 or 60. Coat tie bars as specified in 505.2.4 for coated high-strength steel reinforcement. Ensure that the tie bars are the shape the plans show.

(2) Repair, with compatible coating material, the bend location of field-straightened coated tie bars.

505.3 Construction

505.3.1 General

(1) Store reinforcement above ground on platforms, skids, or other supports. Protect from mechanical injury and deterioration from exposure. Store epoxy-coated reinforcement on wooden cribbing and handle without dragging or dropping using padded or non-metallic slings.

Revise 505.3.1(2) to clarify that cumulative exposure to sunlight for epoxy coated rebar is limited to 2 months.

(2) Cover epoxy-coated bars in storage, or placed in a bridge deck mat, with an opaque engineer-approved material to prevent cumulative exposure to sunlight for more than 2 months before being embedded in concrete. Include portions of partially embedded bars left exposed between construction stages.

(3) Mark reinforcement to facilitate inspection and checking. Ensure reinforcement is free from detrimental dirt, dust, paint, oil, or other foreign material when placed in the work. The engineer will not reject reinforcement with rust, seams, surface irregularities, or mill scale if the weight, dimensions, cross-sectional areas, and tensile properties of a hand wire-brushed test specimen conform to AASHTO M31.

(4) The contractor may field cut reinforcement by sawing, using abrasive cut-off blades, or flame cutting. Do not flame cut epoxy-coated reinforcement.

505.3.2 Bending

(1) Use bent bar reinforcement cold bent to the shapes the plans show, and unless the plans show otherwise or the engineer directs otherwise, conform to Recommended Hooks All Grades and Recommended Sizes for Stirrup and Tie Hooks, of the American Concrete Institute Committee 315. Ensure all bending dimensions are out-to-out of the bar.

505.3.3 Splicing

505.3.3.1 General

(1) Furnish bar steel reinforcement in the full lengths the plans show. Except where the plans show, do not splice reinforcement without the engineer's written approval. The department will allow lapped splices, welded splices, mechanical couplers, or other connections the plans show or the engineer approves in writing. To the extent practicable, stagger splices in adjacent bars and locate splices as far as possible from the point of maximum tensile stress. The engineer will not allow splices at points that do not offer a minimum distance of 2 inches between the splice and the nearest adjacent bar, or design concrete cover the plans show at the splice location.

(2) Overlap the sheets of welded steel wire fabric to maintain uniform strength, and securely fasten at the ends and edges. Ensure the edge lap is at least one mesh wide.

505.3.3.2 Lapped Splices

(1) Ensure that lapped splices conform to plan requirements, are placed in contact with each other, and wired together to hold the bars in position for the full length of the splice.

505.3.3.3 Welded Splices

(1) The contractor may weld uncoated reinforcement only if the plans show welded splices or the engineer approves welded splices in writing. Do not splice epoxy-coated reinforcement by welding. Use welded butt splices conforming to the AWS D 1.4, Structural Welding Code - Reinforcing Steel. Use electrodes conforming to AWS D 1.5 and submit electrode acceptance reports according to AWS D 1.5.

(2) Use AWS D 1.4 certified welders to perform all welding. If welder certification tests are required, a department-approved independent testing agency shall perform the testing. The engineer may require qualification tests according to AWS D 1.4.

(3) Test 4 percent of the total number of splices per each bar size, but not less than 4 splices. For both qualification samples and production splices, conform to AWS radiographic methods and provide test results prepared by an inspector qualified under AWS to perform radiographic interpretation.

505.3.3.4 Bar Couplers

505.3.3.4.1 General

(1) Provide threaded bar couplers unless the engineer approves an alternate coupler system in writing as allowed under 505.3.3.4.3.

(2) If splicing epoxy-coated bars, clean and coat couplers and exposed threads with epoxy. Couplers may be coated with epoxy before or after installation. Use epoxy that is compatible with the touchup epoxy used on coated reinforcing bars.

505.3.3.4.2 Threaded Bar Couplers

(1) Ensure that the threaded bar coupler material is capable of developing 125 percent of the yield strength of the bar being spliced. Provide a manufacturer-certified report of tests, based on a minimum of 3 tests, showing the threaded bar coupler capacity.

505.3.3.4.3 Alternate Bar Coupler System

(1) Do not install alternate bar coupler systems before department proof testing and without the engineer's written approval. Provide 3 sample splices to the department for testing. Conform to the manufacturer's installation instructions and provide a copy of those instructions to the engineer.

505.3.4 Placing and Fastening

(1) Place steel reinforcement precisely in the position the plans show and hold firmly during the concrete placing and setting by using spacer strips, stays, recycled plastic chairs, metal chairs, or other engineer-approved devices or supports. The contractor may use recycled plastic supports for a bottom layer of steel reinforcement which in turn supports upper layers on continuous bar chairs; but do not use individual plastic chairs to directly support upper layers. Unless the contract provides otherwise, use coated high-strength bar steel reinforcement in the top layer of reinforcement in the concrete deck.

(2) Make metal chairs from stainless steel, steel that is zinc coated or epoxy coated after fabrication, or from uncoated steel with engineer-approved plastic tipped legs, or with at least 1/2 inch of the bottom of the legs hot dip zinc coated or plastic-coated. Furnish epoxy-coated metal chairs or recycled plastic chairs to support coated high-strength bar steel reinforcement, subject to the plastic chair restriction stated above. The epoxy coating thickness shall conform to 505.2.4.6.

(3) Use recycled plastic chairs manufactured from recycled plastic obtained from post consumer products. Ensure they are chemically inert in concrete and are molded in a shape that does not restrict concrete flow and consolidation around and under the chairs.

(4) For recycled plastic chairs conform to the following requirements within a temperature range of 20 F to 150 F:

PROPERTY	VALUE	ASTM TEST
Minimum shear strength	5000 psi	ASTM D732
Minimum compressive strength	10,000 psi	ASTM D695
Maximum water absorption	0.1 percent	ASTM D570

(5) Support bar steel reinforcement in the concrete decks and slab spans as follows:

1. For all decks and slab spans, support bottom transverse bars with continuous bar chairs spaced 4 foot on centers or closer. Support the ends of the bars with a line of chairs near each deck or slab edge.
2. On decks less than 12 inches thick, support top longitudinal bars with continuous bar chairs spaced 4 foot on centers or closer. Provide a row of continuous bar chairs directly under each row of transverse bar splices.
3. On decks and slab spans 12 inches thick or thicker, support top transverse bars with individual supports spaced approximately 3 foot on centers or closer in both directions. Use either individual bar chairs setting on the form floor or bent reinforcement bars supported off the bottom mat. Support bars near the edge of the deck or slab with individual supports spaced 3 foot on centers or closer.
4. On decks with prestressed wide flange girders, place bar chairs with continuous bottom runners between the top and bottom longitudinal reinforcement layers at a maximum 4 foot spacing over the girder flange.

(6) The contractor may use precast concrete bricks or other engineer-approved bricks or blocking in structures to support reinforcement in footings or slabs placed on grade; however, the bricks or blocking shall not contact the reinforcement over a distance greater than the depth of a standard concrete brick. Tie the upper layer of reinforcement for bridge decks securely to the girders or forms at a longitudinal spacing not greater than 8 feet. For decks of slab span bridges, the ties shall have a transverse spacing not to exceed 8 feet, and for decks over girders, secure the ties to or next to each longitudinal line of girders.

(7) Tie the bars securely at intersections except if spacing is less than one foot in each direction, if alternate intersections are tied. The contractor shall not use tack welding to tie steel. Before placing any concrete in a unit or section, obtain the engineer's approval of the reinforcement placing and securing in that unit or section.

(8) Tie coated bars using a procedure, equipment, and materials that will not damage or cut the coating. Tie coated reinforcement with one of the following:

1. Ties made from an engineer-approved plastic or nonmetallic material.
2. Stainless steel wire.
3. Nylon, epoxy, or plastic-coated wire.

505.4 Measurement

(1) The department will measure the Bar Steel Reinforcement bid items by the pound acceptably completed. The department will compute the bar weight from the nominal weights for corresponding sizes for deformed bars in AASHTO M31. The department will not measure the extra metal used if the

contractor chooses to substitute bars larger than those specified, the extra metal necessary for splices the plans do not show, or the weight of any devices used to support or fasten the steel in its correct position.

(2) The department will measure the Bar Couplers bid items as each individual coupler acceptably completed.

505.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
505.0100	Bar Steel Reinforcement Structures	LB
505.0400	Bar Steel Reinforcement HS Structures	LB
505.0600	Bar Steel Reinforcement HS Coated Structures	LB
505.0900-0919	Bar Couplers (size)	EACH

(2) Payment for the Bar Steel Reinforcement bid items is full compensation for providing, transporting, and placing reinforcement including supports. Where the plans specify bar couplers, the department will pay for the length of bars as detailed with no deduction or increase for installation of the coupler.

(3) Payment for Bar Steel Reinforcement HS Coated Structures includes coating, including epoxy-coated metal chair supports.

(4) Payment for the Bar Couplers bid items is full compensation for providing couplers, including bar steel that is part of the coupler and not detailed in the plan; for threading reinforcing bars; for installing and coating the splice; and for supplying and testing 3 couplers.

Section 506 Steel Bridges

506.1 Description

(1) This section describes fabricating, furnishing, casting, machining or preparing otherwise, delivering, and erecting the steel and miscellaneous metals required for steel bridges, or metal parts of other bridges.

506.2 Materials

506.2.1 General

(1) Furnish materials conforming to the specifications for the several parts of the completed structure.

506.2.2 Structural Steel

506.2.2.1 General

(1) Furnish structural steel for highway structures conforming to the ASTM specifications the plans show. For material that the plans do not indicate the ASTM specifications, furnish structural carbon steel conforming to ASTM A709 grade 36.

Revise 506.2.2.1(2) to prohibit shearing or punched holes in members requiring Charpy testing.

(2) Ensure that girder flange plates, girder web plates, flange splice plates, hanger bars, links, rolled beams, flange cover plates, and plates and angles connecting floor beams to girders conform to zone 2 toughness requirements for longitudinal Charpy V-Notch tests specified in ASTM A709. Sample and test according to ASTM A673. Use the (H) frequency of testing. Do not shear cut or punch full-sized holes in members requiring Charpy V-Notch testing.

(3) Ensure that structural steel members included in the structural design capacity, and that will be welded, have a maximum carbon equivalent (CE) of 0.48. Steels conforming to ASTM A709 HPS 50 or 70 with carbon contents 0.10 percent or less are exempted from this rule. The engineer may allow steels with up to CE 0.58 only if the contractor uses an engineer-approved adjusted welding procedure. Submit steel mill certifications indicating the composition of the steel provided under the contract. The engineer will calculate the carbon equivalent as follows:

$$CE = C + (Mn+Si)/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$$

506.2.2.2 Structural Carbon Steel

(1) For structural carbon steel 4 inches thick or thinner, conform to ASTM A709 grade 36. For structural carbon steel over 4 inches thick, conform to ASTM A36.

506.2.2.3 High-Strength Structural Steel

(1) Use high-strength structural steel conforming to ASTM as follows:

HSLA columbium-vanadium steels of structural quality:

50 ksi minimum yield point to 4 inches thick ..... ASTM A709, grade 50

HSLA weathering steel:

50 ksi minimum yield point to 4 inches thick ..... ASTM A709, grade 50W

High-yield-strength quenched and tempered alloy steel plate:

Martensitic..... ASTM A709, grade 100 or 100W

Non-martensitic..... ASTM A709, grade 70W

High Performance Steels:

Up to 4 inches thick..... ASTM A709 HPS, grade 50 or 70

506.2.3 Miscellaneous Metals

506.2.3.1 Steel Castings

(1) If using carbon steel castings for bridges and general use, conform to class 70, 90, 120 of AASHTO M192 and the following:

1. Furnish the specific class of steel castings the plans show or are specified in the contract.
2. The plans will specify the nondestructive tests to perform and their extent.
3. Use steel castings that are true to pattern in form and dimensions and free from defects affecting strength or service life.
4. The contractor may weld defects using an engineer-approved process. Perform weld repairs before annealing the casting. If the engineer requires, re-anneal castings after welding.
5. If the engineer requires, the contractor shall test castings by radiography or ultrasonic testing to determine the presence of cracks, flaws, or other defects.

6. Ensure that the metal thickness remaining after completing the machining is not less than the thickness the plans show.
7. Thread the ends of the tensile test specimens for at least 3/4 inch with 3/4-inch American N.C. threads.

506.2.3.2 Bronze Castings

(1) If using bronze castings for bearings, trunnions, journals of bridges, and expansion plates, conform to ASTM B22, alloy No. C91100.

506.2.3.3 Cold-Finished Carbon Steel Shafting

(1) Use cold-finished carbon steel shafting conforming to AASHTO M169, grades 1016 through 1030. If used for structural pins, then conform to ASTM A434, grade BC, quenched and tempered.

506.2.3.4 Lubricated Bronze Plates

(1) Fabricate lubricated bronze plates as the plans show and with materials conforming to ASTM B100, copper alloy No. C51000 or to ASTM B22, alloy No. C91100.

(2) Provide to the engineer a certified report of test or analysis indicating the manufacturer's test results for the lubricated bronze plates on their chemical and physical properties, including the coefficient of friction of the material used.

(3) Bore or cast the surface of the lubricated bronze plates in a geometric pattern of recesses. Fill the recesses with a lubricating compound consisting of graphite and metallic substances with a lubricating binder capable of withstanding the atmospheric elements. Hydraulically press the compound into the recesses to form dense, non-plastic lubricating inserts. Ensure the lubricated area is within a range of 25 to 33 percent, inclusive, of the bearing face with a coefficient of friction not greater than 0.1. Unless the plans show or the contract directs otherwise, only lubricate the top face of the bronze plate.

506.2.3.5 Steel Forgings

(1) Use steel forgings for pins, rollers, trunnions, and other forged parts conforming to the requirements for class M quenched and tempered forgings of ASTM A668. Thread the ends of the tensile test specimens for at least 3/4 inch with 3/4-inch American N.C. threads.

506.2.3.6 Welded and Seamless Steel Pipe

(1) Furnish welded and seamless steel pipe for general use conforming to ASTM A53, type F, or type E, grade B or type S, grade B. Unless provided otherwise, use black, standard weight pipe.

506.2.3.7 Pipe Fittings

(1) Use malleable cast iron or pressed steel pipe fittings for required uses. If zinc coated fittings are required, the coating shall conform to ASTM A123.

506.2.3.8 Sheet Lead

(1) Furnish lead in sheet form conforming to ASTM B29.

(2) Use lead sheets of uniform thickness throughout, free from cracks, seams, slivers, scale, and other surface defects.

(3) Unless the plans show otherwise, use sheet lead 1/8 inch thick with a tolerance of +/- 1/32 inch. Ensure that the length and width are within 1/8 inch of the plan dimensions.

506.2.3.9 Sheet Copper

(1) Furnish strip or sheet copper conforming to ASTM B152 and suitable for the purpose intended. Unless specified otherwise, use sheet copper with a minimum thickness of 0.02 inch.

506.2.3.10 Sheet Zinc

(1) For sheet or plate zinc, conform to Prime Western Grade ASTM B6.

(2) Use sheet and plate zinc of uniform thickness, free from cracks, seams, slivers, scale, surface corrosion, adhering matter, and other surface defects.

(3) Use sheet and plate zinc of the zinc gauge the plans show, with a thickness tolerance of +/- 6 percent. Use sheets within 1/8 inch of the length and width the plans show.

506.2.4 Name Plates

(1) Furnish bronze nameplates for bridges, culverts, and retaining walls cast from material conforming to ASTM B62 for copper alloy UNS No. C83600, common trade name 85-5-5-5. Provide raised lettering in a block gothic font and polish the raised surface of the lettering and borders.

506.2.5 High-Strength Bolts

506.2.5.1 General

(1) Furnish high-strength A325 bolts conforming to ASTM F3125, nuts conforming to ASTM A563, and flat washers conforming to ASTM F436. Use type 1 galvanized bolts, galvanized grade DH nuts, and type 1 galvanized washers. For weathering steel connections use type 3 bolts, grade C3 or DH3 nuts, and type 3 washers.

(2) Hot-dip zinc-coat according to ASTM A153 supplemented by ASTM F2329 or mechanically zinc-coat according to ASTM B695, class 50. Remove excess hot-dip zinc coating on threads by centrifuging or air blasting immediately after withdrawal. Do not flame-chase. Ensure that the same zinc-coating process is used for bolts and nuts within a bolt/nut/washer assembly.

(3) Ensure that the supplier lubricates zinc coated nuts with a lubricant containing dye that contrasts with the color of the zinc coating according to ASTM A563 supplementary requirements S1 and S2.

(4) For, uncoated nuts use grade C, D, or C3 with a minimum Rockwell hardness of 89 HRB or minimum Brinell hardness of 180 HB, or use heat treated grade DH or DH3.

(5) Furnish direct tension indicating (DTI) washers conforming to ASTM F959. Use zinc-coated type 325 DTIs in type 1 galvanized bolt/nut/washer assemblies and type 325-3 DTIs in type 3 weathering steel bolt/nut/washer assemblies. Ensure that DTIs have identifying marks applied by the manufacturer.

506.2.5.2 Bolt and Nut Dimensions

(1) Use high-strength bolts and nuts conforming to the dimensions the plans show and as specified in ASTM F3125. Determine the length as specified in 506.2.5.4.

506.2.5.3 Washer Dimensions

(1) Use flat, smooth, and hardened circular washers conforming to dimensions specified in ASTM F436.

(2) Install bolts with a washer under the nut or bolt head, whichever is turned to tighten. If the bearing faces of the bolted parts have a slope of more than 1:20 with respect to a plane normal to the bolt axis, use smooth, hardened, and beveled washers to compensate for lack of parallelism.

(3) If clearance is necessary, the contractor may clip washers on one side to a point not closer than 7/8 of the bolt diameter from center of washer.

506.2.5.4 Bolt Lengths

(1) The required bolt length is the grip, total thickness of the connected material, plus the tabulated length added to the grip for each bolt size as follows:

BOLT SIZE	LENGTH ADDED TO THE GRIP
5/8-inch	1 1/16 inches
3/4-inch	1 3/16 inches
7/8-inch	1 5/16 inches
1-inch	1 9/16 inches
1 1/8 to 1 1/4-inch	1 13/16 inches
1 3/8 to 1 1/2-inch	2 1/16 inches

(2) The above values are generalized, with allowance for manufacturing tolerances, to provide for a washer and using a heavy nut, with adequate stick-through at the end of the bolt. For each required beveled washer, add 5/16 inch; for any additional washer, add 3/16 inch; and for a load-indicating washer, add 1/8 inch. Adjust the length determined from the above table increment and allowances for additional washers to the next 1/4 inch length increment for bolts up to 5 inches length and to the next 1/2 inch length increment for lengths over 5 inches.

(3) For bolt lengths determined as provided above, the full thread may extend into the grip not more than 3/8 inch for lengths of 5 inches or less, and not more than 5/8 inch for lengths over 5 inches.

506.2.5.5 Identification

(1) Ensure that the manufacturer provides identification marks for high-strength bolts and nuts according to ASTM F3125.

506.2.5.6 Testing and Reporting

(1) Test according to ASTM F3125, ASTM A563, and ASTM F436. For rotational-capacity testing conform to Report No. FHWA SA-91-031 "High-Strength Bolts for Bridges." In addition perform rotational-capacity testing in the field conforming to the procedures enumerated in department form DT2113.

(2) Furnish 2 copies of a certified report of test or analysis indicating the results of required manufacturer/supplier tests. Also verify the results of additional field testing required under FHWA SA-91-031 by submitting 2 copies of department form DT2113.

506.2.6 Elastomeric Bearings

506.2.6.1 General

Revise 506.2.6.1(1) to remove the reference to the bridge secondary item APL for non-laminated bearings.

(1) Furnish laminated bearings from the department's APL of laminated elastomeric bearings

(2) Manufacture bearings according to AASHTO M251 except replace the requirements of sections 4.1 and 4.2 with the following:

- Use virgin crystallization resistant polychloroprene, or virgin natural polyisoprene as the raw polymer. Use only new material with no reclaimed material incorporated in the finished bearing.
- Provide elastomer with durometer hardness of 60 on the Shore "A" scale. Provide elastomer compounds classified as low-temperature zone D, grade 4 or 5, meeting the requirements of AASHTO LRFD Bridge Design Specifications, table 14.7.5.2-1.
- Conform to the following physical properties:

	POLYISOPRENE (NATURAL RUBBER)	POLYCHLOROPRENE (NEOPRENE)
Grade (durometer)	60±5	60±5
Physical properties		
Hardness (ASTM D2240)	60+/-5	60+/-5
Tensile strength (ASTM D412), psi	2500	2500
Ultimate elongation, minimum percent	400	400
Heat resistance (ASTM D573)	168 hrs. @ 158°F	70 hrs. @ 212°F
Hardness, maximum points change	+10	+15
Tensile strength, maximum percent change	-25	-15
Ultimate elongation, maximum percent change	-25	-40
Compression set (ASTM D395, method B)	22 hrs. @ 158°F	22 hrs. @ 212°F
Maximum percent	25	N.A.
Maximum percent	N.A.	35
Low temperature brittleness (ASTM D746, procedure B)		
Brittleness at -54.4°F	No Failure	No Failure
Laminated pad adhesion test (ASTM D429, method B)		
Bond strength, psi	40	40

506.2.6.2 Non-Laminated Elastomeric

(1) Form non-laminated elastomeric bearings by casting or extruding rubber or neoprene in a single, integral layer to the required plan thickness. Avoid heating or damaging the material if cutting.

506.2.6.3 Laminated Elastomeric

(1) Furnish alternate layers of elastomer and steel reinforcement integrally bonded together, with reinforcement spaced as the plans show and parallel to the pad top and bottom surfaces. Cover reinforcement edges with a minimum of 1/4 inch of elastomer. Seal edge cavities using heat bonded vulcanized patching or an engineer-approved elastomeric sealant.

(2) Conform to AASHTO M251 tolerances, dimensions, and configurations; except cover the top and bottom steel plates with 1/4 inch of elastomer with a +1/8 to -1/16-inch thickness tolerance. Use rolled steel conforming to ASTM A36 or ASTM A1011 grade 36 or higher, for internal steel reinforcement.

(3) Ensure that the manufacturer molds their name or trademark into the edge of each pad on a face visible after structure erection.

Revise 506.2.6.3(4) to require electronic submittal of shop drawings to the department's fabrication library.

(4) Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2.

506.2.6.4 Testing

(1) Conform to the bearing testing and acceptance criteria specified in AASHTO M251, section 8 as follows:

- Determine compressive strain according to section 8.8.1. Ensure that compressive strain in any layer of an elastomeric bearing does not exceed 7 percent at 800 psi average unit pressure for the full size bearing.

- Proof load each bearing according to section 8.8.2. Use a compressive load of 1200 psi for non-laminated bearings and 1800 psi for laminated bearings.

(2) Provide a manufacturer's certified report of test or analysis to the engineer for each production lot of bearings at least 30 days before shipment to the contractor. The department may require additional test samples from the bearings to confirm manufacturer test results before shipment.

(3) Ensure that each bearing delivered to the project is labelled to clearly indicate its production lot and can be tied to its associated test results.

506.2.7 Welded Stud Shear Connectors

(1) For shear connector studs conform to ASTM A108, cold-finished bars, grades 1015, 1018, or 1020, either semi- or fully killed. If using flux-retaining caps, use low carbon grade steel for the caps suitable for welding that comply with ASTM A109.

(2) Tensile properties, determined testing bar stock after drawing, or of finished studs, shall conform to the following:

Minimum tensile strength	60 ksi
Minimum yield strength[1]	50 ksi
Minimum elongation	20 percent in 2 inches
Minimum reduction of area	50 percent

[1] As determined by the 0.2 percent offset method.

(3) Determine tensile properties according to ASTM A370. Perform tensile tests of finished studs on studs welded to test plates using a test fixture similar to figure 7.2 of chapter 7 of AWS D 1.5. If fracture occurs outside the middle half of the gauge length, repeat the test.

(4) Ensure that finished studs are of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other injurious defects. Produce the finish by cold drawing, cold rolling, or machining.

(5) Furnish arc shield (ferrule) of heat-resistant ceramic or other material with each stud that does not damage the welds, or does not cause excessive slag, and will not crumble or break due to thermal or structural shock before completing the weld.

(6) The contractor shall submit the following information on the studs to the engineer for approval before installation:

- The name of the manufacturer.
- A detailed description of the stud and arc shield.
- Documentation that the studs qualify as specified in AWS D 1.5.

506.2.8 Bearing Assemblies

506.2.8.1 General

(1) Use bearing assemblies conforming to the material requirements, sizes, and details the plans show.

(2) Blast clean fabricated structural steel bearing components as specified in 506.3.31.3 before zinc coating. After zinc coating, apply a wash primer to the components and the coating system in the color selected for the structural steel under the concrete. If using weathering steel, paint the bearing assemblies with one coat of organic zinc-rich primer and one shop coat of high-build brown epoxy paint. The contractor shall not blast clean, zinc coat, or paint stainless steel and teflon surfaces.

506.2.8.2 Fixed Bearing Assemblies

(1) Zinc coat the complete bearing assembly, including anchor bolts, nuts and washers, but excluding elements welded to the girder. Zinc coat the anchor bolts, nuts, and washers, according to ASTM A153, class C, supplemented by ASTM F2329. Zinc coat the remainder of the assembly according to ASTM A123.

506.2.8.3 Expansion Bearing Assemblies

(1) An expansion bearing assembly unit consists of a top sole plate, a bottom masonry plate, a rocker plate, a slide plate, side retainers, anchor bolts with nuts and washers, and a lead plate, all as described below and as the plans show.

(2) Zinc coat all structural steel surfaces, including anchor bolts, nuts and washers, that do not come in contact with other structural steel surfaces, or stainless steel, or polytetrafluoroethylene (PTFE) surfaces, as specified in 506.2.8.2 for fixed bearing assemblies.

(3) For the stainless steel sheet for the top element of sliding bearings use type 304 conforming to ASTM A240 and ensure it is not less than 1/16 inch thick after finishing. Make the finished stainless surface a plane within a tolerance of 1/32 inch and with a 2B finish as specified in ASTM A480.

(4) During welding, protect the surface of the stainless steel plate from weld splatter.

(5) After fabrication, provide a near mirror finish on the surface of the stainless steel plate.

(6) Use PTFE materials that are virgin polytetrafluoroethylene fluorocarbon resin, unfilled conforming to ASTM D4894. The finished materials shall exhibit the following physical properties:

REQUIREMENT	TEST METHOD	UNFILLED VALUE
Hardness at 78 F	ASTM D2240 Shore "D"	50-65
Tensile strength, psi	ASTM D1708	2800 Min.
Elongation, percent	ASTM D1708	200 Min.
Specific gravity	ASTM D792	2.16 +/- 0.03
Melting point	ASTM D4591	621 +/- 18 F

(7) Ensure the finished PTFE sheet is not less than 1/16 inch or more than 3/32 inch thick.

(8) Bond the PTFE sheet to the 1/2-inch steel sheet with extreme care using a proven high-temperature-resistant epoxy bonding material. Use a 2-component, medium viscosity epoxy resin conforming to ASTM D1763 for this purpose.

(9) The engineer may allow welding to steel plate that has a bonded PTFE surface provided welding procedures are established that restrict the maximum temperature reached by the bond area to less than 300 F. Monitor temperature using temperature-indicating crayons, liquids, or bimetal thermometers.

(10) If epoxy bonding PTFE sheets, ensure that one side of the PTFE sheet is factory treated by the sodium naphthalene or sodium ammonia process by a department-approved manufacturer.

(11) Perform PTFE bonding at the bearing manufacturer's factory under controlled conditions and according to the engineer-approved adhesive systems manufacturer's written instructions. The bonding operation should produce a PTFE surface that is smooth and free from bubbles.

(12) At installation, ensure the stainless steel sliding face of the upper element and the PTFE sliding face of the lower element have the surface finish specified and are clean and free of dust, dirt, moisture, or any other foreign matter.

506.2.8.4 Preformed Fabric Pads, Class A

(1) Furnish fabric pads for use under steel bearings the plans show. Use preformed pads composed of multiple layers of 8-ounce cotton duck impregnated and bound with natural rubber, or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall produce the specified thickness after compression and vulcanizing. When tested according to MIL-C-882E, finished pads shall withstand compression loads of 10,000 psi or more perpendicular to the plane of the laminations without harmful extrusion or reduced thickness.

506.2.9 Steel Diaphragms

(1) Furnish steel diaphragms conforming to the plan details.

506.2.10 Zinc Coated Fabrication

(1) Conform to ASTM A385 for fabricating zinc coated work.

Delete 506.2.11 to move secondary fabrication requirements to 506.3.1.2 now called fabricated bridge components.

506.3 Construction

506.3.1 General

Revise 506.3.1 to clarify requirements for steel primary members and fabricated bridge components.

506.3.1.1 Primary Members

(1) Ensure that the following are fabricated by an approved fabricator selected from the department's APL for primary members:

- Webs and flanges of tub and box girders, rolled beams, and their cover plates.
- Main truss members (chords, verticals, and diagonals of truss panels, transverse wind bracing, floor system).
- Floor beam webs and flanges.
- Arch ribs.
- Ties and hangers.
- Pier diaphragm members for tub girders.
- Splice plates for primary members.
- Columns.

(2) Ensure that the fabricator does the following:

- Submits department form DT2330 electronically to the department's fabrication library for each structure before fabrication.
- Submits and updates weekly fabrication progress reports on department form DT2172 electronically to the department's fabrication library for each structure during fabrication.

506.3.1.2 Fabricated Bridge Components

(1) Ensure that the following are fabricated by an approved fabricator selected from the department's APL for fabricated bridge components:

- Railing assemblies
- Expansion devices
- Bearing assemblies
- Structural steel diaphragms for concrete girders

(2) Ensure that the fabricator does the following:

- Submits a fabrication progress report on department form DT2334 electronically to the department's fabrication library. Update this form weekly for each component in fabrication.

506.3.2 Shop Drawings

(1) Ensure that shop drawings conform to the contract plans and provide additional details, dimensions, computations, and other information necessary for completely fabricating and erecting the work. Include project and structure numbers on each shop drawing sheet.

Revise 506.3.2(2) to clarify shop drawing submittal requirements for primary members and fabricated components.

(2) Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Also certify that shop drawings conform to quality control standards before fabrication by submitting department form DT2333 for primary members and department form DT2327 for fabricated bridge components with each set of shop drawings. Department review does not relieve the contractor from responsibility for errors or omissions on shop drawings.

(3) Shop drawings are part of the contract. The department must approve differences between shop drawings and contract plans. The contractor bears the costs of department-approved substitutions. Do not deviate from or revise drawings without notifying the department and resubmitting revised drawings and an updated department form DT2333.

(4) Ensure that the fabricator delivers 3 sets of shop drawings for railroad structures to the railroad company upon contract completion.

506.3.3 Structural Steel Identification

(1) In addition to ordinary mill identification, paint the appropriate color, according to ASTM A6, on all structural steel, except steel conforming to ASTM A709, grade 36 without toughness requirements, on each end of each piece before shipment from the mill. Before working any piece in the shop, move the identifying paint marks a sufficient distance away from the end to ensure the identity of the piece during fabrication. Mark angles on the inside of a leg. Mark beams and channels on the inside of a flange. Paint the ends of pieces if assembly will destroy or make identification by the above methods impossible. If the contractor fails to exercise the above precautions, the engineer will reject the piece.

506.3.4 Rolled Material

506.3.4.1 Straightening

(1) Ensure rolled material is straight before being laid off or worked. If straightening is necessary, perform it without injuring the metal. The engineer may reject material with sharp kinks and bends.

506.3.4.2 Camber

(1) If the plans show, camber rolled beams. The camber shall conform to a uniform, approximately circular curve for the entire length of the beam or between designated points. Ensure the designated camber is within the tolerance specified in the American Institute of Steel Construction Manual. The steel manufacturer may produce camber, or produce or correct it by local heating. If the plans show camber less than the minimum camber likely to remain permanent as tabulated in the Manual of Steel Construction of the American Institute of Steel Construction, produce the camber by applying heat.

(2) If cambering beams or correcting camber by local heating, take care not to overheat the metal. The contractor shall not heat the metal above 1200 F. Select the areas to heat so that no distortion other than the required camber occurs. Follow a procedure that prevents beam flange warpage.

(3) Support the beam near its ends facing the side made concave upward. Apply propane, natural gas, or other engineer-approved gas flame to areas selected so that no distortion other than the required

camber occurs. Apply heat by playing the flame over the section until the metal attains a maximum temperature of 1000 F to 1200 F. Monitor the temperature using temperature-indicating crayons, liquids, or bimetal thermometers. Notify the engineer before applying any heat.

(4) Heat the areas in generally wedge- or triangular-shaped areas with an included angle between 10 and 20 degrees. Locate the vertex of the angle on the web midway between flanges. Slowly play the flame over the area heated, commencing at the vertex of the angle and finishing at the widest part of the heated wedge, extending across the flange width. Manipulate the torch, or torches, to rapidly bring the total area heated to the proper temperature at the same time.

(5) Space the heated sections to produce uniform curvature. Heat no less than 3 sections, and it may require heating additional sections if the beam is unusually long or heavily cambered. Do not use water to cool the metal, or heat any area more than once. Air cool the heated metal slowly away from wind or drafts. The engineer may reject the beam if improper heating or cooling occurs that might affect the strength or ductility of the metal.

506.3.5 Bolt Holes

(1) Punch or drill holes for bolts. The contractor may punch bolt holes 1/16 inch larger than the nominal diameter of the bolts in material forming a member made of no more than 5 metal thicknesses and if the metal is not thicker than 3/4 inch for structural carbon steel, 5/8 inch for high-strength structural steel, or 1/2 inch for quenched and tempered alloy steel. For more than 5 thicknesses, or if the main material is thicker than 3/4 inch for structural carbon steel, 5/8 inch for high-strength structural steel, 1/2 inch for quenched and tempered alloy steel, or if required otherwise, subpunch, or subdrill holes 3/16 inch smaller. After assembling, ream them 1/16 inch larger or drill from the solid to 1/16 inch larger than the nominal diameter of the bolts. The contractor may use oversized holes in secondary members if the engineer allows.

(2) The die diameter shall not exceed the punch diameter by more than 1/16 inch. If enlarging holes to admit the bolts, then ream the holes. Ensure clean-cut holes without torn or ragged edges. The engineer may reject poorly matched holes.

(3) Make reamed or drilled holes cylindrical, perpendicular to the member and not more than 1/16 inch larger than the nominal diameter of the bolts. If possible, direct the reamers by mechanical means. Remove burrs on the outside surfaces. Poor matching of holes shall be cause for rejection. Perform reaming with tapered reamers. If removing burrs caused by drilling, take apart the assembled parts. For connecting parts that require reamed or drilled holes, assemble them first and then hold securely during reaming or drilling.

506.3.6 Accuracy of Holes

506.3.6.1 Punched and Drilled Holes

(1) Ensure that holes punched full size, subpunched, or subdrilled are so accurate that after assembling (before performing reaming) a cylindrical pin 1/8 inch smaller in diameter than that of the punched hole can enter it, without drifting, in at least 75 percent of the contiguous holes in the same plane. Failure to conform to this requirement will result in rejection of the badly punched pieces. In addition, the engineer will reject any hole that will not pass a pin 3/16 inch smaller in diameter than that of the punched hole.

506.3.6.2 Reamed and Drilled Holes

(1) If holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 inch between adjacent thicknesses of metal.

(2) Use steel templates that have hardened steel bushings in the holes, and are accurately dimensioned from the connection centerlines as inscribed on the template. Use the centerlines to accurately locate the template from the milled or scribed ends of the members.

506.3.7 Shop Assembly

506.3.7.1 General

(1) Unless specified otherwise, subpunch or subdrill, and ream while shop assembled bolt holes in connections and splices (shop and field) of main truss or arch members, continuous beams, floor beam connections to girder or truss, continuous plate girders, and rigid frames; or drill them full size from the solid while assembled at the shop. Subpunch or subdrill floor beam connections for plate girders and trusses and ream or drill full size from the solid in assembly. The contractor may use engineer-approved alternate procedures.

(2) Unless the engineer authorizes otherwise, assemble each individual truss, arch, continuous beam, or girder full length at the shop before reaming or drilling. Obtain approval of other than full-length assembly before submitting the shop drawings and show the engineer-approved alternate assembly

procedure shall on the shop drawings. During shop assembly, support members in a way that does not cause undesirable deflections. The inspector will approve assembly, including camber, alignment, accuracy of holes, and milled joints, before drilling or reaming.

(3) Conform to 506.3.27 for pickup points and girder handling equipment.

(4) Ensure that the component parts of a built-up member are straight and close fitting. Matchmark the members and parts of the built-up members before disassembling.

506.3.7.2 Fitting for Bolting

(1) Clean the metal surfaces in contact with other each other before assembling. Before drilling, reaming, or bolting, assemble the parts of a member, pin, and draw together. Take apart the assembled pieces in order to remove the burrs and shavings this operation produces. Ensure the member is free from twists, bends, and other deformation.

(2) During assembly tolerate only the drifting necessary to bring the parts into position and not sufficient to enlarge the holes or distort the metal.

506.3.8 Flame Cutting

(1) The contractor may flame cut structural steel, provided this process produces a smooth surface free from cracks and notches and a mechanical guide is used to produce an accurate profile. The engineer must approve hand cutting.

(2) Flame cut plates in a direction that allows the stress in the plate, when assembled, to be parallel to the direction the plate was rolled.

(3) Ensure that flame cutting is adjusted and manipulated to cut within the prescribed lines. Flame cut surfaces shall conform to the ANSI surface roughness value of 1000 for material up to 4 inches thick and 1600 for material 4 to 8 inches thick, except that the ends of members not subject to calculated stress at the ends shall have a surface roughness value of 2000. Round the corners of flame cut surfaces of members that carry calculated stress to approximately a 1/16-inch radius by grinding after flame cutting.

(4) Cut re-entrant cuts to a radius of not less than one inch.

(5) Remove surface roughness exceeding the above values and occasional gouges not more than 3/16 inch deep on otherwise satisfactory flame cut surfaces by machining or grinding. Correct defects by flairing into the cut surface on a slope of at least 1 to 10. Repair gouges of flame cut edges more than 3/16 inch deep but not more than 7/16 inch deep by welding, if the engineer approves, with low-hydrogen electrodes not exceeding 5/32 inch in diameter and with a preheat of 250 F. Grind the completed weld smooth and flush with the adjacent surface.

506.3.9 Edge Planing

(1) Plane the sheared edge of plates more than 5/8-inch thick and carrying calculated stress to a depth of 1/4 inch.

506.3.10 Connections

(1) Unless specified otherwise, make connections with 3/4-inch A325 high-strength bolts conforming to ASTM F3125.

506.3.11 (Vacant)

506.3.12 Bolts and Bolted Connections

506.3.12.1 General

(1) Furnish sufficient bolts of each type, size, and length required with an ample surplus to replace those lost or rejected.

(2) Perform shop assembly and matchmarking as specified in 506.3.7.

(3) If assembled, ensure joint surfaces, including those adjacent to washers, are free of scale, dirt, oil, burrs, pits, and other defects that prevent solid seating of the parts.

506.3.12.2 Unfinished Bolts

(1) If using unfinished bolts for temporary connections and other specifically allowed uses, use standard bolts with hexagon heads and nuts. Ensure the bolt hole diameters are 1/16 inch greater than that of the bolt.

(2) Thread bolts transmitting shear so that not more than one thread is within the grip of the metal. Use lock washers under the nuts for unfinished bolts used in permanent connections.

506.3.12.3 High-Strength Bolts

(1) Install bolts according to AASHTO LRFD Bridge Construction Specifications, Article 11.5.6.4, with the following exceptions:

1. If connections are assembled, install bolts with a hardened washer under the nut or bolt head, whichever is the element turned in tightening.
2. If using oversized holes, 2 hardened washers are required, one under the bolt head and one under the nut.
3. Bring the bolted parts into solid contact bearing before final tightening. Use not less than 25 percent of the total number of bolts in a joint to serve as fitting up bolts.
4. For steel diaphragms on prestressed concrete bridges do the following:
   - 4.1. For steel-to-steel connections within diaphragms:
     - No field rotational capacity testing is required. Provide a certified report of test or analysis from the bolt supplier. The department may require field testing to determine inspection torque.
     - Re-lubricate bolt threads with a wax-based lubricant.
     - Tension by the turn-of-nut method.
   - 4.2. For steel-to-concrete girder connections:
     - No testing is required.
     - Tighten as the plan details specify.

(2) The contractor may use a flat washer if the surface adjacent to and abutting 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. For slopes greater than 1:20, use smooth, beveled washers to produce parallelism.

(3) Tighten each fastener to provide, if all fasteners in the joint are tight, at least the minimum bolt tension as follows:

TABLE 506-1 BOLT TENSION

BOLT SIZE	REQUIRED MINIMUM BOLT TENSION[1]
1/2-inch	12,050 pounds
5/8-inch	19,200 pounds
3/4-inch	28,400 pounds
7/8-inch	39,250 pounds
1-inch	51,500 pounds
1 1/8-inch	56,450 pounds
1 1/4-inch	71,700 pounds
1 3/8-inch	84,450 pounds
1 1/2-inch	104,000 pounds

[1] Equal to the proof load by the length measurement method as specified in ASTM F3125.

(4) Tighten threaded bolts by the turn-of-nut method or by the direct tension indicating washer method. Tighten nuts while holding the bolt head. If clearance is an issue, the contractor may tighten the bolt head while holding the nut.

(5) The contractor may propose an alternate tightening method but the engineer must approve it before use.

(6) During installation, regardless of the tightening method used, exercise care to snug all bolts according to AASHTO LRFD Bridge Construction Specifications, Article 11.5.6.4.1.

(7) Do not reuse zinc coated A325 bolts. The contractor may reuse uncoated A325 bolts, if the engineer approves, but not more than once. The department will not consider re-tightening previously tightened bolts that become loosened by the tightening of adjacent bolts as reuse.

(8) Perform the rotational-capacity test on each rotational-capacity lot before beginning bolt installation. Hardened steel washers are required as part of the test although the actual installation procedures may not require them.

(9) Provide and use a Skidmore-Wilhelm Calibrator or an acceptable equivalent tension measuring device at each job site during erection. The contractor may test bolts too short for the Skidmore-Wilhelm Calibrator using direct tension indicators calibrated in the Skidmore-Wilhelm Calibrator using longer bolts. Perform pre-installation testing in the field conforming to the procedures enumerated in department form DT2114. Provide the engineer with the test results by submitting 2 copies of department form DT2114.

(10) Install bolt, nut, and washer combinations from the same rotational-capacity lot.

(11) Check zinc coated nuts to verify that a visible dyed lubricant is on the threads and at least one bolt face.

(12) Ensure that uncoated bolts are oily to the touch over their entire surface when delivered and installed.

(13) Clean and re-lubricate weathered or rusted bolts or nuts not conforming to the requirements above before installation. Retest all re-cleaned or re-lubricated bolt/nut/washer assemblies before installation.

506.3.12.3.1 Turn-of-Nut Method

(1) Snug bolts to ensure connection faying surfaces are in firm contact. Snug-tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a person using an ordinary spud wrench. Snug systematically from the most rigid part of the connection to free edges repeating until all bolts in the connection are snug-tight. Then tighten all bolts in the connection by the nut rotation specified in table 506-2. Ensure the part not turned by the wrench does not rotate.

TABLE 506-2 NUT ROTATION FROM SNUG-TIGHT CONDITION[1]

	DISPOSITION OF OUTER FACES OF BOLTED PARTS		
Bolt length measured from underside of head to extreme end of point	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20(bevel washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis(bevel washers not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters[2]	2/3 turn	5/6 turn	1 turn

[1] Nut rotation is relative to bolt regardless of the element, nut, or bolt, being turned. For bolts installed by 1/2 turn and less, the tolerance should be +/- 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be +/- 45 degrees.

[2] No research work has been performed by the Research Council on Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters, therefore, determine the required rotation by actual tests in a suitable tension device simulating the actual conditions.

506.3.12.3.2 Direct Tension Indicating Washer Method

(1) If using DTIs, install the DTI on the bolt with the protrusions facing away from the connected materials. Install bolt/nut/washer assemblies with DTIs in the same configuration used for pre-installation testing.

(2) Tighten conforming to department form DT2114 to provide the correct installation tension. During the operation, ensure no rotation of the part not turned by the wrench. Snug systematically from the most rigid part of the connection to the free edges. Repeat until the full connection is in a snug condition and the faying surfaces are in firm contact. Systematically tighten the connection required number of refusals is achieved. If the gaps on the DTI are completely closed, discontinue tightening.

506.3.12.3.3 Contractor QC Testing

506.3.12.3.3.1 General

(1) Notify the engineer before performing the required field rotational-capacity and pre-installation testing. Do not begin bolt installation without the engineer's approval. The engineer may verify bolt installation by periodically testing with a calibrated torque wrench for bolts tensioned by turn-of-the-nut or with a feeler gauge for bolts tensioned using DTIs.

506.3.12.3.3.2 Turn-of-Nut Method QC

(1) In the presence of the engineer, use a torque wrench to perform QC testing for each completed bolted connection.

(2) Calibrate the torque wrench using 3 bolt/nut/washer assemblies of the same rotational-capacity lot and condition as those undergoing QC testing. Place a washer under the part turned and tighten each bolt in a contractor-furnished bolt tension calibration device to the minimum inspection tension required on department form DT2114 using a torque wrench. Average the 3 tests to determine the inspection torque for that rotational-capacity lot.

(3) Perform QC testing on a minimum of 10 percent of the bolts, but not less than 2 bolts, selected randomly in each connection. Test bolts by applying the inspection torque determined in the pre-installation test in the tightening direction. If any nut or bolt turns, check all bolts in that connection, or

alternatively, the fabricator or erector may re-tighten all bolts in the connection and retest the retightened connection at the prescribed QC testing frequency.

506.3.12.3.3.3 Direct Tension Indicating Washer Method QC

(1) If using DTIs, use a 0.005-inch metal feeler gauge to perform QC testing for each completed bolted connection in the presence of the engineer. Test a minimum of 10 percent of the bolts, but not less than 2 bolts, selected randomly in each connection.

(2) If the number of refusals required is achieved, the engineer will accept the connection as properly tightened. If for any bolt the required number of refusals is not achieved, tighten all bolts in the connection.

506.3.13 Abutting Joints

(1) Mill or saw cut abutting joints in compression members of trusses and in columns to give a true and square cut.

(2) Openings at abutting joints in tension members in continuous I-beams and plate girders shall not exceed 3/8 inch.

506.3.14 Facing of Bearing Surfaces

(1) Make the top and bottom surfaces of steel slabs and the base plate and cap plates of columns and pedestals straight, smooth, and free from warp and must bear evenly throughout.

(2) If necessary, plane the bases of welded steel bearings after welding to secure an even bearing.

(3) Plane the bases of cast steel bearings after annealing to secure an even bearing.

(4) Ensure that the sole plates of beams and girders have full contact with the flanges, and that the bearing surface is smooth, true, and perpendicular to the web of the member. Ensure that curved sole plates make full line bearing with masonry or bearing plates, and that the line is at right angles to the axis of the member and perpendicular to the web of the member unless the plans show otherwise.

(5) If planing the curved surfaces of expansion bearings, operate the tool so that the cut is in the expansion direction. If the cut of the tool is at right angles, make the finished surface the true arc of a circle, smooth and free from ridges.

(6) Finish contact steel surfaces subject to sliding motion in the direction of motion as specified in ANSI No. 125.

(7) Machine finish surfaces that the plans show to receive a surface finish.

(8) Polish finish the surfaces of bronze bearing plates intended for sliding contact.

(9) If using lubricated bronze plates, cover the finished surface of the expansion plate assembly in contact with the lubricated bronze plate with a plastic or other engineer-approved coating after machining. Before erecting the girder, remove this coating and coat the surface with graphite.

506.3.15 Web and Flange Plates

(1) At bolted splices, the clearance between the ends of the web and flange plates shall not exceed 3/8 inch.

(2) If the plans show camber for welded girders, produce the camber by machine flame cutting the web plate. Cut cambers on a continuous smooth curve. If the engineer approves, correct moderate deviations from specified camber by a carefully supervised application of heat.

(3) For welded girders, if detailed to a horizontal curve greater than 3 degrees, cut the flange plates to a continuous smooth curve by machine flame cutting. If the curve is 3 degrees or less, curve the girder by either heat curving methods that the engineer approves, unless the plans specify otherwise. The contractor may curve the girder by machine flame cutting.

(4) Assemble the web and flange plates in the work so that the direction of stress in the plate, as assembled, is parallel with the direction that the plate was rolled.

506.3.16 Fit of Stiffeners

(1) Ensure that the end stiffeners of girders and stiffeners intended as supports for concentrated loads bear fully on the flanges that they transmit load to or from which they receive load. Obtain full bearing by milling, or grinding, or in the case of weldable steel in compression areas, by welding as the plans show or as specified.

(2) If the clearance between the end of the stiffener and the flange for stiffeners is not intended to support concentrated loads, then the gap shall not exceed 1/16 inch unless the plans show or the contract specifies otherwise.

506.3.17 Pin and Roller Details

506.3.17.1 Pins and Rollers

(1) Turn pins and rollers to the dimensions the plans show and make them straight, smooth, and free from flaws.

(2) Forge and anneal pins and rollers more than 9 inches in diameter. For pins and rollers 9 inches or less in diameter use either forged and annealed or cold-finished, carbon-steel shafting.

(3) In pins larger than 9 inches in diameter, bore a hole, not less than 2 inches in diameter and full length along the axis after the forging cools below the critical range under conditions suitable to prevent injury by too rapid cooling and before annealing.

(4) Use standard recessed pin nuts for nuts in connection with pins.

506.3.17.2 Pinholes

(1) Bore pinholes true to the specified diameter, smooth, straight, at right angles with the axis of the member, and parallel with each other unless required otherwise. Produce the final surface by using a finishing cut.

(2) The pinhole diameter for pins without bushings shall not exceed the pin diameter by more than 1/50 inch for pins 5 inches or less in diameter, or 1/32 inch for larger pins. For pins with bushings, follow the manufacturer's recommendations for tolerances of pins and bushings.

506.3.17.3 Threads for Bolts and Pins

(1) Threads for bolts and pins for structural steel construction shall conform to the Unified Standard Series UNC-ANSI B1.1, Class 2A for external threads and Class 2B for internal threads, except that pin ends with a diameter of 1 3/8 inch or more shall have 6 threads per one inch.

506.3.18 Finished Members

(1) Make finished members true to line and ensure they are free from twists, bends, and open joints.

506.3.19 Welding

506.3.19.1 General

(1) Weld steel structures as the plans show and conforming to the AWS D 1.5, Bridge Welding Code. Furnish welders or welding operators certified to the requirements of AWS D 1.5. If the engineer questions a welder or welding operator's ability, requalification tests are required under AWS D 1.5. A department-approved independent testing agency will perform requalification testing.

Revise 506.3.19.1 to require an inspector from the contractor's current field welding plan described in (DT2337).

(2) Visually inspect and certify the quality of field welds as follows:

1. Designate an inspector listed in the current contractor field welding plan described in department form DT2337.
2. Have the designated inspector complete department form DT2320 and submit to the engineer for inclusion in the permanent project record.

506.3.19.2 Procedures

(1) Submit welding procedures required under AWS D 1.5 to the engineer electronically for approval before fabricating the structural steel.

(2) Use automated submerged arc welding for primary shop welds in the flat position unless the engineer approves another welding process. Place joint designations indicating "automatic welding" by each primary weld on the shop drawings. Primary shop welds are defined as flange and butt welded splices in I-beams, box members, and plate girders; plate girder or box flange to web groove and fillet welds; and cover plate to flange fillet welds.

(3) Do not use electroslag or electrogas weld.

(4) Grind flange butt welds flush. Grind web butt welds to 1/6 of the web depth beginning at the point of maximum tension,1/6 of the web depth beginning at the point of maximum compression, and grind the entire outside surface of exterior girders. Ground surfaces that require grinding before performing radiographic or ultrasonic inspection. Grind plates with a surface or surfaces in the same plane flush. Grind plates with surfaces not in the same plane smooth.

(5) Ensure that weld metal for fillet and groove welds for exposed, bare, unpainted applications of ASTM A709 grade 50 steel possess similar atmospheric corrosion resistance and the same coloring characteristics as that of the base metal.

506.3.19.3 Procedure Qualifications

(1) Ensure that procedure qualifications conform to Section 5 of AWS D 1.5.

(2) Complete qualification tests of the welding procedures and obtain the engineer's acceptance of them before beginning steel fabrication or field welding. Submit revisions in the welding procedure specifications to the engineer for approval and qualify them in the presence of the department's inspector to qualify for acceptance.

(3) Before the starting qualifying welding procedures, the contractor and the department's inspector shall confer to ensure reaching an agreement regarding the procedure details, the welding sequence, the handling of materials to be inspected, the status of welders and welding inspectors qualifications, and the approval of electrodes, wire, flux, and other welding materials and equipment.

(4) Assign each welder or welding operator an identification mark for them to paint on the pieces welded. The welder or welding operator shall use these identification marks for the duration of the contract.

506.3.19.4 Shop Welding Inspection

(1) Inspect shop welding according to AWS D 1.5. Unless specified otherwise, test butt welds in main members by either the radiographic or the ultrasonic method.

(2) Test fillet welds and groove welds not covered otherwise in main members in a non-destructive manner by the magnetic particle method according to ASTM E709, utilizing the yoke method. This includes, but is not limited to, a minimum of 12 inches in every 10 feet or portion thereof of each weld connecting web to flange, bearing stiffener to web or flange, framing connection bar to web or flange, and longitudinal stiffener to web or vertical bar.

506.3.20 Stud Shear Connectors

(1) Use studs for shear connectors if the plans show. Weld conforming to chapter 7 of AWS D 1.5 except as follows:

1. Fillet welds varying in size from 3/16 to 5/16 inch are satisfactory provided the studs pass all other required tests. Make adequate provision in structural member fabrication to compensate for camber loss due to shear connector welding.
2. Ensure the studs are free from rust, scale, rust pits, and oil at the time of welding and immediately before placing the concrete.
3. Longitudinal and lateral spacing of studs with respect to each other and to edges of beam or girder flanges shall not vary more than 1/2 inch from the dimensions the plans show, except that the engineer will allow a variation of one inch if required to avoid obstruction of other attachments on the beam, or if welding a new stud to replace a defective one. Ensure a minimum distance from the edge of a stud shank to the edge of a beam or plate of one inch exists, but preferably 1 1/2 inch or more.
4. Notify the engineer promptly of any changes in the welding procedure at any time during construction.
5. If welding the studs reduces their height to less than normal, immediately stop welding and do not resume until correcting the cause.
6. After welding the studs to the beams, perform a visual inspection and give each stud a light blow with a hammer. Bend test studs without a complete 360-degree end weld, studs that do not ring when given a light blow with a hammer, studs repaired by welding, or studs reduced to less than normal in height due to welding. The bend test consists of bending the stud 15 degrees from its correct installation axis by striking with a hammer. In cases of a defective or a repaired weld, bend the stud in the direction that places the weld's defective portion in the greatest tension. Replace studs that crack either in the weld or in the shank.
7. The engineer may select additional studs to subject to the bend test specified in item 6 above.

506.3.21 Mill Inspection and Tests

(1) Unless directed otherwise, the fabricator of structural steel shall furnish the engineer with 2 copies of a certified report of test or analysis showing both physical and chemical tests of the material for each heat of material. Submit these inspection and test reports to the inspector for examination and before requesting the fabrication shop inspection or when requesting the material prepayment inspection. The engineer will not approve prepayment for material that mill test reports are not submitted.

506.3.22 Shop Inspection

(1) The engineer or an independent inspection agency under department contract may inspect all structural steel and miscellaneous metals furnished. The department will provide the contractor with monthly consultant inspection invoices and identify any quality deficiencies at the fabrication facility.

(2) Give the engineer ample notice of the beginning of the shop work.

(3) Before requesting an inspector, the fabricator shall submit a list of main stress-carrying members and the heat number of the material from which fabricating the member. Preserve the heat number, as marked by the rolling mill, for identification by the inspector. If fabrication hides, cuts off, or obliterates otherwise the original number or marking, the fabricator shall paint the number on the material at a conspicuous location.

(4) Furnish facilities in the shop for inspecting material and work quality and allow the inspectors necessary access to all parts of the work. The facilities shall include adequate office space at the fabricating plant for the inspector's use during fabrication, assembly, cleaning, and painting. At the plants of all major fabricators, as the engineer determines, ensure this office space has at least 100 square feet of floor space and is furnished with at least 2 desks, or a desk and table, a file case, and other necessary furniture. Provide adequate lighting, heating, and ventilation and ensure cleanliness. Provide office space that is a completely partitioned area separated from the fabricator's activities, has a separate door equipped with a suitable lock and key; or is part of a larger facility set aside for the exclusive use of outside inspection personnel. Make available telephone service and adequate sanitary facilities in the immediate area. The engineer may revise the foregoing requirements to accommodate the number of inspectors necessary to inspect the volume of work.

(5) The inspector may reject any material or work that does not conform to the specification requirements.

(6) The inspector’s acceptance of any material or finished members will not preclude their subsequent rejection if found defective.

(7) Inspection at the shop is intended as a means of facilitating the work and avoiding error. It shall not relieve the contractor of responsibility for imperfect material, or technique, or for replacing the same.

506.3.23 Marking and Shipping

(1) Paint or mark each member with an erection mark for identification and furnish an erection diagram showing the erection marks. Mark members weighing more than 3 tons with their weight. Load structural members on trucks or cars in a way that transports and unloads them at their destination without being excessively stressed, deformed, or damaged otherwise. Ship girders and rolled beams in a standing position, maintain this position in subsequent operations. The fabricator may ship haunched sections of built-up girders in an inverted position.

(2) Ship high-strength bolts, nuts, and washers (if 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 supplier may ship the nuts and washers. Pack separately non-high-strength bolts of one length and diameter, and the loose nuts and washers supplied for each size of bolt, except ship zinc coated bolts, nuts, and washers of the same size in the same containers. Ship bolts, nuts, washers, pins, and small parts in boxes, crates, kegs, or barrels, but the gross weight of any container shall not exceed 300 pounds. Clearly and permanently, mark a list on the outside of each shipping container that describes the contained material. Clearly and permanently, mark on the outside of each shipping container of bolts, nuts, and washers the rotational-capacity lot number, in addition to a list and description of the contained material.

506.3.24 Handling and Storing

(1) Place material to be stored on skids above the ground. Keep it clean and properly drained. Place girders and beams upright, shore, and tie or brace to preclude tipping or overturning if exposed to high winds. Support long members, such as columns and chords, on skids placed near enough together to prevent injury from deflection. Loss of any material, or any damage caused after receiving it is the contractor’s responsibility.

(2) Store bolts, nuts, and washers in closed containers in a protected shelter to protect them from dirt and moisture until used. Maintain fastener system components as nearly as possible in the as-manufactured condition until installed. Remove from storage only as needed and promptly return unused components to storage.

506.3.25 Field Inspection

(1) Erections are subject to inspection and the contractor shall furnish facilities for inspection of material and work quality. The inspector will inspect material and work quality not previously inspected after its delivery to the work site.

506.3.26 Falsework

(1) The contractor may furnish used materials for falsework. Ensure proper design, construction, and maintenance of falsework in order to handle the loads placed upon it. Falsework shall provide the required construction camber.

(2) Submit detailed plans for falsework to the engineer if requested. The engineer's approval of these plans, or acceptance in work constructed according to them shall not relieve the contractor of responsibility for successful erection or satisfactory results.

(3) If building falsework over a stream or lake subject to boating use, construct it to provide horizontal and vertical clearance adequate for passage of rowboats and small powerboats. If building falsework over

a highway or street used by traffic provide a minimum clearance, unless the plans or special provisions require otherwise, of 22 feet horizontal and 13 1/2 feet vertical.

(4) After completing the work, remove falsework piles down to at least 2 feet below streambed or finished ground line. Remove entirely any temporary bents, mudsills, and footings.

(5) Do not attach overhang bracket form supports to the girder web.

506.3.27 Erection

(1) Do not apply any part of the steel superstructure load to any concrete substructure unit until the concrete in that unit cures for at least 48 hours. Do not apply loads to beams of open-type structure units until the end of the required period for falsework support of these beams.

(2) Unless specified otherwise the minimum number of pickup points are as follows:

GIRDER LENGTH	MINIMUM NUMBER OF PICKUPS
0-50 feet	1
50 feet and over	2 or more

(3) Use an appropriate balance beam or spreader bar for 2 or more pickup points with a single crane. Locate pickup points to avoid damage to the girder and to balance the load at each point.

(4) The contractor shall not place any bent or twisted member until correcting its defects. The engineer will reject any members seriously damaged in handling or transporting.

506.3.28 Straightening Bent Material

(1) Notify the engineer before straightening structural steel plates, angles, or other shapes. Describe the process that will be used. Do not proceed with the repair unless the engineer allows that process.

(2) If heating, do not exceed 1200 F, a dull red condition, and monitor temperature using temperature-indicating crayons, liquids, or a bimetal thermometer. Ensure that parts to be heated are substantially free of stress and external forces, except for stresses resulting from mechanical means used in the application of heat. After heating, cool the metal as slowly as possible away from drafts. Do not use water for cooling.

(3) After straightening a bend or buckle, inspect the repair and notify the engineer if any evidence of fracture is identified.

506.3.29 Field Assembling and Bolting

(1) Conform to the foregoing requirements for shop assembling. Make field connections, unless specified otherwise, with high-strength bolts as specified in 506.3.12.

(2) Unless the engineer allows, do not use a burning torch to make adjustments or cuts as an aid to field assembling.

(3) Before beginning the field bolting on a continuous span, adjust the span and the immediately adjacent continuous spans to the correct grade, construction camber, and alignment.

(4) Complete field bolting, except for compression joints in trusses, connections for laterals and railings, and connections for those nominal members the plans or contract specifically designates, before releasing and swinging free any part of the span from its supporting falsework.

(5) Swing the span free from falsework before making connections for laterals.

(6) After placing and curing the concrete floor, and sidewalks if any, on all spans of the structure, make the connections for those nominal members as the plans show or the contract specifically designates. Erect, align, and fasten the railings in place.

(7) For splices and field connections using high-strength bolts, fill at least 25 percent of the holes with cylindrical erection pins before placing the permanent high-strength bolts. Fill at least 25 percent of the holes with erection bolts for temporary connections. Place all bolts before proceeding with final tightening as specified in 506.3.12.

(8) Ensure that erection bolts are the same nominal diameter as the high-strength bolts and that cylindrical erection pins are 1/32 inch larger.

(9) The contractor may assemble girders or portions of girders or other units on cribbing to the required blocking before erection or placement in the structure, if the engineer approves. Any necessary adjustments in the joints or splices of the assembled units after erection or placement are the contractor's responsibility.

506.3.30 Bearings and Anchorage

(1) Do not place masonry bearing plates on bridge seat bearing areas improperly finished, deformed, or irregular.

(2) Set the bearing plates level in exact position and have full and even bearing on the masonry. Unless required otherwise, place them on bearing pads conforming to 506.2.6.

(3) After properly aligning and finally connecting the steel in the superstructure, drill the holes in the concrete and set the anchor bolts except if the bolts are built into the masonry.

(4) Set anchor bolts in an engineer-approved, premixed, non-shrink commercial grout, except during freezing weather, or in an epoxy conforming to 416.2.3.2. Place the grout according to the manufacturer's instructions and fill the hole before ramming the bolt in place. Overfill the hole with just enough grout or epoxy to produce a watertight fit when the bearing plate is installed. Remove excess grout or epoxy from the bolt and bearing area.

506.3.31 Cleaning of Surfaces

506.3.31.1 General

(1) Blast clean the surfaces of structural steel to remove rust, mill scale, dirt, oil, or grease and other foreign substances until obtaining the specified finish.

(2) Blast clean all non-machined surfaces of a casting before machining the casting.

506.3.31.2 Coated Surfaces

(1) As specified in 506.3.32, blast clean structural steel and ferrous metal products to be coated as specified for blast cleaning in 517.3.1.3.3 to a near-white finish according to SSPC-SP 10. Blast clean steel that will be encased in concrete to SSPC-SP 6 standards or cleaner.

506.3.31.3 Unpainted Weathering Steel

(1) Blast clean all surfaces of weathering steel, unless designated for coating, until obtaining a finish as described for commercial blast cleaning in SSPC-SP 6. Perform blast cleaning with sand, grit, or steel shot as described for SSPC-SP 6.

(2) Keep or place the following markings on material shipped to the field:

- Weights of members weighing 3 tons or more.
- Piece marks.
- Matchmarks if required.

(3) Place weight markings on interior surfaces of exterior girders and on interior girders in locations inconspicuous after erection and their removal are not required except if the engineer directs.

(4) After erection, clean steel in the completed structure by hand, until free of oil, dirt, grease, mortar and other foreign substances.

506.3.32 Painting Metal

(1) Unless the contract provides otherwise, apply 3 coats of paint to structural steel and ferrous metal products. Furnish and apply paints according to the epoxy system or as specified in the special provisions. The requirements for this system are set forth in 517.

(2) For structural steel, including weathering steel, and miscellaneous metals that will be encased in concrete, paint as specified in 517.3.1.

(3) Use the 3-coat epoxy system to paint the end 6 feet of structural weathering steel at the abutments, the 6 feet on each side of piers, joints, downspouts, hinges, and zinc-coated bearings in contact with weathering steel. Use a coat of brown urethane matching Federal Standard 595 - FS 20059. Apply one coat of zinc-rich paint to surfaces of expansion joint assemblies and other surfaces not in contact with the weathering steel but inaccessible after assembly or erection.

(4) Do not paint structural steel to be welded before completing welding. If welding only in the fabricating shop and subsequently erecting by bolting, coat it after completing shop welding. Apply one coat of weldable primer or other engineer-approved protective coating to steel surfaces to be field welded after completing shop welding and shop fabrication. Protect machine-finished surfaces that do not receive a paint or zinc coating from contamination during the cleaning and painting process.

(5) Upon fabrication and acceptance, coat pins and pinholes with a plastic or other engineer-approved coating before removing from the shop.

(6) Mark members weighing 3 tons or more with their weights on areas that will be encased in concrete, or paint with a compatible paint on zinc-rich primer, or mark with soapstone on an epoxy-coated surface. Wait until material is dry, inspected, and approved for shipment before loading for shipment.

506.3.33 Name Plates

(1) Install nameplates conforming to 506.2.4 at the locations the plans show. Embed in concrete as specified in 502.3.11; do not bolt to steel components. Except for survey benchmarks, do not attach other permanent plates or markers to a structure.

506.3.34 Steel Diaphragms

(1) Install steel diaphragms as the plans show.

506.4 Measurement

(1) The department will measure Structural Steel Carbon, Structural Steel HS, the Castings bid items, Forgings Steel Carbon, Lubricated Plates Bronze, and the Sheet bid items by the pound acceptably completed based on plan quantities the department-approved bridge plans show.

(2) The department will use the following unit weights to compute the weight of metals:

MATERIAL	UNIT WEIGHT
Steel: structural carbon, high-strength structural, castings, or forgings	490 lb/ft^3
Bronze plate and castings	536 lb/ft^3
Sheet copper 0.02 inches thick	0.93 lb/ft^2
Sheet zinc No. 12 zinc gauge, 0.028-inch	1.05 lb/ft^2
Sheet zinc No. 18 zinc gauge, 0.055-inch	2.06 lb/ft^2
Sheet zinc No. 20 zinc gauge, 0.070-inch	2.62 lb/ft^2

(3) Compute the weights of rolled shapes based on their nominal weights and dimensions. Compute the weights of plates, including those of zinc and copper based on their nominal weights and dimensions and make full deduction for cuts except interior cuts, beveled cuts on edges for butt welding, and cuts made by machining to provide other than plane surfaces.

(4) The department will not include the weight of paint, zinc coating, or weld metal in the computed weight.

(5) The department will include the weight of heads, nuts, single washers, and threaded stick-through of high-strength bolts and heads, based on the following weights:

BOLT DIAMETER	WEIGHT PER 100 BOLTS
1/2-inch	19.7 pounds
5/8-inch	31.7 pounds
3/4-inch	52.4 pounds
7/8-inch	80.4 pounds
1-inch	116.7 pounds
1 1/8-inch	165.1 pounds
1 1/4-inch	212.0 pounds

(6) The department will not measure DTIs for payment.

(7) Compute the weight of castings from their dimensions and add 3 percent for fillets and overruns, however, if the scale weight of any casting is less than the computed weight, the department will pay for the weight of that casting at the scale weight. If the scale weight of any casting is less than 97 percent of the computed weight, the department may reject the casting.

(8) If the computed weights of metals, from engineer-approved shop drawings, varies more than one percent from those the engineer-approved bridge plans show for an individual structure, the department will base quantities for that structure on those computed from the engineer-approved shop drawings. The exception is if the contractor elects, with the engineer's permission, to use equivalent sections of greater weight than those the engineer-approved bridge plans show, then the contractor shall bear all additional costs.

(9) The department will measure Bearing Pads Elastomeric Non-laminated and Bearing Pads Elastomeric Laminated as each individual pad acceptably completed.

(10) The department will measure the Welded Stud Shear Connectors bid items as each individual stud acceptably completed. The department will measure the total number of studs incorporated in the work and accepted.

(11) The department will measure the Steel Diaphragms bid items as each individual diaphragm acceptably completed.

(12) The department will measure the Bearing Assemblies bid items as each individual bearing acceptably completed.

506.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT

506.0105	Structural Steel Carbon	LB
506.0605	Structural Steel HS	LB
506.1000 - 1099	Castings (type)	LB
506.1105	Forgings Steel Carbon	LB
506.1405	Lubricated Plates Bronze	LB
506.1500 - 1599	Sheet (type)	LB
506.2105	Bearing Pads	SF
506.2605	Bearing Pads Elastomeric Non-Laminated	EACH
506.2610	Bearing Pads Elastomeric Laminated	EACH
506.3000 - 3099	Welded Stud Shear Connectors (diameter x length)	EACH
506.4000	Steel Diaphragms (structure)	EACH
506.5000	Bearing Assemblies Fixed (structure)	EACH
506.6000	Bearing Assemblies Expansion (structure)	EACH

(2) Payment for Structural Steel Carbon, Structural Steel HS, the Castings bid items, Forgings Steel Carbon, Lubricated Plates Bronze, and the Sheet bid items is full compensation for providing, fabricating, casting, machining or otherwise preparing, transporting, and erecting materials; for providing name plates; and for furnishing radiographic films to the inspector.

(3) Payment for Bearing Pads Elastomeric Non-Laminated and Bearing Pads Elastomeric Laminated is full compensation for providing the pads, and for testing.

(4) Payment for the Welded Stud Shear Connectors bid items is full compensation for providing the shear connectors.

(5) Payment for the Bearing Assemblies bid items is full compensation for providing bearing assemblies, including the anchor bolts, and for fabricating and installing the assemblies.

(6) Payment for the Steel Diaphragms bid items is full compensation for providing, fabricating, zinc coating, transporting, and erecting.

(7) The contractor shall perform miscellaneous work that the plans show or is specified otherwise and included within the scope of this contract but not listed as bid items as a part of and included in the contract price for other bid items, except as follows:

- If the contract does not contain the Welded Stud Shear Connectors, Bearing Assemblies Fixed, or Bearing Assemblies Expansion bid item, and the contract requires this work, the department will pay for this work as Structural Steel Carbon.
- The department will pay for painting structural steel and miscellaneous metals as specified in 517.5.

(8) The department will limit costs for inspections conducted under 506.3.22 to $0.05 per pound of material and deduct costs in excess of that amount from payment due the contractor. The department will determine costs for in-house inspections based on hourly rates for department staff plus overhead and use invoiced costs for contracted-out inspections. The department will administer deductions for the contractor's share of the total inspection cost under the Excess Costs For Fabrication Shop Inspection administrative item.

Section 507 Timber Structures

507.1 Description

(1) This section describes furnishing, framing, treating, delivering, erecting, and painting if required, treated lumber and timber required for timber bridges and other timber structures, or lumber and timber parts of other bridges or structures.

507.2 Materials

507.2.1 General

(1) Furnish hardware required to erect the lumber and timber. Furnish materials conforming to the following:

Structural steel 506.2
Miscellaneous metals 506.2
Paint and painting 517

507.2.2 Lumber and Timber

507.2.2.1 General

(1) If ordering lumber and timber in multiple lengths, grade them after cutting to length.

(2) The engineer will only accept sound pieces free from decay. The engineer will reject pieces exceptionally light in weight.

(3) There is no heartwood requirement for lumber and timber treated with a preservative and no limit on the quantity of sapwood it can contain. Preservative treatment of lumber and timber shall conform to 507.2.2.6.

(4) Ensure that there are no unsound knots or knot holes. Also ensure that there are no tight knots of a diameter exceeding one-quarter of the greater dimension at the point where they occur. Measure a knot by taking its diameter at right angles to the length of the timber. Ensure that the sum of sizes of all knots in any one-foot length does not exceed 2 times the size of the largest allowed single knot. The engineer will treat cluster knots as if they were a single knot. A cluster knot is 2 or more knots grouped together, with the fibers of the wood deflected around the entire unit.

507.2.2.2 Wood Species

(1) Furnish one of the following species for treated structural lumber and timber:

- Douglas Fir-Coastal
- Southern Pine
- Hem-Fir

507.2.2.3 Manufacture

(1) Ensure structural lumber and timber are straight, sawed square at the ends, and have opposite surfaces parallel.

(2) Saw rough structural lumber and timber to the nominal dimensions specified in 507.2.2.3(4). Occasional slight variation is permissible, however, ensure that the specified minimum dressed dimensions are met everywhere along the length.

(3) The manufacturer may surface structural lumber and timber ordered rough, if thicker than specified, to a rough stock thickness.

(4) Manufacture lumber and timber according to the nominal and minimum dimensions in the following table:

AMERICAN STANDARD SIZES FOR STRESS-GRADED & NON-STRESS-GRADED CONSTRUCTION LUMBER[1]

ITEM	THICKNESS			FACE WIDTH		
	NOMINAL inches	MINIMUM DRESSED		NOMINAL inches	MINIMUM DRESSED	
		DRY inches	GREEN inches		DRY inches	GREEN inches
BOARDS	1	3/4	25/32	2	1 1/2	1 9/16
	1 1/4	1	1 1/32	3	2 1/2	2 9/16
	1 1/2	1 1/4	1 9/32	4	3 1/2	3 9/16
				5	4 1/2	4 5/8
				6	5 1/2	5 5/8
				7	6 1/2	6 5/8
				8	7 1/4	7 1/2
				9	8 1/4	8 1/2
				10	9 1/4	9 1/2
				11	10 1/4	10 1/2
				12	11 1/4	11 1/2
				14	13 1/4	13 1/2
				16	15 1/4	15 1/2
DIMENSION	2	1 1/2	1 9/16	2	1 1/2	1 9/16
	2 1/2	2	2 1/16	3	2 1/2	2 9/16
	3	2 1/2	2 9/16	4	3 1/2	3 9/16
	3 1/2	3	3 1/16	5	4 1/2	4 5/8
	4	3 1/2	3 9/16	6	5 1/2	5 5/8
	4 1/2	4	4 1/16	8	7 1/4	7 1/2
				10	9 1/4	9 1/2
				12	11 1/4	11 1/2
				14	13 1/4	13 1/2
				16	15 1/4	15 1/2
TIMBERS	5 and thicker	1/2 less than nominal	1/2 less than nominal	5 and wider	1/2 less than nominal	1/2 less than nominal

[1] This table uses nominal sizes for convenience. They do not represent actual sizes.

507.2.2.4 Stress Grading Requirements

(1) Furnish structural lumber and timber conforming to the stress grade the plans, specifications, or contract shows.

(2) Grade lumber and timber required to conform to a specific stress grade according to AASHTO M168.

(3) Ensure that lumber and timber required to conform to a specific stress grade shows a copyrighted stamp on each piece designating the inspecting agency, inspector, or mill and grade, or furnish a certificate of inspection to the engineer for untreated material, or to the department inspector at the treating plant for treated material. Include the kind and grade of material and the name of the grading agency.

507.2.2.5 Structural Purposes

(1) If the plan or contract does not designate a required stress grade, conform to the minimum stress grade, and associated allowable unit stress, for lumber and timber used for various structural components as follows:

STRESS RATING AT 19 PERCENT MAXIMUM MOISTURE

USE 1750 psi f_b STRUCTURAL JOIST AND PLANK GRADE FOR:

Joists; 4 inches or less.	Floor planks, wearing.
Sidewalk railing posts.	Rails.
Bulkhead planks.	Laminated or strip flooring.

USE 1750 psi f_b STRUCTURAL BEAM AND STRINGER GRADE FOR:

Stringers; 5 inches or more.	Sills.
Roadway railing posts.	Caps.

USE 1200 psi f_b STRUCTURAL JOIST AND PLANK GRADE FOR:

Nailing strips; 4 inches or less.	Subfloor planks.
Bracing; sway and longitudinal.	Subfloor sheathing.
Cross bridging.	Retaining pieces.
Cleats.	Scupper blocks.
Fire stops.	Sidewalks.

USE 1200 psi f_b STRUCTURAL BEAM AND STRINGER GRADE FOR:

Nailing strips; 5 inches or more.	Grillage.
Mud Sills.	

USE 1200 psi f_c STRUCTURAL POST AND TIMBER GRADE FOR:

Posts with longitudinal load.	Wheel guards.

USE THE ENGINEER-DESIGNATED STRESS GRADE FOR ALL OTHER LUMBER AND TIMBER.

507.2.2.6 Preservative Treatments

507.2.2.6.1 General

(1) Use the pressure process to apply preservative treatment to structural lumber and timber, unless specified otherwise in the contract or special provisions, according to AASHTO M133.

(2) Unless the contract specifies otherwise, furnish structural lumber and timber treated with one of the preservatives specified in 507.2.3, except as follows:

- Do not treat coastal Douglas fir with chromated copper arsenate.
- If using pentachlorophenol, use a solution with 5 percent pure pentachlorophenol, by weight, of the total solution. Use the heavy petroleum solvent, except if painting the treated surface then use the light petroleum solvent.

507.2.2.6.2 Treatment Preparation

(1) If possible, sort the material into one kind, or designated group of kinds of wood, and into pieces approximately equal in size, moisture, and sapwood content; and separate to ensure the treating medium contacts all surfaces.

(2) If possible, perform adzing, boring, chamfering, framing, gaining, mortising, surfacing, etc., before treatment.

507.2.2.6.3 Preservative Quantity

(1) Unless the proposal or the plans specify otherwise, use at least the minimum quantity of preservative material retained, and at least the minimum penetration specified in AWPA Standards U1 and T1 for use category UC4A for the species furnished.

(2) Determine the minimum net retention according to AWPA Standard M2.

507.2.3 Wood Preservatives

(1) Use oil-soluble wood preservatives conforming to the following standards:

Creosote-coal tar solution	AWPA P2
Pentachlorophenol	AWPA P35
Petroleum solvents used in pentachlorophenol solutions	AWPA P9
Petroleum solvents used in copper naphthenate solutions	AWPA P9
Copper naphthenate solution	AWPA P36

(2) Use waterborne wood preservatives conforming to the following standards:

Chromated copper arsenate solution type C	AWPA P23
Ammoniacal copper zinc arsenate solution	AWPA P22
Alkaline copper quat solution type D	AWPA P29

Copper azole type C ..... AWPA P48
Copper naphthenate solution ..... AWPA P34

507.2.4 (Vacant)

507.2.5 Timber Connectors

(1) Zinc coat connectors for timber structures, except malleable iron connectors, by hot-dipping according to ASTM A653.

507.2.5.1 Split Ring Connectors

(1) Manufacture split rings of 2 1/2 inch and 4 inch inside diameter from hot-rolled low carbon steel conforming to AASHTO M169 grade 1010. Each ring shall form a closed, true circle with the principal axis of the cross-section of the ring metal parallel to the geometric axis of the ring. Bevel the metal section from the central portion toward the edges to a thickness less than midsection. Provide one tongue and slot cut in the perimeter.

507.2.5.2 Shear Plates

(1) Use hot-rolled low carbon steel conforming to AASHTO M169 Grade 1010 for pressed-steel shear plates.

(2) Cast malleable-iron shear plates from malleable iron conforming to ASTM A47.

507.2.6 Hardware

(1) For machine bolts, timber bolts, drift bolts, lag screws, dowels, rods, and spikes longer than 6 inches left in the finished work, conform to the material specifications for structural steel or miscellaneous metals specified in 507.2.1.

(2) Provide square heads and nuts for machine bolts unless specified otherwise. Ensure the threads on bolts are U.S. Standard and not less than 2 1/2 times the diameter of the bolt in length.

(3) Provide gray or malleable iron casting washers, or cut them from steel plates. Use washers with holes not more than 1/8 inch larger than the bolt diameter. Use ogee type gray iron washers with a diameter at least 3 1/2 times the bolt diameter, and a thickness equal to the bolt diameter. Use malleable iron washers with properly proportioned ribs to develop the bolt's full strength. The malleable iron washer diameter shall at least equal 3 1/2 times the bolt diameter, and have a thickness equal to 1/2 the bolt diameter. Use plate washers with a diameter at least 3 1/2 times the bolt diameter and, unless specified otherwise, a thickness of at least 1/4 inch.

(4) Provide gray or malleable iron casting packing spools or separators, or cut them from steel plates. Ensure the hole diameter is not more than 1/8 inch larger than the packing bolt diameter.

(5) Use oval-headed barbed car nails or ring shank nails for nails and spikes up to and including 60d. For spikes over 60d, use the type and size specified. Unless specified otherwise, use nails no shorter than 2 1/2 times the thickness of the material being driven through. If clinching nails, ensure they project at least one inch before clinching.

(6) Zinc coat hardware unless specified otherwise. The zinc coating shall conform to the quality and weight in ASTM A153.

507.3 Construction

507.3.1 Quality

(1) Ensure first class product quality throughout. Drive nails and spikes with just sufficient force to set the heads flush with the wood surface. Ensure that wood surfaces are free from deep or frequent hammer marks.

(2) The product quality on metal parts shall conform to the requirements specified in 506 for steel bridges.

507.3.2 Storage

(1) Store lumber and timber in neat piles, on suitable blocking or supports, and above the ground. Clear the ground underneath and near piles of weeds and rubbish.

(2) Close-stack treated material to prevent long timbers, or those of small cross-section, from sagging or becoming crooked. If anticipating an extended storage period and the material merits protection from the direct sunlight or possible fire hazard, cover the top of the pile with a layer of tar paper, or equal, and spread not less than one inch of sand or earth over the cover.

507.3.3 Handling

(1) Handle treated lumber and timber carefully to avoid breaking through the treated portions and exposing untreated wood. Do not use chains, peaveys, cant hooks, pickaroons, timber dogs, pike poles, or other pointed tools on treated lumber and timber, use padded or non-metallic slings instead.

507.3.4 Framing and Boring

507.3.4.1 General

(1) Cut and frame lumber and timber to a close fit. If possible, cut, frame, and bore treated timbers before treatment.

507.3.4.2 Holes for Bolts, Dowels, Rods, and Lag Screws

(1) Bore the holes for round drift bolts and dowels with a bit 1/16 inch less in diameter than the bolt or dowel used. Ensure that the diameter of holes for square drift bolts or dowels equals the bolt or dowels least dimension.

(2) Bore the holes for machine bolts with a bit the same diameter as the bolt.

(3) Bore the holes for rods with a bit 1/16 inch greater in diameter than the rod.

(4) Bore the holes for lag screws with a bit not larger than the body of the screw at the thread base.

507.3.4.3 Countersinking

(1) Perform countersinking if smooth faces are required.

507.3.4.4 Connectors

(1) If using timber connectors, use the type and size the plans show. Install split ring connectors in precut grooves to form a snug fit, or as the manufacturer recommends.

507.3.5 Temporary Attachment

(1) If attaching forms or temporary braces to treated timber with nails or spikes, with the engineer's approval, fill the holes by driving zinc coated nails or spikes flush with the surface, or by plugging as required for bolt holes.

507.3.6 Bolts and Washers

(1) Use a washer the size and type specified under all bolt heads, except timber bolts or bolts with button-type heads, and also under lag screws and nuts that would otherwise come in contact with wood.

507.3.7 Treating Cuts, Abrasions, and Holes in Treated Lumber and Timber

(1) Carefully trim and cover abrasions, holes, and cuts made in treated lumber and timber with a compatible preservative material. Use preservatives and application methods specified in AWPA Standard M4. Apply the preservative in 3 applications; wait at least 2 hours between applications.

(2) Carefully trim and then fill holes made in treated material with preservative so that the solution saturates the entire area surrounding the hole. Use copper naphthenate solution containing 2 percent or more copper metal and conforming to 507.2.3 or with another preservative allowed for field applications under AWPA M4.

(3) Treat unfilled holes in treated lumber and timber, except for countersinking recesses, as specified above and then plug with treated plugs.

(4) Fill countersinking recesses that form pockets that might retain water with a copper naphthenate solution containing 2 percent or more copper metal after placing the bolt or screw.

507.3.8 Framed Bents

507.3.8.1 Mudsills

(1) Firmly, and evenly bed mudsills to solid bearing and tamp in place.

507.3.8.2 Concrete Pedestals

(1) Finish the concrete pedestals for supporting framed bents so the sills or posts bear evenly on them. If casting them, set dowels in them of not less than 3/4 inch diameter and projecting at least 6 inches above the tops of the pedestals, for anchoring the sills or posts.

507.3.8.3 Sills

(1) Ensure that sills bear true and even on mudsills, piles, or pedestals. Drift bolt the sills to mudsills or piles with bolts at least 3/4 inch in diameter and extending into the mudsills or piles at least 6 inches. If possible, remove earth from contact with sills so air circulates freely around them.

507.3.8.4 Posts

(1) Ensure that posts bear evenly on cap and sill. Fasten posts to pedestals with dowels at least 3/4 inch in diameter and extending at least 6 inches into the posts.

(2) Fasten posts to sills by one of the following methods, as the plans show:

- With dowels not less than 3/4 inch diameter extending at least 6 inches into posts and sills.
- With drift bolts not less than 3/4 inch diameter driven diagonally through the base of the post and extending at least 9 inches into the sill.

507.3.9 Caps

(1) Place the timber caps so the ends align, to secure an even and uniform bearing over the tops of the supporting posts or piles. Secure caps with drift bolts at least 3/4 inch in diameter and extending at least 9 inches into the posts or piles. Place the drift bolts approximately in the center of the post or pile.

507.3.10 Bracing

(1) Ensure that bracing bears firmly against the pile or cap that it is bolted. Provide and place shims as necessary to avoid bending the bracing more than one inch out of line after drawing the bracing bolts tight. Furnishing and placing shims are incidental to this work. If the opening between the bracing and the cap or pile is less than one inch, there is no need for shims. If the opening between the bracing and the cap or pile is from one to 2 inches, place 2 ogee washers with their narrow faces together on each bolt that passes through the opening. If the opening between the bracing and the cap or pile is over 2 inches, use wooden shims of the proper thickness. Use wooden shims made of untreated white oak, or the treated material used in the structure. Do not use built-up wooden shims. Ensure each wooden shim is a single piece of lumber at least 4 inches wide and at least as long as the bracing is wide, measured along the cap or pile.

(2) The contractor shall not adze, trim, or cut otherwise any treated member to avoid using the above-described shims.

507.3.11 Stringers

(1) Size the stringers at bearings and position so that knots near edges are in the top of the stringers.

(2) Outside stringers may have butt joints but, lap interior stringers to take bearing over the full width of the floor beam or cap at each end. Separate the lapped ends of stringers by at least 1/2 inch for air circulation and securely fasten by drift bolting if specified. If stringers are 2 panels in length, stagger the joints.

(3) Neatly and accurately frame cross bridging between stringers, and securely toe nail with at least 2 nails in each end. Ensure cross bridging members bear at each end against the sides of stringers. Unless specified otherwise in the contract, place cross bridging at the center of each span.

507.3.12 Plank Floors

(1) Use treated lumber and timber in plank floors.

(2) Single plank floors consist of a single thickness of plank supported by stringers or joists. Use planks surfaced on one side and one edge (S1S1E). Lay the planks with the surfaced side down and with close joints. Spike each plank securely to each joist. Lay planks at right angles to the centerline of roadway. Grade the thickness of the planks carefully and lay them so that no 2 adjacent planks vary by more than 1/16 inch.

(3) Two-ply plank floors consist of 2 layers of flooring supported by stringers or joists. Use planks surfaced on one side and on one edge (S1S1E). Lay the planks with the surfaced side down and with close joints. Lay the top course diagonally or parallel to the centerline of roadway, as specified, and fasten each floor plank securely to the lower course or to the joist. Grade the thickness of the planks carefully and lay them so that no 2 adjacent planks vary by more than 1/16 inch. Stagger joints by at least 3 feet. If placing the top flooring parallel to the centerline of the roadway, take care to securely fasten the end of the flooring. At each end of the bridge, bevel the upper course of planks.

(4) Spike side and retaining pieces at one-foot intervals and bolt at 3-foot intervals unless the plans show otherwise. Fasten scupper blocks to the retaining pieces by spikes and bolts through the wheel guards. Bolt the wheel guards in place as the plans show. Lay side retaining pieces and wheel guards true to line, parallel to the centerline of roadway, and flush with the edge of the subflooring.

507.3.13 Laminated or Strip Floors

(1) Use 3-inch or thinner strips, surfaced to a uniform thickness (S1S) and, if specified, to a uniform width (S1S1E).

(2) Place the strips of lumber on edge and at right angles to the centerline of roadway. Spike each strip to the adjacent strip at 2-foot intervals with spikes that stagger 8 inches with those in adjacent strips. Use spikes of sufficient length to pass through 2 strips and at least halfway through the third. Additionally, toe nail the strips to the stringers or nailing strips with 20d spikes, and stagger the nailing of successive strips to space spikes at least 6 inches along each stringer or nailing strip. Keep each strip vertical and tight against the preceding one with even bearing on all the supports. If the plans show, attach the strips securely to steel supports by department-approved zinc coated metal clips.

507.3.14 Wheel Guards and Railings

(1) Unless specified otherwise, furnish wheel guards surfaced on one side and one edge (S1S1E) and rails and rail posts surfaced on 4 sides (S4S).

(2) Lay the wheel guards in sections not less than 12 feet long.

507.3.15 Fire Stops

(1) Provide fire stops in the intervals as the plans show. They consist of wood diaphragms at least as thick as the flooring or sidewalk, are located over caps, and fill the openings between the joists completely.

507.3.16 Painting Lumber and Timber

(1) Paint lumber and timber as specified under 517.3.2 unless the contract provides otherwise.

(2) Painting lumber and timber is incidental to furnishing and erecting the lumber and timber.

507.4 Measurement

(1) The department will measure Treated Lumber and Timber by the thousand feet board measure (MBM) acceptably completed. The department will compute quantities from the nominal sizes and from the lengths as framed and erected. The department will not make any allowance for waste.

(2) The department will only measure lumber and timber that is a part of the completed work. The department will not measure falsework, forms, bracing, sheeting, or other lumber and timber used for erection purposes.

507.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
507.0200	Treated Lumber and Timber	MBM

(2) Payment for Treated Lumber and Timber is full compensation for providing, framing, treating, placing, and painting; and for materials and hardware required for erecting the lumber and timber.

Section 509 Concrete Overlay and Structure Repair

509.1 Description

(1) This section describes cleaning or scarifying areas of decks and approach pavements to be overlaid; removing and disposing any remaining asphaltic patches or unsound concrete from those areas; the furnishing, placing and curing concrete overlays; and full depth deck, surface, curb and joint repairs, as required.

509.2 Materials

(1) Furnish a neat cement bonding grout. Mix the neat cement in a water-cement ratio approximately equal to 5 gallons of water per 94 pounds of cement.

(2) Furnish grade E conforming to 501 for overlays.

(3) Furnish grade C, C-FA, C-S, C-IS, C-IP, C-IT, or E concrete concrete conforming to 501 for surface repairs. The contractor may increase the slump for grade E concrete to a maximum of 4 inches. The contractor may apply an engineer-approved commercial grout or surface coating to surfaces being repaired instead of the grades of concrete designated above if it is impracticable to apply that masonry, if the engineer specifically approves in writing.

(4) Furnish grade C, C-FA, C-S, C-IS, C-IP, C-IT, or E concrete conforming to 501 for joint repairs, curb repairs, and full-depth deck repairs; except as follows:

1. The contractor may increase slump of grade E concrete to 3 inches.
2. The contractor may use ready-mixed concrete.

(5) Provide QMP for class II ancillary concrete as specified in 716.

509.3 Construction

509.3.1 General

(1) Repair damage to existing epoxy-coated reinforcement remaining in place that is either uncovered by or damaged by the contractor's operations. Use engineer-approved patching or repair material compatible with the existing coating and inert in concrete.

509.3.2 Equipment

(1) Use a finishing machine to finish concrete overlays conforming to 502.3.7.8 and the following:

1. The machine shall have 2 linearly oscillating transverse screeds. For the front screed use, a synchronous vibratory screed with a variable frequency the operator can adjust. Provide enough identical vibrators to provide at least 2 vibrators for each 5 feet of screed length. Ensure that the bottom face of each screed is at least 7 inches wide with a rounded leading edge. Each screed shall have an effective weight of at least 75 pounds per square foot of bottom face area. Provide each screed with the capability to positively control of the vertical position, the angle of tilt and the shape of the crown.
2. The machine shall have an adjustable metering device ahead of the leading screed that traverses the width of the machine.
3. The machine shall have capability of forward and reverse motion under positive control. Make provisions for raising the screeds to clear the screeded surface for traveling in reverse.

(2) If placing concrete in a line next to a previously completed lane, equip the side of the finishing machine next to the completed lane, to travel on the lane.

509.3.3 Cleaning

(1) Under the Cleaning Decks and Cleaning Approaches bid items, clean the decks and approach pavements before placing the concrete overlay.

(2) Use construction methods conforming to 502 and the following:

1. Clean the entire surface of the bridge deck or approach pavement receiving the new concrete by using a suitable mechanical scarifyer. Accomplish this in a way that prevents hooking or tearing the reinforcing steel and that removes at least one inch of concrete from the deck or pavement surface but not more than the maximum depth the plans show.
2. If scarification is impracticable, as along curb faces or at expansion joints, remove deteriorated concrete to sound material by using chippers conforming to 509.3.4 for chippers.
3. Perform scarification before preparation. After completing scarification, remove the remaining asphaltic patches and unsound concrete as specified for preparation in 509.3.4.
4. Blast clean the entire surface of the deck and approach pavements being overlaid, all exposed reinforcing steel, the vertical faces of curbs, sidewalks and parapets to the depth of the adjoining concrete overlay after completing preparation.

5. Clean the surface receiving the new concrete by mechanically dislodging contamination or debris and removing loose particles and dust with high-pressure water or air. Ensure that no free-standing water remains before placing grout and that cleaning water conforms to 501.2.4.

509.3.4 Preparation

(1) Under the Preparation Decks and Preparation Approaches bid items, remove all asphaltic patches and unsound or disintegrated areas of concrete decks and approach pavements as the plans show, or as the engineer directs.

(2) Use construction methods conforming to 203 and the following:

1. Under the Preparation Decks Type 1 bid item, remove existing asphaltic patching and unsound bridge deck concrete only to a depth that exposes 1/2 of the peripheral area of the top or bottom bar steel in the top mat of reinforcement.
2. Under the Preparation Decks Type 2 bid item, remove existing unsound bridge deck concrete below the limit of the type 1 removal described above. One inch below the bottom of the top or bottom bar steel in the top mat of reinforcement is the minimum depth of type 2 removal. The engineer will direct any further removal.
3. Remove the existing asphaltic patching and unsound concrete using equipment that causes no damage to the bridge floor. If chipping exposes the existing bar steel reinforcement for more than 1/2 of its peripheral area, and where bond between existing concrete and reinforcing bar has been destroyed, remove the adjacent concrete to provide a minimum one-inch clearance around the bar.
4. For chipping off the old concrete surface, use air chippers or breakers that weigh no more than 35 pounds and are equipped with flat, chisel-type points with a cutting edge not less than 3/4 inch or greater than 3 inches wide.
5. After reaching the top of the reinforcing steel, do not use hammers heavier than 15 pounds within one inch of the steel.
6. Dispose of old concrete and asphaltic patching removed away from the bridge site. Implement necessary procedures to minimize debris dropping into the stream, streambed, roadway, or right-of-way below.

509.3.5 Joint Repair

(1) Under the Joint Repair bid item, remove and dispose of deteriorated concrete at existing joints over piers, abutments and deck ends and other locations, and form new joints as the plans show, and the engineer directs.

(2) Use construction methods conforming to 203, 502, and the following:

1. Remove the concrete at an existing joint to be replaced to the limits the plans show, or as the engineer directs. Place a 1/2 inch deep saw cut at the line of removal on the bottom edge of the deck to control concrete breakout or cover the line of removal with a 1 1/2 inch thick layer of concrete to cover all reinforcing steel exposed during joint repair. Use removal equipment that causes no damage to the portion of the concrete floor, curbs, and reinforcing steel remaining in place. Do not use tractor-mounted rams for removal operations within 9 inches of the edge, or within the depth of the slab from the edge, whichever is less.
2. The contractor shall preserve and utilize the required existing reinforcing steel, and blast clean, realign, and retie, as the engineer considers necessary. If additional reinforcement is required, use grade 60 steel conforming to AASHTO M31, and to 505.2.
3. Dispose of removed material as specified in 509.3.4.
4. Clean the surface receiving the new concrete by brooming and water pressure using a high-pressure nozzle to remove loose particles and dust.
5. Immediately before placing concrete, coat the surfaces of the old concrete receiving new concrete with neat cement as specified for concrete overlays in 509.3.9.2.
6. Restore painted surfaces damaged by any construction operation to the satisfaction of the engineer.
7. Place concrete as specified for joint repair in 509.3.9.1.

509.3.6 Curb Repair

(1) Under the Curb Repair bid item, remove and dispose of portions of deteriorated concrete on the concrete curbs and form new curb faces, top or back as the plans show.

(2) Use construction methods conforming to 203, 502, and the following:

1. Take the precautions necessary while removing deteriorated concrete to preserve existing reinforcing steel. Clean, realign, and retie existing reinforcing steel, as the engineer considers necessary.
2. Remove concrete to sound concrete or at least one inch behind existing reinforcing steel as the plans show and the engineer directs.
3. Make a 1/2-inch deep saw cut at the limits of curb repair before removing the deteriorated concrete.
4. Dispose of removed material as specified in 509.3.4.

5. Clean the surface against which placing the new concrete to remove loose particles and dust, and keep continuously wet for 2 hours before placing new concrete. Immediately before placing concrete, coat the surfaces of old concrete with neat cement as specified in 509.3.9.2.
6. Place concrete as specified in 509.3.9.1.

509.3.7 Concrete Surface Repair

(1) Under the Concrete Surface Repair bid item, remove those portions of abutments, piers, girders, and other elements that the plans show, and the engineer directs, and replace those portions with concrete.

(2) Use construction methods conforming to 203, 502, and the following:

1. Take necessary precautions while removing deteriorated concrete to preserve existing reinforcing steel. Clean, realign, and retie existing reinforcing steel, as the engineer considers necessary.
2. Remove concrete to sound concrete or to one inch behind the existing reinforcing steel, whichever depth is greater, at locations the plans show or as the engineer directs.
3. Make a 1/2-inch deep saw cut at the limits of the concrete surface repair before removal of the deteriorated concrete.
4. Dispose of removed material as specified in 509.3.4.
5. Clean the surfaces against which placing the new concrete to remove loose particles and dust, and keep continuously wet for a period of 2 hours before placing new concrete.

509.3.8 Full Depth Deck Repair

(1) Under the Full-Depth Deck Repair bid item, perform full-depth removal of unsound concrete at locations on the deck as the engineer directs, and then prepare and form these areas.

(2) Use construction methods conforming to 203, 502, and the following:

1. Completely remove the existing concrete deck areas being repaired using equipment that causes no significant damage to that portion of the structure remaining in place. The contractor shall preserve and utilize the required existing reinforcing steel.
2. If damage occurs to anything designated for re-use in the new work repair, or replace it at no expense to the department.
3. Dispose of removed material as specified in 509.3.4.
4. Blast clean, realign, and retie the existing reinforcing steel to be re-used, as the engineer considers necessary.
5. Clean the vertical surface receiving the new concrete by brooming and water pressure to remove loose particles and dust, and keep continuously wet for 2 hours before placing concrete. Immediately before placing concrete in the full depth deck replacement, coat the entire surface receiving the new concrete with neat cement as specified in 509.3.9.2.
6. Place the concrete for the repair as specified in 509.3.9.1.

509.3.9 Concrete

509.3.9.1 General

(1) Under the Concrete Masonry Overlay Decks and Concrete Masonry Overlay Approaches bid items, construct a concrete overlay course on concrete deck and approach pavement to the lines, grades, thickness, and cross-section the plans show, or the engineer directs.

(2) Use construction methods conforming to 502 and the following:

1. For joint repair, place the concrete and consolidate by vibrating in the prepared joints before placing the overlay.
2. For curb repair, place the concrete, consolidate, and strike off to the required alignment for curb faces, tops, and backs.
3. For full depth deck repair, place the concrete; consolidate by internal vibration, and strike off to the existing deck elevation before placing the overlay.

509.3.9.2 Placing Concrete Overlays

(1) Do not place the concrete overlay less than 24 hours after placing concrete in the joint repair and full-depth deck repair areas.

(2) Immediately before placing the concrete overlay, coat the surface of the bridge decks or approach pavement being overlaid, and all vertical joints with a neat cement mixture. Ensure the surface of the existing deck is moist without any standing water before coating with the neat cement mixture. Brush the neat cement over the prepared concrete surface to ensure all parts receive an even coating and do not allow excess neat cement to collect in pockets. Apply the neat cement at a rate that ensures the cement does not dry out before covering with the new concrete.

(3) Place concrete for deck preparation immediately in front of the overlay course and vibrate internally in addition to surface screed vibration. Place concrete in a single operation, with no construction joints in the overlay section except as the plan show or the engineer directs. Do not place concrete if the ambient air temperature is above 88 F.

(4) The contractor may operate the finishing machine with the transverse screeds normal to the centerline of the structure. Conduct bridge deck finishing operations so that the elapsed time between depositing the concrete on the deck and final screeding does not exceed 10 minutes.

(5) If the plan requires construction joints, make them sharp-edged, perpendicular to the overlay surface, at the locations the plan show, and true to the alignments the plan show.

(6) Provide the final surface finish specified in 502.3.7.8 for floors of structures having approach pavements with design speeds of 40 mph or greater, except there is no requirement for the turf drag or broom finish.

(7) Form or saw contraction joints to the width, depth, and at locations the plans show and seal as the plans show. Begin sawing joints within 6 hours after placing the concrete, unless the engineer directs otherwise, and complete within 12 hours.

509.3.9.3 Curing Concrete Overlays

(1) Cure concrete overlays as specified for curing concrete in floors, wearing surfaces, and sidewalks in 502.3.8, including fogging, and allow to cure for 3 days.

509.3.9.4 Opening to Traffic

(1) Do not allow traffic on the completed overlay for a minimum of 3 days after placement. The engineer may extend this time if conditions warrant.

509.4 Measurement

(1) The department will measure Preparation Approaches and the Preparation Decks bid items by the square yard acceptably completed. The department will not subtract areas of type 2 removal from areas of type 1 removal. The department will subtract areas of full-depth deck repair, the engineer directs before beginning the type 1 or type 2 deck removals, from the areas of the type 1 or type 2 removals. The department will not subtract areas of full-depth deck repair, the engineer directs after type 1 or type 2 deck removals are underway, from the areas of the type 1 or type 2 removals. The department will not measure areas of joint repair under these bid items.

(2) The department will measure Cleaning Decks, Cleaning Approaches, Joint Repair, and Full-Depth Deck Repair by the square yard acceptably completed.

(3) The department will measure Curb Repair by the linear foot acceptably completed.

(4) The department will measure Concrete Surface Repair by the square foot acceptably completed, measured as the exposed surface area, following removal, as delineated by the saw cuts.

(5) The department will measure the Concrete Masonry Overlay bid items by the cubic yard acceptably completed. The department will include the volume of concrete used in associated approach and deck preparation, joint repair, curb repair, and in full-depth deck repair as part of the Concrete Masonry Overlay bid items. The department will compute yardage based on the nominal cubic yard of concrete defined in 501.3.2.2. The department will not measure wasted concrete.

509.5 Payment

509.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
509.0200	Preparation Approaches	SY
509.0300 - 0399	Preparation Decks (type)	SY
509.0500	Cleaning Decks	SY
509.0600	Cleaning Approaches	SY
509.1000	Joint Repair	SY
509.1200	Curb Repair	LF
509.1500	Concrete Surface Repair	SF
509.2000	Full-Depth Deck Repair	SY
509.2500	Concrete Masonry Overlay Decks	CY
509.2600	Concrete Masonry Overlay Approaches	CY

(2) Repairing damage to existing reinforcement is incidental to the contract.

509.5.2 Preparation

(1) Payment for Preparation Approaches and the Preparation Decks bid items is full compensation for removing asphaltic patches and unsound concrete; and for disposing of waste materials.

(2) The department will pay separately for the volume of concrete used under the Concrete Masonry Overlay bid items.

509.5.3 Cleaning

(1) Payment for Cleaning Decks and Cleaning Approaches is full compensation for scarifying, and cleaning the deck or approaches; and for blast cleaning the entire deck or approaches, including all exposed existing reinforcing steel.

509.5.4 Joint Repair

(1) Payment for Joint Repair is full compensation for removing and disposing of deteriorated concrete, and for forming new joints.

(2) The department will pay separately for the volume of concrete used under the Concrete Masonry Overlay bid items.

(3) The department will not pay for restoration of painted surfaces damaged by construction operations.

509.5.5 Curb Repair

(1) Payment for Curb Repair is full compensation for removing and disposing of deteriorated concrete; for forming; and for disposing of waste material.

(2) The department will pay separately for the volume of concrete used under the Concrete Masonry Overlay Decks bid item.

509.5.6 Concrete Surface Repair

(1) Payment for Concrete Surface Repair is full compensation for providing the repair; for removing and disposing of deteriorated concrete; for cleaning reinforcing steel; and for the volume of concrete used in the surface repair.

509.5.7 Full Depth Deck Repair

(1) Payment for Full-Depth Deck Repair is full compensation for completely removing the deteriorated concrete areas; for disposing of waste material; for forming; and for salvaging and using the existing bar steel reinforcement. The department will pay for this bid item at the contract unit price regardless of whether the engineer directs it before or after beginning the type 1 or type 2 removals.

(2) The department will pay separately for the volume of concrete used under the Concrete Masonry Overlay Decks bid item.

509.5.8 Concrete Overlays

(1) Payment for the Concrete Masonry Overlay bid items is full compensation for providing the overlay; for the concrete used including the volume needed to complete the work done under the associated Preparation Approaches, Preparation Decks, Joint Repair , Curb Repair, and Full-Depth Deck Repair bid items; and for sawing and sealing joints.

Section 511 Temporary Shoring

511.1 Description

(1) This section describes designing and providing temporary shoring at locations the plans show.

511.2 Materials

(1) Provide a shoring design for each location where the plan requires temporary shoring. Conform to AASHTO Load and Resistance Factor Design Specifications and the WisDOT Bridge Manual. Design to address all limit states using a design life of 36 months or the project specific duration, whichever is greater. Have a professional engineer, registered in the state of Wisconsin and knowledgeable of the specific site conditions and requirements, verify the adequacy of the design. Submit one copy of each shoring design, signed and sealed by the same professional engineer verifying the design, to the engineer for incorporation into the permanent project record.

511.3 Construction

(1) Provide temporary shoring at each required location conforming to the design developed for that location as follows:

Under the Temporary Shoring bid item: for all temporary shoring locations the contract shows.

Under the Temporary Shoring (structure) bid items: for temporary shoring associated with structure ID numbers identified in the bid item supplemental descriptions.

Under the Temporary Shoring (location) bid items: for temporary shoring associated with roadway locations identified in the bid item supplemental descriptions.

(2) Remove temporary shoring no longer needed unless the engineer allows it to remain in place. Under the left-in-place bid items, leave the shoring in place as the special provisions specify or as the plans show. Place backfill conforming to 206.3.13 in excavated space not occupied by the new permanent construction.

511.4 Measurement

(1) The department will measure the Temporary Shoring bid items by the square foot acceptably completed at locations the plans show, measured as the area of exposed face in the plane of the shoring from the ground line in front of the shoring to a maximum of one foot above the retained grade. Shoring used for staged construction in multiple configurations without removal and reinstallation will be measured once based on the configuration with the largest area of exposed face.

511.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
511.1100	Temporary Shoring	SF
511.1200	Temporary Shoring (structure)	SF
511.1300	Temporary Shoring (location)	SF
511.2200	Temporary Shoring Left In Place (structure)	SF
511.2300	Temporary Shoring Left In Place (location)	SF

(2) Payment for the Temporary Shoring bid items is full compensation for designing and providing shoring; for providing a signed and sealed copy of the design; for removal or additional work required to leave in place; and for backfilling.

(3) The department will not pay for temporary shoring for locations the plans do not show.

Section 512 Steel Sheet Piling

512.1 Description

(1) This section describes providing permanent and temporary steel sheet piling.

512.2 Materials

512.2.1 Permanent Steel Sheet Piling

(1) Furnish permanent sheet piling conforming to ASTM A328 and with the section modulus, the plans or special provisions specify.

(2) Unless specified otherwise, do not furnish used material under the Piling Steel Sheet Permanent bid items.

(3) Unless the engineer directs otherwise, the contractor shall submit before or at delivery of steel sheet piling the certified report of test or analysis as specified for mill inspection and tests in 506.3.21.

512.2.2 Temporary Steel Sheet Piling

(1) Furnish temporary steel sheet piling with a section modulus equal to or greater than the plans show. Extend one foot or higher above the retained grade unless the plans show a greater height. The contractor may employ used steel sheet piling in good condition instead of new material. Remove and dispose of temporary sheet piling when no longer needed.

512.3 Construction

512.3.1 Driving and Cutting Off

512.3.1.1 General

(1) Coordinate driving operations to prevent damage or displacement of concrete in substructure units or damage to adjacent facilities due to vibrations.

(2) Drive sheeting with a variation of 1/4 inch or less per foot from the vertical or from the batter the plans show. Ensure that the sheetpiles are within 6 inches of the plan position after driving. Do not damage sheetpiles attempting to correct for misalignment.

(3) Remove and replace, or otherwise correct, sheetpiles the engineer deems unacceptable under 105.3. Submit details of planned corrections to the engineer for review and approval before initiating any corrective action.

(4) Drive sheetpiles to or beyond the required tip elevation the plans show.

512.3.1.2 Driving System

(1) Furnish a sheetpile driving system capable of driving the sheetpiles to the required minimum tip elevation the plans show.

(2) The engineer may order the contractor to remove a pile driving system component from service if it causes insufficient energy transfer or damages the sheetpiles. Do not return a component to service until the engineer determines that it has been satisfactorily repaired or adjusted.

(3) Drive sheetpiles with diesel, air, steam, gravity, hydraulic, or vibratory hammers.

512.3.1.3 Cut-Offs

(1) Cut off sheetpiles at the elevations the plans show or as the engineer directs. Pile cut-offs become the contractor's property. Dispose of cut-offs not incorporated into the work.

512.3.2 Wales

(1) Brace the steel sheet piling with waling strips as the plans show. Preferably, make the wales one length between corners and bolt to the piles.

512.3.3 Painting

(1) Paint permanent steel sheet piling as specified for painting steel piling in 550.3.11.3.

512.4 Measurement

(1) The department will measure Piling Steel Sheet Permanent Delivered by the square foot acceptably completed. The department will obtain the measured quantity by multiplying the length of the wall the plans show by the length of sheeting required.

(2) The department will measure Piling Steel Sheet Permanent Driven by the square foot acceptably completed. The department will measure the area of the wall from the sheet pile tip elevation to the top cutoff. The department will make no allowance for overlap of the piles.

(3) The department will measure Piling Steel Sheet Temporary by the square foot acceptably completed. The department will measure the area from the sheet pile tip elevation to one foot above the retained

grade unless the plans show a greater height. The department will make no allowance for overlap of the piles.

512.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
512.0500	Piling Steel Sheet Permanent Delivered	SF
512.0600	Piling Steel Sheet Permanent Driven	SF
512.1000	Piling Steel Sheet Temporary	SF

(2) Payment for Piling Steel Sheet Permanent Delivered is full compensation for providing and delivering acceptable piling for this work.

(3) Payment for Piling Steel Sheet Permanent Driven is full compensation for driving, cutting off, disposing of cutoffs, and painting.

(4) Payment for Piling Steel Sheet Temporary is full compensation for providing, driving, and removing.

Section 513 Railing

513.1 Description

(1) This section describes providing railing fabricated from structural steel, steel structural tubing, steel guardrail, or aluminum.

513.2 Materials

513.2.1 General

(1) Furnish railing and railing components from a department-approved fabricator. A list of approved fabricators is available on the department's APL for structures under bridge secondary metals.

(2) Conform to the department's certification method of acceptance, as defined in CMM 8-75.2, for railing and railing components. Furnish a certificate of compliance for miscellaneous hardware.

(3) Furnish chain link fence fabric with a bonded polyvinyl chloride (PVC) coating and conforming to ASTM F668, class 2B. Furnish fabric woven of 9-gauge wire in 2-inch diamond pattern mesh with both the top and bottom selvages knuckled. Also provide PVC-coated ties and tension bars conforming to ASTM F626.

(4) Furnish stainless steel nuts, bolts, anchor bolts, and washers conforming to the following:

Hex nuts	ASTM F594
Hex bolts and anchor bolts	ASTM F593, type 316
Washers	ASTM A240

(5) Furnish galvanized steel nuts, bolts, anchor bolts, and washers hot-dipped according to ASTM A153 supplemented by ASTM F2329.

513.2.2 Aluminum Railing

(1) Conform to dimensional tolerances for aluminum products according to ASTM B210. Furnish aluminum railing components as follows:

Cast aluminum railing posts	ASTM B108, alloy A 444.0
Tubular rail and extrusions	ASTM B221, alloy 6061-T6 or alloy 6351-T5
Shims	ASTM B209, alloy 1100
Plates	ASTM B209, alloy 6061-T6
Standard aluminum structural shapes	ASTM B308
Stainless steel clamping bars	ASTM A276, any type in the 300 series
Stainless steel cap screws	ASTM F593, any type in alloy groups 1, 2, or 3
Aluminum clamping bars	ASTM B211, alloy 6061-T6
Cast aluminum washers	ASTM B26, alloy 356.0
Aluminum pins	ASTM B211, alloy 6061-T6

513.2.3 Steel Railing

(1) Furnish steel railing components as follows:

Structural steel	506.2.2
High strength bolts	506.2.5
Steel guardrail	614.2
Round structural steel tubing for steel pipe railing	ASTM A500 grade B
Structural steel tubing used with other steel railings	ASTM A500 grade B or C

(2) Furnish a two-coat paint system from the department's APL for structure painting systems under paint - galvanized railing.

513.3 Construction

513.3.1 General

Revise 513.3.1(1) to clarify shop drawing submittal requirements.

(1) Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2 before ordering or fabricating the material. Include the size and location of vent or drainage holes. For painted railings, state the name of the painting manufacturer and the product name of the tie-coat and top-coat used along with the color number and name on the drawings.

(2) Before erecting the railing, swing the spans free from falsework. Make the railing's line and grade true; do not follow unevenness in supporting sidewalk or walls. Unless the plans require otherwise, construct the railing with the posts normal to the grade of the structure.

(3) Unless the plans provide otherwise, set anchor bolts during concrete placement. Locate to provide the correct railing alignment. Ensure that bolts do not project more than 3/8 inch beyond the nut after attaching the rail. If setting anchor bolts in holes drilled in concrete for combination or pedestrian railings, use adhesive anchors conforming to 502.2.12 and installed conforming to 502.3.14.

(4) Shim to align each railing post and end base plate as the plans show.

(5) Galvanize, or galvanize and paint steel railings as the plans specify. Do not paint aluminum railing

(6) Under the Railing Tubular Type H bid item, furnish either aluminum railing or steel railing, except if furnishing railings for adjacent structures on a dual highway, use the same material and finish.

(7) Use stainless steel nuts, bolts, anchor bolts, and washers for aluminum railing. Use galvanized steel nuts, bolts, anchor bolts, and washers for steel railings unless the plans show stainless steel.

513.3.2 Aluminum Railing

(1) Fabricate according to Part 1 of the Aluminum Design Manual published by the Aluminum Association.

(2) Do not oxygen cut materials.

(3) Blast clean, or polish and burnish, cast posts to provide a finished surface with a uniform texture and a smooth, uniform appearance.

(4) Before laying out or working on aluminum materials, ensure they are straight. If straightening is necessary, straighten in a way that causes no injury to the appearance or strength of the metal. The engineer will reject material with sharp kinks and bends.

(5) Store aluminum railing above the ground on platforms, skids, or other suitable supports. Protect the material from moisture and keep it free from oil, grease, dirt, and contact with dissimilar metals until the railing is complete. Handle, ship, and erect the material in a manner to preclude any scratching, denting, or other defects that may affect the railing durability or appearance.

513.3.3 Steel Railing

(1) Saw the members of the railing to length; do not shear. Grind welded joints to a smooth finish.

(2) Fabricate railings to meet the requirements of ASTM A385. After fabrication, blast clean assemblies per SSPC-SP6 and galvanize according to ASTM A123. Provide vent holes in members to facilitate galvanizing and provide drainage. Remove burrs at component edges, corners, and holes; and chamfer sharp edges before galvanizing. Condition thermal cut edges before blast cleaning by shallow grinding or other cleaning to remove hardened surface layer material. Remove steel defects according to AASHTO M 160 before blast cleaning. Remove lumps, projections, globules, and heavy deposits of galvanizing. Do not use water quenching; and do not use chromate or other passivating treatments.

(3) Use a two-coat paint system if painting after galvanizing as follows:

- Coat exterior surfaces of railing assemblies and inside of rail elements at field erection joints.
- Coat inside of rail elements at expansion joints.

(4) Clean galvanized surfaces before coating according to SSPC-SP1 to remove chlorides, sulfates, zinc salts, oil, dirt, organic matter, and other contaminants. Ensure tie-coat adhesion by brush blasting the cleaned surface according to SSPC-SP16 to create a slight angular surface profile according to manufacturer's recommendations of 1 mil to 1.5 mils. Remove wet storage stains before blasting according to SSPC-SP16.

(5) Brush blast at an angle of 30 to 60 degrees at no greater than 50 psi using garnet or other engineer-approved soft abrasive. Do not use steel shot or angular iron blasting grit. Brush blast the surface to produce a matte silver appearance. Do not fracture the galvanizing finish or remove any dry film thickness. Before applying the tie-coat, remove visible deposits of oil, grease, and other contaminants according to SSPC-SP1 and remove dust, dirt, and loose residue.

(6) After cleaning and within 8 hours of blasting, apply the tie-coat from a coating system intended for galvanized surfaces, according to manufacturer's recommendations. Apply the top-coat according to manufacturer's recommendations, matching the color the plans show. Use a top-coat that is UV resistant and suitable to a marine environment. Ensure that the tie and top-coats are of contrasting color and come from the same manufacturer.

(7) Ensure that the coating manufacturer reviews the process for surface preparation and application of the coating system with the coating applier. The review includes a visit to the facility performing the work if the coating manufacturer requests. Provide written confirmation, from the coating manufacturer to the engineer, that the review took place and that issues raised were addressed before beginning the coating work under the contract.

(8) The department will reject coating with bubbles, blisters, or flaking.

(9) Handle steel railings in conforming to 517.3.1.7.4. Repair or replace railing assemblies if the zinc coating or the two-coat paint system is damaged. Store the material off the ground, providing proper ventilation and drainage. Do not field weld, field cut, or drill without the engineer's written approval.

(10) For minor damage to coated surfaces caused by shipping, handling, or installation; touch-up the surface conforming to the manufacturer's recommendation for the two-coat paint system and conforming to ASTM A780 for the zinc coating.

513.3.4 Screening

(1) Install chain link screening fence fabric conforming to 616.3.3.3 and the plan details. Touch up painted framework surfaces marred by fencing installation.

513.3.5 Welding

(1) Weld railing as the plans show and conforming to the following:

For steel railing: AWS D 1.5, Bridge Welding Code.

For aluminum railing: AWS D 1.2, Structural Welding Code - Aluminum.

513.4 Measurement

(1) The department will measure the Railing bid items by the linear foot acceptably completed.

513.5 Payment

Revise 513.5(1) to eliminate the structure number requirement from the LF railing bid items.

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
513.2001	Railing Pipe	LF
513.4000 - 4090	Railing Tubular (type)	LF
513.4091	Railing Tubular Screening	LF
513.7000 - 7099	Railing Steel (type)	LF
513.8000 - 8099	Railing Steel Pedestrian (type)	LF

(2) Payment for the Railing bid items is full compensation for providing railing; for anchor bolts; and for painting.

Section 514 Floor Drains, Deck Drains, and Downspouts

514.1 Description

(1) The section describes providing drainage components for highway structures and drainage systems for railroad structures.

514.2 Materials

514.2.1 General

(1) Furnish materials conforming to the following:

Structural carbon steel 506.2
Miscellaneous metals 506.2
Paint 517
Corrugated steel pipe 521
Cast Iron ..... ASTM A48, class 30

514.2.2 Highway Structures

(1) Use structural carbon steel or cast iron, whichever the plans show, for floor drain frames and grates. After fabrication, blast clean and zinc coat steel components according to ASTM A123 as follows:

- Structural steel frames and grates.
- Steel pipes, clamps, fittings, and brackets for lateral piping.

(2) Furnish UV-resistant reinforced thermosetting resin pipe (RTRP) and pipe fittings for downspouts conforming to ASTM D2996, designation code RTRP-12EA1-2122 or RTRP-11AQ2-2112. Furnish stainless steel brackets for attaching RTRP to the structure.

(3) Furnish adhesive anchors as specified in 502.2.12 with stainless steel anchor bolts, nuts, and washers conforming to 513.2.1. Unless the plans show otherwise, use 1/2-inch diameter anchor bolts.

(4) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716 for concrete used in aprons for downspouts. Provide QMP for class II ancillary concrete as specified in 716.

514.2.3 Railroad Structures

(1) Furnish perforated half-round corrugated steel pipe, drainage pans with end closure plates, and unperforated outlet stubs and downspouts of the sizes and gauges the plans show. Ensure that these components are galvanized and fully coated with asphalt according to AASHTO M190.

(2) Furnish galvanized pipe clamps and hardware the plans show.

514.3 Construction

514.3.1 Floor Drains

(1) Set floor drains with the grate at the elevation, relative to the top of the deck, the plans show.

514.3.2 Adjusting Floor Drains

(1) If the plans show or contract specifies, provide new drain frames and inserts. Fabricate, blast clean, and apply a shop coat of primer. Touch up areas of damaged primer after installation with a department-approved organic zinc-rich primer.

(2) After placing and curing adjacent concrete, paint exposed surfaces of inserts and frames with a coat of department-approved ready-mixed leafing aluminum paint. Brush clean existing drain grates and apply a similar coat of leafing aluminum paint.

514.3.3 Railroad Structure Deck Drain Systems

(1) Develop and submit shop drawings conforming to 107.17.1. Fabricate and install deck drain systems conforming to the shop drawings and as the plans show.

(2) Set the deck drains in a thick coat of hot asphalt mopped on asphalt panels to anchor the drains in place. Ensure that pipe perforations are not plugged with asphalt. Clear plugged holes without exposing bare metal using engineer-approved methods.

514.3.4 Downspouts

(1) Fabricate and install downspouts according to the plan details. Make RTRP connections using an epoxy adhesive following the RTRP pipe manufacturer's installation recommendations. Make connections to steel or cast iron components as the plans show.

(2) If the plans require color matching, paint steel components conforming to 517.3 and use RTRP pipe and pipe fittings either pigmented throughout or that have a resin-rich pigmented exterior coat specifically designed for overcoating fiberglass, as the RTRP manufacturer recommends.

(3) Space brackets every 12 feet on center or closer. Place at least one bracket at each elbow and 2 brackets, one on each side, at each lateral joint connection. Attach to concrete piers, abutments, and decks using adhesive anchor bolts.

(4) Construct concrete aprons as the plans show.

514.4 Measurement

(1) The department will measure the Floor Drains and Adjusting Floor Drains bid items as each individual drain acceptably completed.

(2) The department will measure the Railroad Deck Drain System bid items as a single lump sum unit for each railroad structure acceptably completed.

(3) The department will measure the Downspout bid items by the linear foot acceptably completed, measured in place along the centerline of pipe, from end to end through all fittings.

514.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
514.0400 - 0499	Floor Drains (type)	EACH
514.0900	Adjusting Floor Drains	EACH
514.1000	Railroad Deck Drain System (railroad structure)	LS
514.2600 - 2699	Downspout (inch)	LF

(2) Payment for the Floor Drains bid items is full compensation for providing floor drains including the frames, grates, and lateral pipes.

(3) Payment for Adjusting Floor Drains is full compensation for providing floor drain frames and inserts including new materials; and for required fabrication, cleaning, and painting.

(4) Payment for the Railroad Deck Drain System bid items is full compensation for providing the deck drainage system; for shop drawings; and for asphalt coatings.

(5) Payment for the Downspout bid items is full compensation for providing downspouts; for painting; for attachment hardware; and for providing concrete aprons.

Section 515 Steel Grid Floors

515.1 Description

(1) This section describes providing steel grid floors of the open type, or concrete filled type.

515.2 Materials

(1) Furnish materials conforming to the following:

Concrete 501
Paint 517

(2) All steel in steel grid floors shall conform to ASTM A36, with a minimum copper content of 0.2 percent.

(3) Zinc coat open type grid floors according to ASTM A123.

(4) For concrete filled type floors, use grade C, C-FA, C-S, C-IS, C-IP, or C-IT concrete. Provide QMP for class I structure concrete as specified in 715.

515.3 Construction

515.3.1 Fabrication

(1) Manufacture the steel grid floors to conform to the thickness, section, loading, and other requirements the plans show; and so if assembled in place they conform to the camber the plans show. The engineer will reject steel grid floors not within 1/2 inch of specified camber. Serrate the top edges of open type grid floors.

(2) If fabricating the floor with the main elements normal to the centerline of the roadway, extend the units the full width of the roadway for roadways up to 40 feet wide. If multiple units are allowed, extend the units over at least 3 panels. If the main elements are parallel to the centerline of the roadway, extend the section over not less than 3 panels. If joints are required, weld the ends of all main floor members at the joints over their full cross-sectional area to provide full continuity and, preferably, place joints, if assembling the floor in place, over a supporting member.

(3) Before fabricating, submit complete detailed shop drawings to the engineer for approval. These drawings shall show the spacing and size of component parts, the size and length of welds, splices and trims, and complete assembly details, including size and location of recommended erection welding.

(4) Fabricate and construct steel grid floors being filled with concrete to provide adequate support for the concrete filler.

515.3.2 Erection

(1) Assemble the units or sections of the grid floor on the structure and weld the abutting main elements and connecting members between the sections to provide full continuity for the entire floor or between any points the plans show. Weight the floor assembly down or clamp it in place to make a tight joint with full bearing on its supports before welding. If there is a roadway crown, weld beveled bars to the stringer flange to provide a bearing surface parallel to the crown, unless placing the stringers with their vertical axes normal to the crown. Use the location, size, and length of the welds that the manufacturer recommends or as the engineer approves.

515.3.3 Welding

(1) Weld steel grid floors as the plans show and conforming to AWS D 1.1, Structural Welding Code - Steel.

515.3.4 Painting

(1) Spot paint damaged places in the zinc coating and field welds with a department-approved zinc-rich paint. Clean field welds of scale or slag and neutralize the welds as specified in 517.3.1.3.1 before spot painting.

515.3.5 Concrete Filler

(1) Mix, place, and cure the concrete as specified in 501 and 502. Unless directed otherwise, compact the concrete thoroughly by vibrating. The vibrating device and manner of operation are subject to the engineer's approval.

515.4 Measurement

(1) The department will measure the Steel Grid Floor bid items by the square foot acceptably completed.

515.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT

515.4000	Steel Grid Floor Open (inch)	SF
515.5000	Steel Grid Floor Concrete Filled (inch)	SF

(2) Payment for the Steel Grid Floor bid items is full compensation for fabricating, zinc coating, and furnishing the steel grid floor; for providing paint and concrete; and for erecting and welding, painting, placing and curing concrete.

Section 516 Waterproofing

516.1 Description

(1) This section describes providing rubberized membrane waterproofing and dampproofing on concrete surfaces of structures.

516.2 Materials

516.2.1 Dampproofing

(1) Furnish asphalt dampproofing conforming to ASTM D449 type II and primer conforming to ASTM D41.

(2) Furnish coal-tar pitch dampproofing conforming to ASTM D450 type I and a primer conforming to ASTM D43.

(3) Furnish emulsified asphalt dampproofing conforming to ASTM D1227 type II class 1 and a manufacturer-approved primer.

516.2.2 (Vacant)

516.2.3 Rubberized Membrane

(1) Select the rubberized membrane, primer, and mastic from the department's APL. Use membrane at least 60 mil thick.

516.3 Construction

516.3.1 General

(1) Do not perform dampproofing and waterproofing in wet weather or if the air temperature or the concrete temperature is below 45 F, unless the engineer specifically allows.

(2) Do not cure surfaces that require dampproofing or waterproofing with membrane curing material.

(3) Cure the concrete and finish the concrete surface as specified for concrete surface finish in 502.3.7 before applying dampproofing or waterproofing.

(4) During primer application, ensure the concrete surface is dry and thoroughly clean, free from contaminants, dust, or other loose material.

(5) Apply at a material temperature that allows uniform application. If required, heat material uniformly in a kettle with an armored thermometer. Do not heat asphalt above 350 F or coal-tar pitch above 250 F.

516.3.2 Dampproofing

(1) Under the Dampproofing bid item, provide a prime coat and a finish coat of asphalt, coal-tar pitch, or emulsified asphalt.

(2) Apply a light coating of the primer to the concrete surface after preparation, cleaning, and drying. Apply the primer to thoroughly and uniformly coat the concrete surface. Apply the finish coat after the prime coat cures but is still tacky to the touch.

(3) Apply asphalt, coal-tar pitch, or emulsified asphalt so that it uniformly and completely covers the primed surface. Use no less than 4 1/2 gallons, for each 100 square feet of surface, of asphalt, coal-tar pitch, or emulsified asphalt.

516.3.3 Rubberized Membrane

(1) Under the Rubberized Membrane Waterproofing bid item, provide a prime coat, one layer of a preformed rubberized asphalt and plastic film membrane, and cold-applied rubberized asphalt mastic.

(2) Prime the concrete surfaces with the membrane manufacturer's primer, applied by brush or roller at the rate of 250 to 350 square feet per gallon. Let the primer dry one hour or until tack free. Re-prime primed surfaces not covered within 36 hours. Do not prime dense surfaces like metal, but ensure it is clean, dry, and free of grease, oil, dust, or other contaminants.

(3) Apply a single layer of membrane to the accepted primed surface. Overlap 9 inches at membrane joints and double cover intersections to eliminate butt joints in the membrane. Chamfer or round the exterior corners.

(4) Apply a double layer of membrane around drains, posts, bolts, or other protrusions and liberally coat them with mastic next to seams and protrusions after applying the membrane.

(5) Apply a trowelled bead of cold-applied rubberized asphalt mastic to the perimeter of the membrane placed in any day's operation and to all outside edges of membrane after placing the membrane.

(6) Make a careful inspection of the membrane and patch any ruptures, misaligned seams, or other discontinuities with membrane and place any required backfill material against the membrane. Backfill within 30 days of installation or otherwise protect from ultra violet radiation.

516.4 Measurement

(1) The department will measure Dampproofing by the square yard acceptably completed.

(2) The department will measure Rubberized Membrane Waterproofing by the square yard acceptably completed, measured as the length of concrete joint sealed times the plan width of membrane with no additional allowance for overlap at joints and intersections.

516.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
516.0100	Dampproofing	SY
516.0500	Rubberized Membrane Waterproofing	SY

(2) Payment for Dampproofing and Rubberized Membrane Waterproofing is full compensation for heating materials; for applying prime coats, mastic, and asphalt, coal-tar pitch, or emulsified asphalt; and for placing preformed membrane.

Section 517 Paint and Painting

517.1 Description

(1) This section describes furnishing paint materials and applying paint to steel or timber structures, including structural steel, miscellaneous metal or lumber, or timber parts of other structures. This work also includes, unless specified otherwise in the contract, preparing surfaces for painting, applying paint, protecting and drying the paint coatings; protecting traffic and property upon and in the vicinity of the structure; and protecting of all portions of the structure against disfigurement by paint or paint materials.

(2) This section also describes shop cleaning; the furnishing and shop application of a complete epoxy coating system on new structural steel; the field cleaning and repair of surfaces field welded or damaged in shipping, handling and erecting the structural steel; and providing a field-applied urethane top coat on exterior girders.

517.2 Materials

517.2.1 General Requirements

(1) All coatings or paints shall conform to the requirements specified for the type of coating or paint named.

(2) Furnish factory mixed paint or field mix according to the manufacturer's directions and as the contract directs.

(3) Ready-mixed paints shall not settle or cake in the container, but should break up readily with a paddle to a smooth, uniform paint of good brushing consistency that dries without streaking, wrinkling, running, or sagging if painted on smooth, vertical surfaces. Prime and undercoats shall dry to a dull gloss, and finish coats to a full gloss. If required, colors and hiding powers shall equal those of samples the department furnished. Any proportions specified in formulae are by weight, unless indicated otherwise in the requirements for specific paint.

517.2.2 Containers

(1) Generally, paint shall arrive packaged in strong, tight, standard commercial, 5 US standard-gallon capacity metal containers, except for the fractional parts of units. Package the fractional parts in one US standard-gallon capacity metal containers. If mechanical means for mixing and stirring are provided at the job site or painting facility, then the contractor may furnish the paint in 30 gallon or other suitable size metal containers.

(2) Mark each container with the name and address of the manufacturer, the type of paint contained, and the date of manufacture. Use tight-fitting covers on the containers and arrange them so that the inspector may attach wire-lead seals.

(3) Except as specified above for mixing paint mechanically, mix paint on the job in containers with not more than 15 gallons capacity.

517.2.3 Inspection, Sampling, and Testing

(1) Paint sampling and inspection normally takes place at the point of manufacture; the department may sample the paint at the fabricating shop or in the field. The engineer will obtain samples of paints purchased directly by the state, either for approval at their point of manufacture, or at their destination as indicated, either at the time contracts are awarded, or in the invitation for bids.

(2) If inspecting paints at the point of manufacture, the manufacturer shall furnish, if requested, any formulae required to determine the ingredients before making the paints. The manufacturer shall allow the inspector to check the makeup and grinding of paint batches and shall allow test sampling of any or all batches. The manufacturer also shall furnish, if requested, any formulae required to determine specification conformance.

(3) Take representative samples of ready-mixed paints after thoroughly mixing the paints. Consider one container chosen at random from each lot or batch for each coat, or if a batch or lot exceeds 500 gallons, one container for each 500 gallon increment or fraction thereof, as representative. Take a one-pint sample from the representative container in the inspector’s presence. It is the contractor or manufacturer’s responsibility to ensure paint mixing occurs in a container that allows sampling of the paint it contains. Take field samples only from paint that is on the job. Take samples in fabricating shops from containers of paint proposed for the specific bid item of work.

(4) Perform tests according to applicable standard methods of ASTM or AASHTO.

(5) The engineer may waive sampling and testing requirements for quantities of 5 gallon or less of paint of any single formulation required for each project, provided the paint purchased is from stock that demonstrated a satisfactory service record.

517.2.4 Structural Steel Paint-Epoxy System

517.2.4.1 General

(1) The epoxy system consists of a prime or shop coat of organic zinc-rich paint, an intermediate shop coat of high-build epoxy paint, and a protective shop coat of urethane paint.

(2) The contractor shall furnish and apply paints conforming to the requirements of the epoxy system as specified in the special provisions.

517.2.4.2 Coating System

(1) Furnish an epoxy coating system from the department's APL for new structural steel. Use a white epoxy and a urethane that matches the color represented by the number the plans show according to Federal Standard 595C. Submit product data sheets to the engineer before applying coatings. Ensure that product data sheets indicate mixing and thinning directions; recommended spray nozzles and pressures; minimum drying times for shop and field applied coats; recommended procedures for painting galvanized bolts, nuts, and washers; and a telephone number for technical service.

517.2.4.3 Zinc Coating

(1) Zinc coat the bearing assemblies specified in 506.2.8. Coat any other structural members and parts that require zinc coating according to ASTM A123, after blast cleaning.

(2) High-strength bolts, nuts, and washers shall conform to the material requirements of 506.2.5 and be hot-dip zinc coated as specified in 506.2.5.1.

517.2.5 General-Purpose White Exterior Alkyd Wood Primer

517.2.5.1 General

(1) This subsection covers a ready-mixed modified alkyd prime coat used as a primer in a 3-coat system on highway posts. This is a lead free paint.

(2) The paint shall not skin, liver, curdle or thicken materially in the container. It shall brush easily at package consistency and allow lapping without difficulty. It shall conform to or exceed the performance requirements, not necessarily the composition, of Commercial Item Description A-A-2336A.

517.2.5.2 Composition and Properties

(1) Furnish material conforming to the following:

PIGMENT

Percent by weight	49.0%
Titanium dioxide	16.0%
Calcium carbonate, silica/silicates	33.0%

VEHICLE

Percent by weight	51.0%
Soya and tall alkyd resin	24.0%
Aliphatic hydrocarbon solvent	23.0%
Driers and additives	4.0%
Total	100%

FINISHED PAINT TECHNICAL DATA

Generic type	Alkyd Resin, flat finish, exterior primer
Color	White
Gloss or sheen	Flat 0-15 units at 59 F
Dry time	Touch: 4-8 hours
At 77 F, 50% RH	Recoat: 24 hours
Flash point, closed cup	108 F
VOC, Maximum as packaged	2.92 lb/gal
Solids by Volume (percent)	56% +/- 2%
Solids by Weight (percent)	74% +/- 2%
Weight per gallon, pounds	3
Coverage	108 sq ft/gal at 4 mils wet, 2.4 mils dry
Clean-up Solvent	Mineral Spirits
Type of Cure	Oxidation

517.2.6 White Paint for Wood - Intermediate and Finish Coat

517.2.6.1 General

(1) This subsection covers a ready-mixed, ready-to-apply white paint for exterior exposure, used for an intermediate and finish coat in a 3 coat system on marker posts or other wooden structures. This is a lead-free paint.

517.2.6.2 Composition and Properties

(1) Furnish material conforming to the following:

PIGMENT

Percent by weight	48.0% min to 51.0% max
Titanium dioxide	38.0% min to 41.0% max
Zinc oxide	16.5% min to 18.5% max
Calcium carbonate	40.5% min to 45.5% max

VEHICLE

Percent by weight	49.0% min to 52.0% max
Long oil soya alkyd resin	32.0% min to 35.0% max
Linseed oil, heat bodied	29.0% min to 32.0% max
Mineral spirits	32.0% min to 34.0% max
Linseed/tung oil, heat bodied	1.0% min to 2.0% max
Driers and rheology agents	2.5% min to 3.5% max

FINISHED PAINT TECHNICAL DATA

Viscosity - Krebs units at 77 F	95 min to 100 max
Drying time	18 hours max
Total solids by weight	82.0% min to 84.0% max
Total solids by volume	67.0% min to 71.0% max
Weight per gallon	11.77 lb/gal min to 12.02 lb/gal max
Gloss at 59 F	80% minimum
Clean-up solvent	Mineral spirits
Type of cure	Oxidation

517.2.6.3 Condition in Container

(1) The ready-mixed paint as received shall not liver, skin, lump, or separate, or corrode the container, or contain hard settled pigment. Pigment shall disperse easily in the liquid portion by hand stirring to form a smooth, homogeneous paint, free from lumps, particles, or foreign material.

517.2.7 (Vacant)

517.2.8 Black Paint for Wood - Intermediate and Finish Coat

517.2.8.1 General

(1) This subsection covers a ready-mixed, ready-to-apply black paint for exterior exposure, used for an intermediate and finish coat in a 3-coat system on marker posts or other wooden structures. This is a lead-free paint.

517.2.8.2 Composition and Properties

(1) Furnish material conforming to the following:

PIGMENT

Percent by weight	40.0% min to 42.0% max
Lampblack	
Nephaline Syenite	

VEHICLE

Percent by weight	58.0% min to 60.0% max
Long oil alkyd resin	16.0% min to 17.0% max
Linseed oil, heat bodied	17.75% min to 18.25% max
Mineral spirits	23.20% min to 25.60% max
Linseed/tung oil, heat bodied	9.75% min to 10.25% max
Driers and rheology agents	1.40% min to 1.60% max
Fungicide- tetrachloroisophthalonitrile	0.70% min

FINISHED PAINT TECHNICAL DATA

Viscosity - Krebs units at 77 F ..... 95 min to 100 max

Drying time ..... 18 hours max

Total solids by weight ..... 80.0% min to 82.0% max

Total solids by volume ..... 68.0% min to 70.0% max

Weight per gallon ..... 10.27 lb/gal min to 10.52 lb/gal max

Gloss at 59 F ..... 80% minimum

Clean-up solvent ..... Mineral spirits

Type of cure ..... Oxidation

517.2.8.3 Condition in Container

(1) The ready-mixed paint as received shall not liver, skin, lump, or separate, or corrode the container, or contain hard settled pigment. Pigment shall disperse easily in the liquid portion by hand stirring to form a smooth, homogeneous paint, free from lumps, particles, or foreign material.

517.2.9 Brown Stain for Wood

517.2.9.1 General

(1) This subsection covers using a brown stain on rustic wood fences and other similar rustic materials. If the contractor cannot obtain stain conforming to these specifications because of the small quantities required, it may use an equal dark brown semi-transparent oil stain the engineer finds acceptable. This is a lead-free stain.

517.2.9.2 Composition and Properties

(1) Furnish material conforming to the following:

PIGMENT

Percent by weight ..... 11.0% min to 13.0% max

Black Synthetic Iron Oxide ..... 59.0% min to 61.0% max

Dark Brown Iron Oxide ..... 39.0% min to 41.0% max

VEHICLE

Percent by weight ..... 87.0% min to 89.0% max

Linseed oil, raw ..... 69.0% min to 71.0% max

Mineral spirits ..... 25.0% min to 27.5% max

Driers and rheology agents ..... 0.09% min to 0.12% max

Fungicide- tetrachloroisophthalonitrile ..... 0.50% min to 0.75% max

Water repellent: poly-oxo aluminum stearate ..... 2.0% min to 2.5% max

FINISHED PAINT TECHNICAL DATA

Viscosity - Krebs units at 77 F ..... 45 min to 50 max

Drying time ..... 48 hours max

Total solids by weight ..... 76.5% min to 79.0% max

Total solids by volume ..... 70.0% min to 72.5% max

Weight per gallon ..... 8.18 lb/gal min to 8.35 lb/gal max

Clean-up solvent ..... Mineral spirits

Type of cure ..... Oxidation

517.3 Construction

517.3.1 Coating or Painting Metal

517.3.1.1 General

(1) Clean and prepare the surfaces of metal parts before coating or painting.

(2) The contractor or fabricator shall furnish and erect scaffolding, meeting the engineer's approval, to allow steel inspection before and after coating.

(3) Use rubber rollers or other protective devices, meeting the engineer's approval, on scaffold fastenings. The contractor shall not use metal rollers or clamps and other type fastenings that mar or damage freshly coated surfaces.

(4) For all colors, conform to the standard color samples the department furnished, or as specified.

(5) For structural steel, including weathering steel, and miscellaneous metals that will be encased in concrete, apply only zinc-rich primer as specified in 517.3.1.7.2. The contractor is not required to prime or paint welded stud shear connectors and anchor bolts.

517.3.1.2 Weather Conditions

517.3.1.2.1 General

(1) The contractor shall not apply paint if the air is misty or if conditions are otherwise unsatisfactory for the work. Do not apply paint on damp or frosted surfaces.

(2) If coating or painting material under cover in damp or cold weather, it shall remain under cover until dry or until weather conditions allow its open exposure. The contractor shall not perform coating or painting if the metal is hot enough to cause the coating to blister and produce a porous paint film.

517.3.1.2.2 Temperature

(1) Do not expose coated surfaces to temperatures below 35 F until after dry enough for recoating or applying the top coat.

(2) Do not apply zinc-rich coatings if the temperature of either the air or the steel is below 40 F.

(3) Do not apply epoxy and urethane coatings if the temperature of either the air or the steel is below 50 F.

517.3.1.2.3 Humidity

(1) Do not apply the epoxy coating system if the relative humidity is greater than 90 percent, or unless the steel temperature is at least 5 F higher than the dew point temperature.

517.3.1.3 Surface Cleaning

517.3.1.3.1 General

(1) Clean metal surfaces before painting and surfaces in contact because of bolting, removing rust, mill scale, dirt, oil, or grease and other foreign substances. Unless blast cleaning, neutralize weld areas with a proper chemical and rinse with water, before cleaning.

(2) Blast clean non-machined surfaces of a casting before machining the casting.

(3) Blast clean structural steel, including steel encased in concrete.

517.3.1.3.2 Hand and Power Tool Cleaning

(1) If the engineer allows, use metal brushes, scrapers, chisels, hammers, power tools, or other effective means to remove rust, scale, and dirt. The contractor shall not use tools that excessively scar the metal. Remove oil and grease by solvent cleaning according to SSPC-SP 1. Remove dust or other loose material.

517.3.1.3.3 Blast Cleaning

517.3.1.3.3.1 General

(1) Blast clean metal surfaces to remove mill scale, rust, dirt, and other substances until the specified profile is obtained. Grind or plane flame-cut edges before blast cleaning to remove flame-hardened material as required to ensure that blast cleaning will produce the specified profile. Ensure that corners and re-entrant angles are adequately cleaned. Remove sand, grit, or shot before painting. Obtain the engineer's approval of the cleaning before painting. Apply paint before rust forms.

517.3.1.3.3.2 Epoxy Coating System

(1) Blast clean structural steel receiving this coating to a near-white finish according to SSPC-SP 10.

(2) Solvent clean oil and grease on surfaces receiving this coating according to SSPC-SP 1 and blast clean to a near-white finish according to SSPC-SP 10.

(3) Remove fins, tears, slivers, and burred or sharp edges present on any steel member, or that appears during blasting, by grinding then re-blast the area to a one to 2 mils surface shape.

(4) If using abrasives for blast cleaning, use either clean dry sand, steel shot, mineral grit, or manufactured grit of a gradation that produces a uniform one to 2 mils profile as measured with a department-approved impregnated surface profile tape.

(5) Remove abrasive and paint residue from steel surfaces with a commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. If using the double blowing method, vacuum the top surfaces of structural steel, including top and bottom flanges; longitudinal stiffeners, splice plates, and hangers after completing the double blowing operations. Ensure that the steel is dust free when applying primer. Apply the primer within 8 hours after blast cleaning.

(6) Protect all freshly coated surfaces from later blast cleaning operations. Brush any blast damaged primed surfaces with a non-rusting tool, or if visible rust occurs, re-blast to a near white condition. Clean the brushed or blast cleaned surfaces and re-prime within the manufacturer’s recommended time.

517.3.1.3.4 Unpainted Weathering Steel

(1) Clean and surface prepare unpainted weathering steel as specified for this steel in 506.3.31.3.

517.3.1.4 Paint Mixing

517.3.1.4.1 General

(1) During use, stir the paint or coatings to keep the solids uniformly suspended. Mix the paint or coatings according to the manufacturer's directions to a smooth lump free consistency, use a high shear mixer. The contractor shall not use paddle mixers or shakers. Perform mixing, as much as practicable, in the original container and continue until all the metallic powder or pigment is suspended. Equip air container paint pots with agitators.

(2) Insure thorough dispersion of all pigment or solids that settle to the bottom of the container.

517.3.1.4.2 Zinc-Rich Primers

(1) After mixing, strain the coating through a screen with openings no larger than those for a No. 50 sieve. After straining, continuously agitate the mixed primer up to and during the application.

517.3.1.5 Application

517.3.1.5.1 General

(1) Perform painting in a neat and skillful manner. Apply epoxy system coatings by spraying. Apply the coating smoothly and uniformly so no excess paint collects at any point. Provide a finished surface free of streaks, pitting, wrinkling, or other irregularities.

(2) Use power spraying equipment that applies the coatings in a fine, even spray without adding any thinner. If applying paint with spray equipment, immediately brush it smooth, if necessary, to provide uniform coverage and to eliminate wrinkling, blistering, and air holes.

(3) In cool weather, the contractor may warm the paint to reduce the viscosity. Heat the paint by placing the paint containers in water or on steam radiators.

(4) Thin the paint, if necessary for proper application during cool weather, according to the manufacturer's recommendations.

517.3.1.5.2 Epoxy System

(1) Apply coating in a neat and skillful manner according to SSPC-PA 1, producing a uniform, even coating.

(2) Transfer or preserve erection marks, for the field identification of members, and weight marks with a compatible paint on zinc-rich primer, or mark with soapstone on an epoxy coated surface.

(3) Apply the coating with the spray nozzles and pressures the coating system manufacturer recommends to attain the specified film thickness. Apply coating to faying, contact, surfaces of bolted shop and field splices.

(4) Depending on site conditions, paint may require additional time beyond that specified in the product data sheets to ensure proper drying before applying a succeeding coat. For maximum time between coats, adhere to the manufacturer's recommendations except, let no more than 60 days elapse between coats.

(5) Determine the dry film thickness by using magnetic film thickness gauges calibrated for dry film thickness measurement according to SSPC-PA 2. The engineer will reject the coating system if minimum dry film thicknesses are less than specified.

517.3.1.6 Paint Removal

(1) The contractor shall remove coating that does not conform to specifications or is unsatisfactory; and thoroughly clean and recoat, or correct the metal at no expense to the department.

517.3.1.7 Shop Painting

517.3.1.7.1 General

(1) If welding structural steel, complete welding before coating the metal. If welding in the fabricating shop and later erecting by bolting, coat it after completing shop welding. Give steel surfaces welded in the field one coat of weldable primer or other department-approved protective coating after shop welding and shop fabrication.

(2) Apply one coat to the surfaces of iron and steel castings, either milled or finished.

(3) Upon fabrication and acceptance, coat pins and pinholes with a plastic or other department-approved coating before removing from the shop.

(4) Remove dry spray by vacuuming or sanding, if necessary, before shipment.

(5) Do not load material for shipment until the final shop coating cures and inspection is complete. Mark the components, "RECOMMENDED FOR USE," only after completion and approval of loading.

517.3.1.7.2 Organic Zinc-Rich Primer

(1) After the inspector approves the entire cleaned surface to be coated, apply a prime coat uniformly to the entire surface. Either before or after applying the prime coat, brush or spray a stripe coat of primer on all plate edges, bolt heads, nuts, and washers. Apply succeeding coats as the product data sheet shows.

(2) The organic primer color shall contrast markedly with the blasted surface color. The fabricator shall submit primer color samples to the engineer for approval.

(3) The primer coat shall have a dry film thickness on the bolted friction splices of the main members of not less than one mil or greater than 2.5 mils. Apply a coating of primer, of not less than than 3 mils dry film thickness, to the top of the top flange where the stud shear connectors will be welded.

(4) On all other areas, including the outside surfaces of splice plates, ensure that the dry film thickness above the surface profile for the primer coat is 3 mils to 7 mils.

(5) Remove bolted shop connections before blasting and coating the members. Blast and prime the parts separately then reassemble and torque the bolts fully.

(6) If applying the coating at the required thickness in one coat produces runs, bubbles, or sags, apply the coating in 2, wet, even coats, using a 50 percent overlap with minimum dry or overspray. If excessive coating thickness produces mud cracking, remove the coating back to soundly bonded coating and recoat the area to the required thickness.

(7) In areas lacking in primer thickness, clean the areas with power washing equipment to remove dirt; then brush the areas with a non-rusting tool, vacuum and recoat.

517.3.1.7.3 Epoxy System Intermediate and Protective Coats

(1) Mask the faying surfaces of bolted field splices and the top of the top flanges where welding the stud shear connectors during coat application. On all other areas including the outside surfaces of splice plates, ensure that the dry film thickness conforms to the following:

1. For the white intermediate coat, 3.5 mils to 8 mils.
2. For the protective coat, sufficient thickness to provide a uniform color and appearance but not less than 2 mil or more than 5 mils.

517.3.1.7.4 Handling Coated Steel

(1) Exercise extreme care in handling the steel in the shop, during shipping, during erection, and during subsequent construction of the bridge. Insulate the steel from the binding chains by engineer-approved softeners. Use padded hooks and slings to hoist steel. Pack diaphragms and similar pieces so that no rubbing occurs during shipment that damages the coating. Store the steel at the job site on pallets or other engineer-approved supports, free of the ground or water, and stabilize to preclude falling or contact between members.

517.3.1.8 Field Painting

517.3.1.8.1 General

(1) After completing erection, including all bolting, welding, and straightening, remove all adhering rust, scale, dirt, grease, or other foreign material as specified for cleaning surfaces in 517.3.1.3.

(2) Coat surfaces inaccessible after erection with the field coats the plans show. If the retouch coating applied to the shop coat dries thoroughly and the field cleaning is satisfactorily complete, then apply the field coats as called for.

(3) If traffic produces visible dust, control the dust, at no expense to the department, as necessary on each side of the site and take necessary precautions to keep dust and dirt off freshly painted surfaces or those awaiting paint.

(4) Complete adjoining concrete work including form removal before applying the last field coat. If concrete operations damage the paint, reclean and repaint the surface.

(5) If the precautions taken to protect the work required in 517.3.3 are inadequate, or the atmospheric conditions cause paint drift to become a problem, the engineer may require that the contractor discontinue spraying until taking adequate precautions or until favorable atmospheric conditions exist.

517.3.1.8.2 Field Repair of Shop-Applied Epoxy Systems

(1) Provide a way to inspect structural steel as specified for erecting scaffolding in 517.3.1.1.

(2) Make field repairs according to the coating supplier's recommendations, supplied to the engineer by the steel fabricator. Field repairs include preparing the surface of damaged or welded areas by blast cleaning, and applying the complete 3-coat system of primer, intermediate coat, and protective coat.

(3) Repair and recoat surfaces, that cannot be accessed after erection, before erection.

(4) After completing erection, including all connections and any bent metal straightening, prepare the steel for repairs. Remove adhering scale, dirt, grease, form oil or other foreign matter by appropriate means, and blast clean any rusted or uncoated areas to a near-white finish according to SSPC-SP 10. Remove abrasive and paint residue from steel surfaces by vacuuming or double blowing, except, if double blowing, vacuum the top surfaces of structural steel, including top and bottom flanges, splice plates and hangers afterward. Brush the coating surrounding the blasted area with a non-rusting tool, and recoat with an organic zinc-rich primer produced by the manufacturer that produced the organic zinc-rich primers used in the shop. These requirements for cleaning, mixing, and applying the coating, shall govern applying coating to repaired areas. Dry film thickness requirements for repair coats are the same as for the shop coats. Ensure proper drying conditions exist between coating applications.

(5) Zinc coat bearings, nuts, and bolts according to the coating system manufacturer's recommendations. This procedure includes removing any residuals that might impair application, and applying a wash primer or tie coat before the shop coats.

(6) Any temporary attachments or supports for scaffolding or forms shall not damage the coating system. Use support pads of sufficient size on the fascia where using bracing. Repair any damage that occurs from these devices by the above procedures.

517.3.1.8.3 Urethane Top Coat for Exterior Girders

(1) Field apply a second coat of urethane as a fourth coat to the exterior girder fascia and bottom exterior girder flange surfaces after completing adjoining concrete work, form removal, and repairing field damage as specified in 517.3.1.8.2. Immediately before applying the second coat of urethane, clean 3-coat surfaces to be top coated using a light water blast and allow them to fully dry. Do not apply paint until the engineer has approved the cleaning.

(2) Apply the urethane top coat conforming to 517.3.1.2 and 517.3.1.5 except the top coat may be applied more than 60 days after the first coat of urethane. Use enough urethane to provide a uniform color and appearance, but do not provide less than 1.0 mil or more than 3.0 mils of dry film thickness.

517.3.2 Painting Lumber and Timber

517.3.2.1 General

(1) If painting lumber and timber, unless the contract provides otherwise, prepare the surface; apply, protect, and dry the paint coatings; also, protect traffic and the property upon and in the vicinity of the structure; and protect all portions of the structure against disfigurement by paint or paint materials.

(2) Clean surfaces being painted to ensure they are free from dust, dirt, or other loose or adhering foreign material.

(3) Unless the plans, the specifications, or the contract provides otherwise, apply 3 coats of paint to surfaces requiring paint, consisting of a prime, second and finish coat, with paint conforming to 517.2 for paint for wood surfaces. Ensure each coat conforms to the type of paint the plans, the specifications, or the contract designates, or as the engineer directs.

517.3.2.2 Weather Conditions

(1) If painting wood surfaces, conform to the general weather conditions specified in 517.3.1.2. Do not apply paint if the air temperature is below 40 F.

517.3.2.3 Paint Mixing

(1) Mix paint as specified in 517.3.1.4.

517.3.2.4 Application

(1) Apply paint as specified in 517.3.1.5.1 and in the following:

- If using brushes, apply paint to produce a smooth, uniform, even coating over the wood or previously applied paint and work it into all corners and crevices.
- Do not apply the following coat until the previous coat dries throughout, provided, that at least 3 days elapse before applying any later paint coat.

517.3.3 Protection

(1) The contractor shall remain responsible and shall take precautions, during painting operations, for protecting traffic, parked vehicles, and the property upon and in the vicinity of the structure against damage by paint drift, drops, or spatters; and for protecting all portions of the structure against disfigurement by paint or equipment. The contractor shall also maintain responsibility for protecting the

paint coating during the life of the contract as specified for the contractor's responsibility for work in 107.14.

517.3.4 Structure Repainting

(1) The contractor shall clean and repaint existing structures or parts of existing structures as specified in the special provisions.

517.4 Measurement

(1) The department will measure the Painting Epoxy System bid items as a single lump sum unit for each structure acceptably completed.

517.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
517.0600	Painting Epoxy System (structure)	LS
517.1000	Painting Epoxy System Steel Truss (structure)	LS

(2) Payment for the Painting Epoxy System bid items is full compensation for surface preparation; for furnishing and applying paint materials; for protecting traffic and property; for field repairs; and for applying a urethane top coat to exterior girders.

(3) Unless the plans or special provisions specify otherwise, the department will not pay for priming steel encased in concrete; for painting weathering steel as required under 506.3.32; or for painting steel grid floors, steel railing, steel piling and pile shells, steel sheet piling, drains, downspouts, and miscellaneous steel, This work, including surface preparation, furnishing and applying paint materials, and protecting traffic and property, is incidental to the bid items for the various steel components.

(4) The department will not pay for painting timber structures, timber parts of steel structures, and miscellaneous wooden objects. This work, including surface preparation, furnishing and applying paint materials, and protecting traffic and property, is incidental to the bid items for the various lumber and timber components.

Section 519 Brick Masonry and Concrete Brick or Block Masonry

519.1 Description

(1) This section describes furnishing and laying brick or concrete brick or blocks in cement mortar beds to construct manholes, inlets, or other similar drainage structures, or parts thereof.

519.2 Materials

519.2.1 Clay or Shale Brick

(1) Conform to ASTM C32, grade MS.

519.2.2 Concrete Brick and Block Masonry Units

(1) Conform to ASTM C139 as revised here in 519.2.

(2) For concrete used in footings, furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

(3) For the concrete of these units, use sized, graded, proportioned, aggregates thoroughly mixed in a batch mixer with the required proportions of cement and water, to produce a homogeneous concrete mixture of a quality that the brick or block units conform to the following requirements:

1. Have a minimum compressive strength of 5000 psi (average of 3 units) at 28 days or at the time incorporating into the work if less than 28 days.
2. The maximum water absorption shall not exceed 6 percent by weight.
3. If steam curing the brick or block units, reduce the temperature at a rate not to exceed 40 F per hour until within 20 F of the outside temperature. Maintain the units at a temperature above 32 F during the first 6 days after curing.
4. Identify masonry units conforming to these specifications by stamping a mark on each unit, a pigment color code, or other engineer-approved markings.
5. Use either rectangular block units, or block units curved in shape with the inside and outside surfaces curved to the required radii. For corners use blocks with a return side not less than 1/2 the length of the normal block. Curved blocks shall have inside and outside surfaces parallel.
6. Each block shall have a length of not more than 18 inches, a height of not more than 8 inches. The block width or multiple block widths shall at least equal the structure width the plans show.
7. If using blocks in the cones, or tops of manholes, or other structures, they may have any shape required to form the structure as the plans show with inside and outside joints not more than 3/8 inch thick. Also, design the block so that only full-length or 1/2-length units are required to lay any one course.

519.2.3 Mortar

519.2.3.1 Cement

(1) Furnish masonry cement conforming to ASTM C91, type S.

(2) Furnish hydrated lime conforming to ASTM C207.

519.2.3.2 Sand

(3) Use sand conforming to 501.2.5, except as follows:

- Ensure that sand subjected to the mortar strength test has a tensile or compressive strength at 3 days and 7 days of not less than 85 percent of that developed by mortar of the same proportions and consistency, made of the same cement and standard Ottawa sand.
- Use sand uniformly graded from coarse to fine conforming to the following gradation requirements:

SIEVE	PERCENT PASSING BY WEIGHT
No. 8	95-100
No. 100	25 maximum
No. 200	10 maximum

519.2.3.3 Mortar

(1) Use mortar composed of 3 parts of sand for mortar, and one part of either a mixture of 50 percent portland cement and 50 percent masonry cement, or a mixture of 75 percent portland cement and 25 percent hydrated lime.

(2) Use a machine to mix the mortar unless the engineer allows otherwise. Prepare machine-mixed mortar in an engineer-approved mixer and mix not less than 1 1/2 minutes. If preparing hand-mixed mortar, mix the sand and cement thoroughly in a clean, tight mortar box until uniform in color, then add clean water in a quantity that forms a stiff paste. Do not use mortar mixed longer than 30 minutes or that develops its initial set.

519.3 Construction

(1) Unless the plans or contract provides otherwise, construct concrete footings, not less than 6 inches thick, and that cover the entire structure area under all brick or concrete block masonry.

(2) The contractor shall not construct brick or block masonry in freezing weather or if the bricks or blocks contain frost, except with the engineer's written permission and subject to the conditions the engineer requires.

(3) Before laying, thoroughly wet bricks or blocks and let the surface dry just enough to prevent slipping on the mortar.

(4) The contractor shall not use broken or chipped bricks or blocks on the structure faces except if using to shape around irregular openings.

(5) Lay the first course of bricks or blocks on a full bed of mortar. Lay bricks or blocks in courses with full and close mortar joints. Maintain horizontal courses throughout the structure. Adjoining courses shall break joints by 1/2 the length of a brick or block, if possible. Make at least one course in every 7, for double-wall construction, all headers. If using brick for making closures, make their length not less than the width of a whole brick and, if possible, make closures with whole brick as headers.

(6) Do not make joints more than 1/2 inch thick and use a uniform thickness throughout the structure. Finish joints properly as the work progresses and on exposed faces strike them neatly using the "weather" joint, except if a plaster coat is required rake the joint.

(7) Apply a plaster coat of mortar to the interior and exterior surfaces of brick, concrete brick, or block masonry, in manholes, inlets, and similar drainage structures. Make this plaster coat with the same mortar used in laying the bricks or blocks and make it not less than 1/2 inch thick. Before applying a plaster coat to a brick or block surface, wet them with water and let the surface dry enough to bond to the plaster coat.

(8) As soon after applying the plaster coat to a structure as possible, apply a uniform coating of curing compound conforming to 501.2.9 to the interior and exterior surfaces.

519.4 (Vacant)

519.5 Payment

(1) The department will not pay directly for providing and laying brick masonry or concrete brick or block masonry specified under this section. This work is incidental to the various bid items using it.

Section 520 Pipe Culverts

520.1 Description

(1) This section describes providing culvert pipe, cattle pass, and apron endwalls where the material used is a contractor option; providing and removing temporary culvert pipe; and cleaning existing culvert pipes.

520.2 Materials

520.2.1 Culvert Pipe

(1) Furnish culvert pipe consistent with the diameter the bid item indicates. Furnish materials for the various classes of pipe as follows:

TABLE 520-1 ALLOWABLE MATERIALS FOR CULVERT PIPE

CLASS	ALLOWABLE MATERIALS
III	Class III reinforced concrete, corrugated steel pipe of the thickness contract designates
III-A	Class II and Class III reinforced concrete, corrugated steel of the thickness the contract designates, corrugated polyethylene, corrugated polypropylene
III-A Non-metal	Class II and Class III reinforced concrete, corrugated polyethylene, corrugated polypropylene
III-B	Class III reinforced concrete, corrugated steel of the thickness the contract designates, corrugated polypropylene
III-B Non-metal	Class III reinforced concrete, corrugated polypropylene
IV	Class IV reinforced concrete, corrugated steel pipe of the thickness contract designates
V	Class V reinforced concrete, corrugated steel pipe of the thickness contract designates

(2) For the given materials, conform to the following:

Corrugated steel pipe 521.2
Reinforced concrete pipe 522.2
Corrugated polyethylene pipe 530.2
Corrugated polypropylene pipe 530.2

(3) Under the Culvert Pipe Temporary bid items, use either new or used culvert pipe in a condition suitable for the purpose intended.

520.2.2 Pipe Cattle Pass

(1) Under the Pipe Cattle Pass bid item, if the plans do not designate a specific material, the contractor may use either corrugated steel or reinforced concrete. For the given materials, conform to the following:

Corrugated steel pipe cattle pass 521.2
Reinforced concrete pipe cattle pass 522.2

520.2.3 Apron Endwalls for Culvert Pipe

(1) Under the Apron Endwalls for Culvert Pipe bid items, use steel apron endwalls for corrugated steel, corrugated polyethylene, and corrugated polypropylene pipe culvert installations, and use concrete apron endwalls with concrete pipe culvert installations. For the given materials, conform to the following:

Steel apron endwalls 521.2
Concrete apron endwalls 522.2

520.2.4 Concrete Pipe Collars and Cattle Pass Walkways

(1) For concrete collars and cattle pass walkways, furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

520.2.5 Backfill

520.2.5.1 General

(1) Submit daily quantities for material requiring department testing to the engineer as follows:

- For foundation backfill.
- For trench backfill not obtained from the excavation.

(2) Determine quantities at the point of placement by collecting truck tickets as the material is placed or by another engineer-approved method.

(3) Ensure there is adequate moisture in backfill during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

520.2.5.2 Foundation Backfill

520.2.5.2.1 General

(1) Furnish virgin materials consisting of either sand-sized particles or sand-sized particles mixed with gravel, crushed gravel, or crushed stone. Do not use materials classified under 301.2.4.3 as crushed concrete, reclaimed asphalt, reprocessed material, or blended material. The contractor may use material from the work site.

(2) Ensure that material provided has a liquid limit less than or equal to 25 and a plasticity index less than or equal to 6.

520.2.5.2.2 Gradation

(1) Furnish foundation backfill with a gradation conforming to the following:

- For the entire sample, conform to the following gradation limits:

SIEVE	PERCENT PASSING BY WEIGHT
1 1/4-inch	100
No. 4	25 - 100

- For the portion of the sample passing the No. 4 sieve, conform to the following gradation limits:

SIEVE	PERCENT PASSING BY WEIGHT
No. 4	100
No. 40	___
No. 100	0 - 30
No. 200	0 - 15.0

(2) The contractor may substitute material with a gradation conforming to the following:

3/4-inch dense-graded base course 305.2.2.1
1 1/4-inch dense-graded base course 305.2.2.1

520.2.5.2.3 Sampling and Testing

(1) The department will sample and test material according to the following:

Sampling[1] ..... AASHTO T2
Percent passing the 200 sieve ..... AASHTO T11
Gradation[1] ..... AASHTO T27
Liquid limit ..... AASHTO T89
Plasticity index and plastic limit ..... AASHTO T90

[1] As modified in CMM 8-60.

(2) Submit contractor test results for gradation, liquid limit, and plasticity index testing to the engineer for approval before placing backfill. The engineer may waive contractor testing for known sources.

520.2.5.3 Trench Backfill

(1) Furnish trench backfill consisting of material from the typical roadway section. Use material from the excavation that is free of large lumps, clods, rocks and other perishable and deleterious matter. If the engineer determines that material from the excavation is not suitable, backfill the trench with an engineer-approved material.

520.2.6 Joint Connections

(1) Wrap or seal joints with material conforming to:

Geotextile Type DF, Schedule A 645.2.2.4
Bituminous Mastic Joint Sealer 608.2

520.3 Construction

520.3.1 General

(1) Unless the engineer authorizes otherwise in writing, do not order or deliver pipe culverts for the project until the engineer furnishes a corrected list of sizes and lengths.

(2) Provide temporary drainage facilities necessary to protect the work and adjacent property. Maintain temporary drainage in effective operating condition, as the engineer approves, until the permanent

culvert pipe installations are operational. Remove and dispose of temporary culverts after the permanent culvert pipe installations are operational.

(3) Place foundation and trench backfill in a way that does not damage the pipe.

Revise 520.3.1 to clarify locations where pipe collars are needed.

(4) Construct concrete cattle pass walkways using concrete conforming to 520.2.4 where and as the plans show.

(5) Construct concrete collars using concrete conforming to 520.2.4 where and as the plans show. Also use collars for connections to existing pipe, existing endwalls, or dissimilar pipe materials where the engineer agrees a mortar joint, manufactured joint, coupling, or restraint can not be used.

520.3.2 Excavating and Constructing Foundations for Pipe Culverts

520.3.2.1 Public Highway Culvert

(1) If placing pipe culverts under any public highway in open trenches, either place them in an excavation in the existing ground, or in previously placed embankment compacted as specified for embankment in 207. Place and compact the embankment to at least one foot above the top of the culvert before excavating the trench. Avoid placing embankment to an elevation exceeding 2 feet above the top of the culvert before placing the culvert.

(2) Perform trenching, shoring, and excavating according to 29 CFR part 1926, OSHA subpart P. If utilities and other restraints make sloping or benching of the excavation impracticable, employ a shoring system.

http://www.dol.gov/dol/cfr/title_29/

(3) Make trenches wide enough to provide free working space on each side of the pipe. This space shall not exceed 1/2 the nominal diameter of the pipe, and never be less than 6 inches. The required working space shall depend upon the size of the pipe and the character of the material in the excavation; however, always provide sufficient space between the pipe and the sides of the trench to allow for preparing the foundation, laying the pipe, and placing and compacting the backfill. If the height of the proposed embankment or earth cover above the top of the pipe exceeds 6 feet, excavate the trench below the top of the pipe as vertical as possible.

(4) For steel or concrete pipe, make the trench wide enough to allow for preparing the foundation, laying the pipe, and placing and compacting backfill, except that the trench width shall not exceed the pipe's outside diameter by more than 36 inches. For polyethylene and polypropylene pipe, conform to ASTM D2321 and ensure that the trench is as wide or wider than the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches whichever is wider.

(5) Excavate the trench to at least 6 inches below the elevation established for the bottom of the pipe. Backfill to this depth with foundation backfill. Mechanically compact foundation backfill before laying the pipe. After laying the pipe, place and mechanically compact foundation backfill to an elevation of 12 inches above the pipe to provide full and continuous support. Do not place lifts more than 6 inches thick as measured after compaction. Compact the entire layer before placing the next layer. Do not compact by flooding if using foundation backfill with a dense-graded base gradation.

(6) Excavate and backfill pipe arches as specified above, except backfill and trim to a height that fully and continuously supports the pipe arch.

(7) If the engineer determines that existing foundation material for at least 6 inches below the bottom of the pipe conforms to 520.2.5.1; the contractor need not excavate, backfill, or shape the bed under the pipe.

(8) If rock, hardpan, or fragmented material exists, excavate the trench below the pipe to a depth equal to 1/2 inch per foot of proposed embankment above the top of the pipe, but not less than 6 inches. Construct the foundation and backfill to 12 inches above the pipe with foundation backfill as specified above.

(9) Excavate recesses to receive bells if necessary.

(10) Notify the engineer if the proper bearing cannot be obtained 6 inches below the bottom of the pipe. Excavate unsuitable material as the engineer directs and backfill with foundation backfill.

520.3.2.2 Private Entrance and Temporary Culverts

(1) Shape the earth foundation for the pipe culverts for private entrances, and temporary installations to fit the pipe exterior with reasonable closeness for a height of at least 10 percent of the pipe's overall diameter.

(2) If rock, hard pan, boulders, or fragmented material exist, bed the pipe on an earth, or granular bedding, compacted and shaped similarly to the above, for no less than 6 inches below the pipe.

520.3.3 Laying Pipe

(1) Do not place any pipe culvert until the engineer approves the foundation. Additionally, do not place pipe culverts in cuts until completing the rough grading.

(2) Unless the plans show otherwise, if laying 2 or more pipes next to each other, separate them by a distance equal to at least 1/2 the pipe diameter, with a minimum distance of 18 inches. For pipes with attached apron endwalls, separate them by a distance that provides a minimum of 6 inches between the apron endwalls. For cast-in-place concrete or other alternate endwall installations, space pipes as the plans show.

(3) Lay concrete pipe with bells or grooves up grade and with spigot or tongue ends fully inserted in the bells or grooves. Protect each joint against backfill infiltration by providing a full circumferential wrap of geotextile extending one foot or more on each side of each joint and securing the wrap in place.

(4) The contractor may use sealers instead of the geotextile joint wrap. Seal conforming to 608.3.4.

(5) Provide joint ties on the upstream and downstream ends of circular and horizontal elliptical concrete culvert and concrete cattle pass installations. Tie the last 3 sections or, if using apron endwalls, the endwall and the last 2 sections. Ties are not required on culverts with masonry endwalls unless the plans show otherwise.

(6) For polyethylene or polypropylene pipe, use full pipe sections except as needed to meet the plan specified length. Place full pipe sections at infall or outfall ends unless the engineer allows otherwise. If a partial pipe section must be used at an infall or outfall end, restrain as the manufacturer recommends, or absent a recommendation, use one or more of the following:

- A manufacturer supplied external mechanical coupling.
- A manufactured coupling with a mastic impregnated geotextile wrap and mechanical fastening bands.
- A concrete collar meeting 520.2.4.

(7) Lay riveted or spot-welded corrugated steel pipe so that flow is over the lap of the sheets, except for beveled end sections where the contractor may reverse the lap at the outlet end. Make field joints by joining the metal pipe sections together with a band bolted firmly in place. If elongation of the vertical diameter is specified, provide an appropriately modified prefabricated section.

(8) Ensure that culvert pipe joints are soil-tight as follows:

- For polyethylene according to AASHTO M294.
- For polypropylene according to AASHTO M330.

(9) Lay pipes true to the designated line, grade, and required camber. Fit and match them to form a smooth and uniform invert.

(10) Carefully fit the sections of pipe together to keep the size of joint openings to a minimum.

(11) Clean sockets carefully before lowering pipes into trenches. Lower the pipes in a way that avoids unnecessary handling in the trench.

520.3.4 Backfilling Trenches

520.3.4.1 Public Highway Culverts

(1) Place trench backfill from 1 foot above the top of the pipe to the top of the subgrade in layers no more than 8 inches thick after compaction. Mechanically compact the entire length of each layer to the same degree as the material next to the trench before placing the next layer.

(2) Immediately after backfilling, cushion pipe for at least the trench width with compacted earth. Provide 2 feet or more cover, including backfill depth, above the pipe to prevent damage under construction loads. Maintain this cushion during subsequent operations. Do not walk, travel across, or work near completed pipe until minimum cover is established.

(3) Place the remaining portion of the embankment, if any, above the top of the trench as specified for the adjacent embankment.

520.3.4.2 Private Entrance and Temporary Culverts

(1) Carefully backfill private entrance and temporary culverts in layers no more than 8 inches deep after compaction, then ram and tamp material to completely fill spaces under and next to the pipe.

520.3.5 Placing Apron Endwalls

(1) Excavate the foundation for the apron endwall to the required width and grade. For metal aprons with toe plates, excavate a trench to allow placing the toe plate against the inner face of the trench if the apron is in its final position. After securing the apron to the pipe, backfill and firmly compact the trench.

(2) Place the concrete apron endwall with its tongue or groove fully entered in the groove or tongue of the pipe.

(3) Use the same backfill for the apron as required for the culvert pipe unless the engineer directs otherwise.

520.3.6 Cleaning Culvert Pipes

(1) Clean the existing culvert pipes of dirt and vegetation. Use all suitable materials removed from the culvert pipes in other areas requiring fill material within the project limits as the engineer directs. Dispose of surplus and unsuitable material as specified in 205.3.12.

520.3.7 Deflection Testing

(1) The department accepts polyethylene and polypropylene pipe based on testing with a department-approved mandrel. Test pipe as the engineer directs after installation but before paving or finish grading.

(2) Provide a mandrel with a diameter equal to 92.5 percent of the pipe's nominal diameter and having cable attachment points on each end of the core. Ensure that the mandrel has nine fins or legs permanently marked to designate the pipe size and the allowable percent deflection.

(3) The engineer will designate at least 10 percent of the installed length of pipe for testing The mandrel must pass through the entire section in one pass when pulled by hand without using excessive force. If the designated length of pipe fails, engineer may require additional testing.

(4) Relay or replace pipe with deflection greater than 5 percent. Retest all relayed or replaced pipe.

520.4 Measurement

(1) The department will measure the Culvert Pipe bid items and Pipe Cattle Pass by the linear foot acceptably completed, measured along the invert.

Revise 520.4(2) to specify measurement of Concrete Collars for Pipe only where the plans show or contract requires.

(2) The department will measure the Apron Endwalls, Cleaning Culvert Pipes, and Concrete Collars bid items as each individual unit acceptably completed. The department will only measure Concrete Collars for Pipe if required under 520.3.1(5) or 608.3.3(10).

(3) The department will measure Cleaning Culvert Pipes as each individual culvert acceptably completed.

520.5 Payment

520.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
520.1000 - 1199	Apron Endwalls for Culvert Pipe (size)	EACH
520.2000 - 2099	Culvert Pipe Temporary (size)	LF
520.3100 - 3199	Culvert Pipe Class III (size)	LF
520.3300 - 3399	Culvert Pipe Class III-A (size)	LF
520.3400 - 3499	Culvert Pipe Class III-A Non-metal (size)	LF
520-3500 - 3599	Culvert Pipe Class III- B (size)	LF
520.3600 - 3699	Culvert Pipe Class III-B Non-metal (size)	LF
520.4100 - 4199	Culvert Pipe Class IV (size)	LF
520.5100 - 5199	Culvert Pipe Class V (size)	LF
520.8000	Concrete Collars for Pipe	EACH
520.8500	Pipe Cattle Pass	LF
520.8700	Cleaning Culvert Pipes	EACH

(2) Payment for the Apron Endwalls for Culvert Pipe bid items is full compensation for providing apron endwalls; and for excavating, constructing the foundation, and backfilling. The department will pay separately for cast-in-place concrete and alternate endwall installations under the Concrete Masonry Endwalls bid item as specified in 504.5 and other associated bid items.

Revise 520.5.1(3) to clarify payment for concrete collars.

(3) Payment for Concrete Collars for Pipe is full compensation for providing concrete pipe collars required under 520.3.1(5) or 608.3.3(10).

(4) Payment for Cleaning Culvert Pipes is full compensation for cleaning the culvert pipe and for disposing of excess material.

(5) Payment for the 520 bid items also includes water for compaction and dust control, except if the contract contains the Water bid item, the department will pay separately for water under 624.5.

520.5.2 Culvert Pipe and Cattle Pass

Revise 520.5.2(1) to clarify payment for concrete collars.

(1) Payment for the Culvert Pipe bid items and Pipe Cattle Pass is full compensation for providing pipe; for concrete collars not required under 520.3.1(5) or 608.3.3(10); for excavating, constructing the foundation, and backfilling; for associated dewatering and maintaining drainage; and for concrete cattle pass walkways.

(2) If material from the typical roadway section is not suitable for trench backfill, the department will pay separately for trench backfill under other contract bid items.

(3) The department will pay separately for excavating unsuitable material and backfilling as specified in 520.3.2.1(10) as extra work.

Section 521 Corrugated Steel Culverts

521.1 Description

(1) This section describes providing corrugated steel culvert including pipe, pipe arch, cattle pass, and steel apron endwalls.

521.2 Materials

(1) Furnish corrugated steel pipe and steel apron end walls as follows:

- Corrugated steel culvert pipe, steel apron endwalls, aluminum coated corrugated steel culvert pipe, and other components conforming to AASHTO M36.
- Polymer coated corrugated steel culvert pipe and pipe arch fabricated from zinc coated sheet steel conforming to AASHTO M218. Before fabrication, coat the sheets on both sides with polymer protective coating grade 250/250 according to AASHTO M246. Fabricate the pipe according to AASHTO M245.

521.3 Construction

521.3.1 General

(1) Construct as specified in 520.3.

521.3.2 Coating Repair

(1) Repair damaged zinc coating on cuts according to AASHTO M36.

(2) Repair damaged aluminum coating by blast cleaning, power sanding, or wire brushing the damaged and surrounding areas. Apply zinc-rich paint to the cleaned area within 24 hours and before rusting or soiling occurs, to a minimum thickness of 5 mils.

(3) Repair damaged polymer coating with a polymer coating similar to, and compatible with the original coating, or with a tar base material or asphaltic mastic conforming to AASHTO M243.

521.3.3 Handling Polymer Coated Pipe and Pipe Arch

(1) Minimize damage to polymer coatings during transportation, handling, and installation. Store on padded supports and pad objects placed against polymer coated materials.

521.4 Measurement

(1) The department will measure the LF bid items under this section acceptably completed as specified for pipe in 520.4 and the Apron Endwalls bid items acceptably completed as specified for apron endwalls in 520.4.

521.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
521.0300 - 0699	Apron Endwalls for (type) Cross Drains Steel (size) (slope)	EACH
521.1000 - 1399	Apron Endwalls for (type) Steel (size)	EACH
521.1500 - 1899	Apron Endwalls for (type) Side Drains Steel (size) (slope)	EACH
521.1900	Pipe Cattle Pass Corrugated Steel	LF
521.3100 - 3299	Culvert Pipe Corrugated Steel (size)	LF
521.3700 - 3899	Pipe Arch Corrugated Steel (size)	LF
521.5100 - 5299	Culvert Pipe Corrugated Steel Polymer Coated (size)	LF
521.5700 - 5899	Pipe Arch Polymer Coated Corrugated Steel (size)	LF
521.6100 - 6299	Culvert Pipe Corrugated Steel Aluminum Coated (size)	LF
521.6700 - 6899	Pipe Arch Corrugated Steel Aluminum Coated (size)	LF

(2) The department will pay for the work under this section as specified in 520.5 as follows:

- Pipe, pipe arch, cattle pass, and apron endwalls bid items.
- Cast-in-place concrete and alternate endwall installations.
- Water for compaction and dust control.
- Excavation and foundation backfill at depths greater than 6 inches below the culvert.

Section 522 Reinforced Concrete Culverts

522.1 Description

(1) This section describes providing reinforced concrete culvert including pipe, cattle pass, and concrete apron endwalls.

522.2 Materials

(1) Furnish circular pipe, cattle pass, and circular apron endwalls conforming to AASHTO M170 and as follows:

- Pipe: furnish the class of pipe the bid item indicates.
- Cattle pass: use class III reinforced concrete pipe. Construct walkways as the plans show using cast-in-place grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. For walkway concrete, provide QMP for class III ancillary concrete as specified in 716.
- Apron endwalls: conform to class II.

(2) Furnish horizontal elliptical pipe and elliptical apron endwalls conforming to AASHTO M207 and as follows:

- Pipe: furnish the class of pipe the bid item indicates.
- Apron endwalls: conform to class HE-II.

(3) Manufacture precast reinforced concrete pipe, cattle pass, and apron endwalls in a plant listed under precast concrete fabricators on the department's APL. Conform to the specified AASHTO standard materials requirements except as follows:

- Use concrete with 565 pounds or more cementitious material per cubic yard.
- The contractor may use cement conforming to 501.2.1 or may substitute for portland cement at the time of batching conforming to 501.2.6 for fly ash, 501.2.7 for slag, or 501.2.8 for other pozzolans. In either case the maximum total supplementary cementitious content is limited to 30 percent of the total cementitious content by weight.

(4) Furnish material for joint connections conforming to 520.2.6.

522.3 Construction

(1) Construct as specified in 520.3. For horizontal elliptical pipe also conform to 520.3.2.1(6). Do not use pipe with different wall thicknesses in the same installations unless the plans or special provisions specify otherwise.

522.4 Measurement

(1) The department will measure the LF bid items under this section acceptably completed as specified for pipe in 520.4 and the Apron Endwalls bid items acceptably completed as specified for apron endwalls in 520.4.

522.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
522.0100 - 0599	Culvert Pipe Reinforced Concrete (class) (size)	LF
522.1000 - 1199	Apron Endwalls for Culvert Pipe Reinforced Concrete (size)	EACH
522.1500	Pipe Cattle Pass Reinforced Concrete	LF
522.2300 - 2499	Culvert Pipe Reinforced Concrete Horizontal Elliptical (class) (size)	LF
522.2600 - 2699	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical (size)	EACH

(2) The department will pay for the work under this section as specified in 520.5 as follows:

- Pipe, cattle pass, and apron endwalls bid items.
- Cast-in-place concrete and alternate endwall installations.
- Water for compaction and dust control.
- Excavation and foundation backfill at depths greater than 6 inches below the culvert.

Section 524 Salvaged Culverts

524.1 Description

(1) This section describes excavating and removing existing culvert pipe, including pipe arch, and pipe cattle pass, and apron endwalls; and transporting, cleaning, and reinstalling at new locations the plans show or the engineer directs.

524.2 Materials

(1) Use existing materials. Use new material conforming to 520.2.6 for joint connections.

524.3 Construction

(1) If existing pipe culverts and or apron endwalls, are designated for salvage and use in the new work, remove them from the existing location, clean, handle, transport to, and install at the new location without damaging the pipe culvert. Replace any material damaged by the contractor.

(2) Construct pipe, cattle pass, and apron endwalls at the new location as specified in 520.3.

524.4 Measurement

(1) The department will measure the LF bid items under this section acceptably completed as specified for pipe in 520.4 and the Apron Endwalls bid items acceptably completed as specified for apron endwalls in 520.4.

524.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
524.0100 - 0299	Culvert Pipe Salvaged (size)	LF
524.0600 - 0799	Apron Endwalls for Culvert Pipe Salvaged (size)	EACH
524.0800	Pipe Cattle Pass Salvaged	LF
524.0900	Pipe Arch Salvaged Corrugated Steel (rise x span)	LF

(2) Payment for the LF bid items under this section is full compensation for excavating and removing pipe from existing location; for excavating and associated dewatering; for placing pipe, including furnishing any necessary new bands; for backfilling; for maintaining temporary drainage; for replacing damaged installations; and for providing geotextile joint wrap and joint ties.

(3) Payment for the Apron Endwalls for Culvert Pipe Salvaged bid items is full compensation for excavating and removing apron endwalls from existing location; for cleaning and installing apron endwalls, including bands or connectors; for excavating, including forming bed; for providing geotextile joint wrap and joint ties; and for backfilling.

(4) Payment for the 524 bid items also includes water for compaction and dust control, except if the contract contains the Water bid item, the department will pay separately for water under 624.5.

(5) The department will pay separately for excavating unsuitable material and backfilling as specified in 520.3.2.1(10) as extra work.

Section 525 Corrugated Aluminum Culverts

525.1 Description

(1) This section describes providing corrugated aluminum culvert pipe and aluminum apron endwalls.

525.2 Materials

(1) Furnish corrugated aluminum pipe and aluminum apron endwalls conforming to AASHTO M196.

525.3 Construction

(1) Construct as specified in 520.3.

(2) If the plans show steel apron endwalls with corrugated aluminum pipe, install a suitable insulating material approximately 1/16 inch thick between the pipe and the endwall at the joint. The contractor may use one or more of the following:

- Asphalt impregnated fabric.
- A sheet plastic.
- A rubber gasket.
- Other non-degradable material of substantial strength.

525.4 Measurement

(1) The department will measure the LF bid items under this section acceptably completed as specified for pipe in 520.4 and the Apron Endwalls bid items acceptably completed as specified for apron endwalls in 520.4.

525.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
525.0100 - 0299	Culvert Pipe Corrugated Aluminum (size)	LF
525.0300 - 0399	Apron Endwalls for Culvert Pipe Aluminum (size)	EACH

(2) The department will pay for the work under this section as specified in 520.5 as follows:

- Pipe and apron endwalls bid items.
- Cast-in-place concrete and alternate endwall installations.
- Water for compaction and dust control.
- Excavation and foundation backfill at depths greater than 6 inches below the culvert.

Section 526 Temporary Structures

526.1 Description

(1) This section describes the design, construction, maintenance, and removal of a temporary structure of the width specified and of the necessary waterway area.

526.2 Materials

(1) Furnish materials conforming to part 5. The contractor may incorporate used materials in the structure if they are sound and suitable for the purpose intended.

526.3 Construction

526.3.1 Permits and Coordination

(1) The contractor shall obtain any necessary permits as specified in 107.3 and shall coordinate with the issuing agency in securing the permits and complying with the terms of the permits.

526.3.2 Design

(1) Provide plans, signed and sealed by a professional engineer registered in the state of Wisconsin, for all temporary structures. Submit one copy of plans to place on file. If the engineer requests, submit 2 extra copies of plans for review before ordering materials or starting construction.

(2) The temporary structure shall span the stream and have dimensions sufficient to not constrict stream flow during use. The basic design criteria shall provide for a 5-year frequency storm with 6 inches of backwater. The plans shall show the minimum bridge length between abutment sheet piling, and the resultant five-year frequency high water elevation. Determine the minimum low superstructure elevation using the given high water elevation and considering local conditions. The structure shall have the minimum roadway width specified in the special provisions as measured between the faces of the railings or curbs, and at right angles to the centerline. Provide vertical abutments designed to prevent spilling fill material into the stream. If building a temporary crossing over a stream or lake subject to boating use, construct it to provide horizontal and vertical clearance, as the jurisdictional agency may require, adequate for row boats and small power boats.

(3) Design, construct, and maintain temporary structures conforming to AASHTO LRFD Bridge Construction Specifications, Article 3.5. Design rail and posts according to the WisDOT Bridge Manual, chapter 30.

526.3.3 Temporary Structures

(1) Construct temporary structures conforming to part 5. Backfill conforming to 206.3.13 with structure backfill conforming to 210.2.

(2) Inspect temporary structures conforming to the National Bridge Inspection Standards and the department's structure inspection manual before opening to traffic. Perform additional inspections, as the department's structure inspection manual requires, based on structure type and time in service. Submit inspection reports on department form DT2007 to the engineer and electronic copies to the department's bureau of structures maintenance section. Ensure that a department-certified active team leader, listed online in the department's highway structures information system, performs the inspections.

(3) Maintain temporary structures and approaches in place until no longer needed. Unless the engineer directs otherwise, completely remove and dispose of as specified in 203.3.4. Contractor-furnished materials remain the contractor's property upon removal.

526.4 Measurement

(1) The department will measure the Temporary Structure bid items as a single lump sum for each structure acceptably completed.

526.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
526.0100	Temporary Structure (station)	LS

(2) Payment for the Temporary Structure bid items is full compensation for providing a temporary structure including design and construction; for backfilling with structure backfill; for maintaining; and for removing when no longer needed.

Section 527 Structural Plate Pipe and Pipe Arches

527.1 Description

(1) This section describes providing structural plate pipe, or structural plate pipe arches.

527.2 Materials

(1) Furnish structural plate pipe or structural plate pipe arches fabricated from zinc coated corrugated steel or aluminum alloy structural plates unless the contract specifies otherwise.

(2) Furnish erection bolts and zinc coated corrugated steel plate conforming to AASHTO M167.

(3) Furnish erection bolts and aluminum alloy structural plate conforming to AASHTO M219, except do not use aluminum bolts and nuts.

(4) Furnish plates of the thickness the plans show or the contract specifies.

(5) Furnish pipe arches, for a designated span width, conforming to the span and rise dimensions, and the radii of curvatures the contract designates.

(6) Unless the contract specify otherwise, furnish structural plate pipe and pipe arches with square ends.

(7) Repair damaged spelter coating according to AASHTO M167.

527.3 Construction

527.3.1 Fabrication

527.3.1.1 Description of Plates

(1) Plates shall consist of zinc coated corrugated steel or aluminum alloy structural units. Use the manufacturer's standard plate width and length for the size structure specified, and stagger the joints either circumferentially or longitudinally. Measure plate width circumferentially, or parallel to the highway centerline. Plates shall include an approximately 2-inch lip beyond each end crest, resulting in the given structure's actual length being approximately 4 inches longer than the nominal length, except if skewed or beveled. Connect the plates at longitudinal and circumferential seams by bolts.

(2) Provide the radius of curvature the plans show.

527.3.1.2 Forming and Punching Plates

(1) Curve each plate to the proper radius and punch the bolt holes so all plates curved to the same radius, except end plates, are interchangeable during erection.

(2) Place bolt holes along those plate edges that form longitudinal seams in rows 2 inches apart, with one row in the valley and one in the crest of the corrugations. Stagger the bolt holes between crest and valley for steel plates.

(3) Space the bolt holes along those plate edges that form the circumferential seams in the finished structure approximately 10 inches.

(4) Place the center of the hole no closer to the plate edge than 1 3/4 times the diameter of the bolt.

(5) Punch the bolt holes in steel plates 3/16 inch to 9/32 inch in thickness, inclusive, before zinc coating the plates.

(6) If the completed structure is a circular pipe, curve the plates so that if bolted together they form true circles of the required diameters.

(7) Cut plates for forming skewed or sloped ends to produce the angle of skew or slope specified. Keep burned edges free from oxide and burrs. Place legible identification numerals on each plate part to designate its proper position in the finished structure.

527.3.2 Erection

(1) If erecting a pipe or pipe arch structure in a trench, make the trench a sufficient width to allow thorough backfill compaction.

(2) Bed the pipe or pipe arch in an earth foundation of uniform density, carefully shaped by a template supported at the specified grade to fit the lower plates of the structure. If rock, in either ledge or boulder form is encountered, remove it below grade and replace with foundation backfill conforming to 520.2 to provide compacted bedding of a thickness of not less than 1/2 inch for every foot of fill above the structure, with a minimum allowable thickness of 8 inches. If there is no stable foundation at the grade established, remove and replace unstable soil under the structure and for a width of at least one diameter on each side of the structure with foundation backfill, and compact to provide adequate support for the structure, unless the plans or special provisions specify other special construction methods.

(3) Provide the camber the plans show or the engineer specifies in the foundation bed for a pipe or pipe arch.

(4) After placing all the plates, tighten all bolts to a torque value between 100 foot-pounds and 300 foot-pounds inclusive. Tighten all bolts before starting backfilling.

527.3.3 Backfilling Pipe and Pipe Arches

(1) Backfill with structure backfill conforming to 210.2.

(2) After assembling the pipe or pipe arch, deposit backfill material evenly on both sides of the pipe or pipe arch in layers not greater than 6 inches until at least 3/4 of the depth is backfilled. Ensure thorough backfill compaction at the haunches of pipe arches and between the pipe or pipe arch and the sides of the trench, or for a distance each side of the pipe or pipe arch equal to the diameter of the pipe or pipe arch. Place the remaining 1/4 depth of fill to the top of structure equally on each side of the structure in layers not greater than 12 inches.

(3) Under the engineer's supervision, construct an earth cover over the structure before driving heavy construction equipment over it.

527.3.4 Vertical Elongation

(1) If the plans specify pipe of 60 inch diameter or more, elongate it vertically 5 percent before placing fill. Pre-form the plates in the shop to provide the required elongation.

527.3.5 Defective Work

(1) The department may reject work containing one or more of the following defects:

Elliptical shaping, unless specified.	Uneven laps.
Variation from a straight centerline.	Ragged edges.
Loose, unevenly lined, or spaced bolts.	Illegible brand.
Bruised, scaled, or broken spelter coating.	Dents or bends in the metal.

527.4 Measurement

(1) The department will measure the Pipe Structural Plate and Pipe Arch Structural Plate bid items installed by the linear foot acceptably completed, measured along the invert.

527.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
527.0100 - 0299	Pipe Structural Plate (size)	LF
527.0300 - 0499	Pipe Arch Structural Plate (span)	LF

(2) Payment for the Pipe Structural Plate and Pipe Arch Structural Plate bid items is full compensation for providing the pipe or pipe arch including foundation backfill. The department will pay separately for cast-in-place concrete and alternate endwall installations under the Concrete Masonry Endwalls bid item as specified in 504.5 and other associated bid items.

(3) The department will pay separately for backfilling under the Backfill Structure bid item as specified in 210.5.

(4) The department will pay separately for excavation under the Excavation for Structures Structural Plate Pipe or Pipe Arches bid item as specified in 206.5.

(5) Payment for the 527 bid items also includes water for compaction and dust control, except if the contract contains the Water bid item, the department will pay separately for water under 624.5.

Section 530 Corrugated Plastic Pipe Culverts

530.1 Description

(1) This section describes providing corrugated polyethylene and polypropylene culvert pipe.

530.2 Materials

(1) Furnish culvert pipe with a corrugated outer wall and a smooth inner liner. Ensure that the culvert pipe conforms to the plans and as follows:

- For polyethylene conform to AASHTO M294 type S.
- For polypropylene conform to AASHTO M330 type S.

(2) If the contract requires apron endwalls, use standard steel apron endwalls, steel endwalls sloped for cross or side drains conforming to 521.2, or aluminum apron endwalls conforming to 525 as the contract specifies. Furnish connector rods, connector bands, or other devices that fit the culvert pipe corrugations and provide a tight connection between the culvert and endwall.

530.3 Construction

(1) Construct as specified in 520.3 for pipe culverts.

530.4 Measurement

(1) The department will measure the Culvert Pipe items under this section acceptably completed as specified for pipe in 520.4.

530.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
530.0100 - 0299	Culvert Pipe Corrugated Polyethylene (size)	LF
530.1100 - 1299	Culvert Pipe Corrugated Polypropylene (size)	LF

(2) The department will pay for the work under this section as specified in 520.5 as follows:

- Pipe bid items.
- Cast-in-place concrete and alternate endwall installations.
- Water for compaction and dust control.
- Excavation and foundation backfill at depths greater than 6 inches below the culvert.

(3) The department pay separately for steel apron endwalls, sloped steel endwalls for cross drains, or sloped steel apron endwalls under the appropriate 521 bid items; and for aluminum apron endwalls under the appropriate 525 bid items.

Section 550 Driven Piles

550.1 Description

(1) This section describes providing steel piles, cast in place concrete piles, and precast concrete piles; providing test piles; driving piles; and determining required driving resistance. This section also describes preboring or redriving.

550.2 Materials

550.2.1 Steel Piles and Pile Shells

(1) Submit a certified report of test or analysis as specified in 506.3.21 at or before pile delivery unless the engineer directs or allows otherwise. Ensure that piles have marks tying them to a specific test report, or absent marks, certify that all material furnished is represented by a submitted test report. Provide marks or certifications for each piece of a pile fabricated from multiple pieces.

(2) For HP sections, use ASTM A572 grade 50 steel unless the plans show otherwise. If the engineer allows, the contractor may substitute steel pipe or steel oil field pipe for HP piles. Use pipe with an outside diameter of 7 3/4 inches or greater, a wall thickness of 3/8 inch or greater, and a cross-sectional area that equals or exceeds 97 percent of the area of the HP section replaced.

(3) For steel pipe sections and steel pile shells for cast-in-place concrete piles, use ASTM A252 grade 2 steel or an engineer-approved alternate.

(4) For steel oil field pipe sections, use ASTM A252, Grade 3 steel with a maximum tensile strength of 85,000 psi. At or before delivery, certify the pipe's chemical composition and ensure that its carbon equivalency (CE) does not exceed 0.50 calculated as follows:

$$CE = C+(Mn+Si+Cr+Mo+V)/6+(Ni+Cu)/15$$

(5) Ensure that each individual oil field pipe delivered to the project conforms to the bill of lading and is marked to uniquely identify the load with a marking that is durable and legible. Use oil field pipe delivered in a magnetized condition for non-welded applications only.

550.2.2 Cast in Place Concrete Piles

(1) Furnish materials conforming to the following:

Concrete Grade A, A-FA, A-S, A-T, A-IS, A-IP, and A-IT 501
Steel Reinforcement 505
Steel pile shells 550.2.1
Steel shell end plates 506.2.2.2

(2) The department will accept concrete by certification as specified for class III ancillary concrete in 716.

(3) Ensure that steel pile shells have a minimum nominal wall thickness of 0.219 inches unless the plans or special provisions specify otherwise. Use seamless cylindrical tubes or cylindrical tubes with a straight or spiral welded seam.

Revise 550.2.2(4) to require watertight welds for pile shell end plates.

(4) Ensure that shell end plates are 3/4 or more inches thick, and have an outside diameter that does not exceed the pile outside diameter by more than 3/4 inch unless the plans show otherwise. Also ensure that shell end plate welds are watertight.

550.2.3 Precast Concrete Piles

(1) Furnish materials for precast concrete piles as specified for I-type girders in 503.2 modified as follows:

1. Use air-entrained concrete for all piles unless the contract specifies otherwise.
2. Provide 28-day compressive strength of 6000 psi unless the contract specifies greater strength.

(2) Construct precast concrete piles conforming to 503.3.2 and 503.3.3 to plan dimensions within the following tolerances:

Cross-sectional dimensions ..... +/- 1/8 inch
Chamfers, miters, bevels, and radii ..... +/- 1/8 inch
Pre-stressing steel location ..... +/- 1/8 inch
Length ..... +/- 1/8 inch per 10 feet of length, not to exceed +/- 1/2 inch
Variation from true plane along the long axis ..... +/- 1/8 inch per 10 feet of length, not to exceed +/- 1/2 inch

(3) Transport, handle, and store to prevent damage. Do not deliver to the job site until the piles have developed their full design strength. Support during transport at designated lifting or supporting points or provide additional support as the fabricator recommends. Lift at points the plans show using fabric or braided wire rope slings or other device that will not damage the pile surface or corners. Store on supports positioned, at a minimum, at designated lifting or supporting points.

550.2.4 Pile Points

(1) Furnish commercially manufactured pile points from the department's APL.

550.3 Construction

550.3.1 General

(1) Use only one type of pile throughout a structure unless the plans show or the engineer allows otherwise.

(2) Coordinate pile driving operations to prevent damage or displacement of concrete in substructure units. Do not drive test or production piles until excavation for that unit is complete. Remove material after driving piles as required to reestablish the correct elevation within the substructure footing limits before placing concrete.

(3) Drive piles with a variation of 1/4 inch or less per foot from the vertical or from the batter the plans show. Ensure that trestle bent piles, concrete encased pile bents, and piles within mechanically stabilized earth walls are within 3 inches of the plan position after driving and that pile cap placement does not adversely affect pile resistance. Ensure that other piles are within 6 inches of the plan position after driving. Do not damage piles attempting to correct for misalignment.

(4) Drive piles continuously to the required driving resistance, and if the plans show, to or beyond the required minimum tip elevation. Do not suspend driving operations for more than 3 hours without the engineer's approval.

(5) Drive piles in pile groups starting at the center of the group and proceeding outward in both directions, or start at the outside row and proceed progressively across the group. Re-drive piles pushed up 0.25 inch or more using engineer-approved equipment and methods.

(6) Remove and replace or otherwise correct piles the engineer deems unacceptable under 105.3. Causes for rejecting a pile include but are not limited to the following:

- Piles placed out of position or misaligned vertically by more than the specified tolerance.
- Piles with damage such as bends, breaks, kinks, deformation, cracking, or spalling resulting from internal defects, improper handling, or improper driving.

(7) Submit details of planned corrections to the engineer for review and approval before initiating any corrective action.

550.3.2 Ordering Piles

(1) Pile lengths the plans show are approximate. Furnish piles long enough to obtain the required driving resistance the plans show for each pile. Furnish test piles of the length the plans show. Order production piles based on test pile driving results.

550.3.3 Required Lengths

550.3.3.1 Steel Piles and Pile Shells

(1) Furnish steel HP, steel pipe, and steel oil field pipe sections 20 feet or shorter with no splices. For piles greater than 20 feet long through 50 feet long, furnish piles with no more than two shop or field splices. For piles greater than 50 feet long, furnish piles with no more than four shop or field splices.

(2) Furnish steel pile shells 50 feet or shorter with no more than three shop or field splices. For piles greater than 50 feet long, furnish piles with no more than four shop or field splices.

(3) The contractor may extend piles with 5-foot or longer field cutoffs to provide the additional length needed to achieve required driving resistance.

550.3.3.2 Precast Concrete Piles

(1) Furnish precast concrete piles 60 feet or shorter with no splices. For piles greater than 60 feet long through 120 feet long, furnish piles with no more than one splice. For piles greater than 120 feet long, conform to splicing requirements the plans show or special provisions specify.

550.3.4 Splices

550.3.4.1 Steel Piles and Pile Shells

550.3.4.1.1 General

(1) Conform to splice details the plans show. If substituting pipe or oil field pipe for HP piles, submit proposed splicing details to the engineer for approval. Ensure that splices transfer the full pile or pile shell strength in compression, tension, and bending. Ensure that pile shell splices are watertight. Except as allowed for oil field pipe, do not use mechanical splices.

(2) Weld splices conforming to the AWS D1.1/D1.1M Structural Welding Code-Steel. Use shielded metal arc welding (SMAW) for welds on portions of piles that will be above grade in service.

Revise 550.3.4.1.1 to require an inspector from the contractor's current field welding plan described in (DT2337).

(3) Visually inspect and certify the quality of field welds as follows:

1. Designate an inspector listed in the current contractor field welding plan described in department form DT2337.
2. Have the designated inspector complete department form DT2320 and submit to the engineer for inclusion in the permanent project record.

550.3.4.1.2 Steel Oil Field Pipe Piling

(1) Position backup rings flush with the joint and place according to AWS D1.1/D1.1M Structural Welding Code-Steel. Ensure that the rings allow the joint to contract freely as the weld cools. Make tack welds the smallest size necessary to hold the pipe ends in alignment for welding.

(2) For materials not listed in table 3.1 of the AWS D1.1 code, preheat for a distance of 5 inches on both sides of the weld as follows:

- CE less than 0.35: heat to 100 F.
- CE greater than or equal to 0.35 and less than or equal to 0.45: heat to 175 F.
- CE greater than 0.45 and less than or equal to 0.50: heat to 300 F.

(3) Protect the pipe ends from high winds and precipitation during welding.

(4) If the engineer approves, the contractor may use threaded or mechanical splices.

550.3.4.2 Precast Concrete Piling

(1) Conform to splice details the plans show.

550.3.5 Driving Equipment

550.3.5.1 General

(1) Furnish a pile driving system capable of driving piles to the required driving resistance with a minimum blow count of 30 blows/foot and with a minimum rated hammer energy of 12,500 ft-lbs.

(2) The engineer will determine if the contractor's equipment is capable of driving piles to the required driving resistance and tip elevation. Do not drive piles until the engineer approves the driving equipment.

(3) Use an engineer-approved pile driving system. Submit department form DT3550 to the engineer at least 30 days before driving piles. Resubmit DT3550 if proposing changes to a previously approved pile driving system.

(4) The engineer may order the contractor to remove pile driving system components from service it they cause insufficient energy transfer or damage the pile. Do not return a component to service until the engineer determines that it has been satisfactorily repaired or adjusted.

550.3.5.2 Hammers

(1) Drive piles with diesel, air, steam, gravity, or hydraulic hammers. Do not use vibratory hammers unless the engineer approves. Re-strike piles driven with vibratory hammers with an impact hammer to determine the required driving resistance.

(2) Ensure that single acting diesel hammers are configured to accurately determine hammer stroke visually during driving. Provide a hammer manufacturer's chart equating stroke to equivalent energy.

(3) Ensure that double acting diesel hammers have a bounce chamber pressure gauge easily read from ground level. Provide a chart, calibrated to actual hammer performance, certifying the bounce chamber pressure that equates to either equivalent energy or stroke. At the beginning of pile driving, provide a hammer calibration chart that is less than 90 days old and recalibrate and provide a new certified chart at least every 90 calendar days during driving operations.

(4) Ensure that air, steam, or hydraulic hammers and associated equipment can maintain the manufacturer’s specified volume and pressure under working conditions and have easily accessible pressure gauges. Also ensure that the hammer striking parts of air or steam hammers weigh at least 2750 pounds and exceed the weight of the helmet plus pile being driven.

550.3.5.3 Hammer Cushions

(1) For impact driving systems designed to use hammer cushions, provide cushions thick enough to prevent hammer or pile damage and ensure uniform driving behavior. Use materials conforming to the hammer manufacturer’s specifications except do not use wood, wire rope, or asbestos. Use a manufacturer recommended striker plate to ensure uniform compression within the cushion. Remove the cushion for engineer inspection when project pile driving begins and after each 100 hours of driving. Replace when the cushion is less than 75 percent of its original thickness.

550.3.5.4 Helmets

(1) Use lead-guided helmets to distribute hammer blows to the pile head while maintaining axial alignment between the hammer, helmet, and pile. Do not use free-swinging helmets.

550.3.5.5 Pile Cushions

(1) Use a new plywood, hardwood, or composite plywood/hardwood cushion to protect the head of each pre-cast concrete pile. Provide 4-inch or thicker cushions shaped to match the top of the pile. Replace when less than 50 percent of its original thickness or if it begins to burn. Submit requests to use cushions made of materials other than wood to the engineer for review and approval.

550.3.5.6 Leads

(1) Provide either fixed or swinging leads with all pile hammers. Ensure that leads give the hammer freedom of movement while maintaining a concentric impact under each hammer blow.

(2) Rig swinging leads to maintain axial alignment between the hammer line of travel and pile. Maintain alignment during driving using braces or other supports and provide a pile gate at the bottom of the leads.

(3) Unless driving piles through water, use leads long enough to preclude the need for followers.

550.3.5.7 Followers

(1) If driving piles through water and if the engineer allows, the contractor may use followers to drive the pile to the required depth or elevation. Ensure that using followers does not damage the piles.

550.3.5.8 Water Jets

(1) If the contract allows or engineer approves, the contractor may use water jets for end bearing piles. Use enough jets with enough water volume and nozzle pressure to freely erode material next to the pile without affecting lateral stability of the completed pile. Use equipment capable of operating two 3/4-inch nozzles simultaneously with 100 or more psi pressure at each nozzle.

550.3.6 Driving Resistance

(1) Drive piles to the depths necessary to obtain the required driving resistance as determined by the modified Gates formula as follows:

$$P = (0.875 \times E^{1/2} \times \log(10/s)) - 50$$

where:

P = Nominal resistance in tons.

E = Energy produced by the hammer per blow in foot-pounds.

s = Average penetration in inches per blow for the final 10 to 20 blows. For piles driven to a predominantly end bearing condition, compute over a maximum distance of 1 inch.

(2) If the plans show a minimum tip elevation, drive to that elevation even if required driving resistance is achieved sooner. Drive beyond that elevation if necessary to also achieve required driving resistance.

550.3.7 Pile Redriving

(1) Under the Pile Redriving bid item, drive 15 percent of the piles in each substructure unit to plan length or to the required driving resistance whichever occurs sooner. If required driving resistance is not obtained in the plan length, allow the pile to set up for 24 hours or more, then restrike. Determine the required driving resistance using the first 10 hammer blows during restrike. If required driving resistance is still not obtained, splice on additional length if needed, and drive the pile an additional 10 feet, or to the depth the engineer directs, and restrike after allowing the pile to set up for another 24 hours or more. Repeat this process until the required driving resistance is obtained. After obtaining the required driving resistance, drive the other piles in the substructure to the same tip elevation.

(2) Restrike with the same pile driving system used to drive the production piles. Warm up the hammer by striking another pile a minimum of 20 blows before restriking.

550.3.8 Test Piles

(1) Drive test piles at locations the plans show to both the required driving resistance, and if the plans show, to the required minimum tip elevation. Complete excavation for the associated substructure unit before driving test piles. Use the same driving system as will be used to drive the production piles. Do not drive any production piles for the associated substructure unit until all test piles are driven.

550.3.9 Pre-Boring

550.3.9.1 General

(1) Pre-bore holes to the depth the plans or special provisions require. Submit written requests for pre-boring not required under the contract to the engineer for review and approval. Do not impair the capacity of in-place piles or damage adjacent structures by pre-boring operations.

550.3.9.2 Pre-Boring in Unconsolidated Materials

(1) For round piles, pre-bore holes of approximately the pile diameter. For other shapes, pre-bore holes of a diameter approximately equal to the greatest diagonal pile section dimension. Increase the diameter as necessary for pile installation if subsurface obstructions are encountered.

(2) Maintain an open hole for pile installation using temporary casing if necessary. Do not remove casing until the pile is placed in the pre-bore hole. After driving, backfill around the pile with sand or other engineer-approved material and dispose of excess material.

550.3.9.3 Pre-Boring in Rock or Consolidated Materials

(1) For round piles, pre-bore holes at least one inch larger than the pile outside diameter. For other shapes, pre-bore holes at least one inch larger than the greatest diagonal pile section dimension.

(2) Case holes as necessary to prevent introduction of unconsolidated material. Seat the casing firmly into the rock or consolidated material surface. Clear debris from the pre-bore hole before installing the pile.

(3) Firmly seat piles after preboring and backfill within the rock or consolidated material with a cement grout. Remove the casing, backfill the piles with sand or other engineer-approved material, and dispose of excess material.

(4) Do not blast without the engineer's approval.

550.3.10 Pile Points

(1) Attach pile points conforming to the manufacturer’s instructions unless the plans show otherwise.

550.3.11 Finishing Piles

550.3.11.1 General

(1) Cut off piles to a true plane at the plan elevation. Cut off pile shells for cast-in-place concrete piles before placing concrete. Pile cut-offs become the contractor's property.

(2) For steel oil field pipe piles, remove soil, water, and other materials within the pile to the bottom of the footing elevation. Fill any void below this elevation with engineer-approved material or install a barrier acceptable to the engineer at or below this elevation.

550.3.11.2 Cast-in-Place Concrete

(1) Remove water or other foreign material from inside shells before placing concrete. Do not place concrete under freezing conditions without the engineer's approval.

(2) Place steel reinforcement as the plans show ensuring that it is in the correct location when the level of concrete placement reaches the lower limits of that reinforcement.

(3) After the engineer inspects and approves the pile shells, deposit the concrete in each shell in a continuous operation at a rate that causes no air pockets or cold joints. For pile shells with an inside diameter greater than 16 inches, place concrete with a tremie or downspout within the shell. Fill the shell completely with concrete and consolidate to a depth as great as practicable with a mechanical vibrator or by other engineer-approved method.

(4) Do not place concrete in shells that are within a 15 feet radius of other shells not yet driven. If this requirement cannot be met, suspend pile driving operations until minimum concrete cures times are met or minimum compressive strengths are achieved. If using high early strength concrete, the minimum cure time is 3 days. If using a grade A concrete, the minimum cure time is 14 days. For A-FA, A-S, A-T, A-IS, A-IP, and A-IT concrete, the minimum cure time is 7 days. If using strength, do not resume driving until achieving a compressive strength of 2500 psi or more, determined as specified in 502.3.4.2.

550.3.11.3 Painting

(1) Use a paint system from the department's APL. Paint steel piles that are exposed in the completed work from the top of the pile to 4 feet or more below the streambed or ground line. Ensure that painted areas are fully cured before driving.

(2) Prepare the surface and apply paint as specified in 517, except blast clean conforming to SSPC-SP10.

(3) Handle painted piling with padded slings, nonmetallic slings, or softeners to minimize paint damage. Repair damaged paint exposed above either the water or ground line.

550.4 Measurement

(1) The department will measure the Piling bid items by the linear foot acceptably completed, measured as the length of piling driven and left in place below the cutoff elevation.

(2) The department will measure Pile Points as each individual point acceptably installed.

(3) The department will measure the Pre-Boring bid items by the linear foot acceptably completed, measured from the footing base to the depth the plans show or engineer directs.

(4) The department will measure Pile Splices Precast Concrete as each individual splice acceptably completed. The department will not measure splices for production or test piles fabricated to plan length or more than 1 splice per 20 linear feet of pile length in excess of the plan length.

(5) The department will measure Pile Redriving as each individual restrike acceptably completed. There may be multiple restrikes per pile.

550.5 Payment

550.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
550.0010	Pre-Boring Unconsolidated Materials	LF
550.0020	Pre-Boring Rock or Consolidated Materials	LF
550.0500	Pile Points	EACH
550.0600	Pile Redriving	EACH
550.1100 - 1500	Piling Steel HP (size)	LF
550.2100 - 500	Piling CIP Concrete (size) (shell thickness)	LF
550.3100 - 3500	Piling Precast Concrete (size)	LF
550.3810 - 3816	Pile Splices Precast Concrete (size)	EACH

(2) Payment for the Pre-Boring bid items is full compensation for drilling the pre-boring holes; for furnishing; installing, and removing casing; for backfilling; and for disposing of excess material. The department will not pay for pre-boring the contract does not require or for repairing damage to adjacent structures caused by the contractor's pre-boring operations.

(3) Payment for Pile Points is full compensation for providing and attaching pile points.

(4) Payment for Pile Redriving is full compensation for restriking as required to measure the driving resistance including associated delay, movement of equipment, and mobilization costs.

(5) Payment for the Pile Splices Precast Concrete is full compensation for providing field splices.

550.5.2 Piling

(1) Payment for the Piling bid items is full compensation for providing piles; for driving piles; for cutting off piles; for re-driving heaved up piles; for concrete; for painting; and for excavating material within the footing perimeter heaved up by pile driving operations.

(2) Except for precast concrete piles, the department will pay the contract price for 9 feet of HP piling or 6 feet of other piling types for splices under the Pile Splices administrative item. The department will not pay for splices made between the pile tip and the plan length. For splices made beyond the plan length, the department will pay for a maximum of one splice for each 30 feet or fraction of 30 feet beyond plan length. The department will only pay for splicing if piles conform to the following:

1. The required driving resistance cannot be achieved in the length the plans show.
2. Splices conform to the contract.
3. The spliced pile is acceptably driven to the plan required driving resistance.

(3) The department will not entertain a change order request for a differing site condition under 104.2.2.2 or for a quantity change under 104.2.2.4.3 for the Piling bid items. Instead the department will adjust pay under the Piling Quantity Variation administrative item if the total driven length of each size is less than 85 percent of, or more than 115 percent of the contract quantity as follows:

PERCENT OF CONTRACT LENGTH DRIVEN	PAY ADJUSTMENT
< 85	(85% contract length - driven length) x 20% unit price
> 115	(driven length - 115% contract length) x 5% unit price

Part 6 Incidental Construction

Section 601 Concrete Curb and Gutter

601.1 Description

(1) This section describes constructing concrete curb, gutter; or curb & gutter, with, or without reinforcement.

601.2 Materials

(1) Furnish materials conforming to the following:

Joint filler 415.2.3

Concrete 501

(2) Provide grade A, A2, A-FA, A-S, A-S2, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class II ancillary concrete as specified in 716.

601.3 Construction

601.3.1 General

(1) The engineer will inspect concrete built under 601 for transverse cracking as specified in 415.3.17 for ancillary concrete. Repair cracked concrete as the engineer directs.

601.3.2 Preparing the Foundation

(1) Prepare the foundation by excavating to the lines, grades, and cross-section the plans show and required for placing concrete. Remove and replace soft or unsuitable material with suitable material. Compact thoroughly and finish the foundation or material underlying the proposed curb, gutter, or curb & gutter to a firm, true surface. Thoroughly moisten the foundation immediately before placing the concrete.

(2) If the plans show, place aggregate base under curb, gutter, or curb & gutter, at the locations, thickness, and section the plans show.

(3) Place granular subbase, if the plans show, or the special provisions specify, under curb, gutter, or curb & gutter at the locations, thickness, and section called for.

(4) If the plans show, provide drainage for curb, gutter, or curb & gutter, foundation with underdrains, constructed as specified for underdrains in 612, where the plans show or the engineer directs.

601.3.3 Forms

(1) Use wood or metal forms straight and with sufficient strength to resist springing, tipping, or other displacement during depositing and consolidating the concrete. Use surfaced planks for wood forms at least 2-inch nominal thickness stock, except for sharply curved sections. Use metal forms of engineer-approved section. Use forms that are the full depth of the required curb, gutter, or curb & gutter sections and designed to allow secure fastening. If used, construct and shape face boards, so that their lower edge conforms to the lines and radius shown by the cross-section for the pertinent structure the plans show. For curves of 100-foot radius or less, use flexible or curved forms of proper radius. Clean and oil forms before placing concrete against them.

601.3.4 Placing Concrete

(1) The contractor may use a machine to place, form, and consolidating curb, gutter, or curb & gutter. The resulting curb, gutter or curb & gutter shall equal or exceed that produced by forming.

(2) Deposit, consolidate, and slip form the concrete to the required section. If not using a slip form process, deposit the concrete in the forms to the proper depths, spade against the forms, and consolidate thoroughly. Use mechanical vibration for concrete with slump less than 2 inches. After consolidation strike off, and finish to the required section.

(3) Unless constructed integrally with concrete pavement, securely anchor concrete curb, gutter, or curb & gutter, to adjoining concrete pavement by placing specified tie bars if and as the plans show.

(4) Tie new work to existing concrete pavement using tie bars driven or epoxied into the existing concrete. Use only cast-in-place tie bars in construction joints between pavement and curb, gutter, or curb & gutter placed under the contract.

(5) Form contraction joints by sawing or forming an induced plane of weakness at least 2 inches deep in the curb, gutter, or curb & gutter directly opposite construction or contraction joints in adjoining concrete pavement and at the required spacing in curb, gutter, or curb & gutter adjoining asphaltic pavement. Space joints between 6 feet and approximately 20 feet apart, as the engineer directs.

(6) Obtain the engineer's approval for the cut depth and the sawing equipment. Saw as soon as possible after the concrete sets sufficiently to prevent raveling during sawing, and before shrinkage cracking takes place. If this method results in random cracking, then form an induced plane of weakness.

(7) If using separators, remove them as soon as possible after striking off, consolidating, and setting sufficiently to protect the joint width and shape. If using face forms, remove them for finishing curb face and fillets as soon as the concrete retains its shape.

(8) Construct depressions in or revisions of the curb, in curb, or curb & gutter to accommodate curb ramps and driveways at locations and as the plans show.

601.3.5 Finishing

(1) Float and brush the face surfaces of the curb, or curb & gutter. Unless specified otherwise, round the back edge of curbs, the edge of the gutter next to the pavement, and edges next to expansion joints or induced contraction joints, with a 1/4 inch radius edger.

601.3.6 Expansion Joints

(1) Place expansion joints in curb, gutter, or curb & gutter constructed next to asphaltic pavement or surfacing. Locate joints everywhere that tangent and radial curb, or curb & gutter meet; on each side of every inlet 3 feet from the inlet, but no closer than 6 feet from another joint; and on tangent sections place between 6 feet and 300 feet.

(2) If constructing curb, gutter, or curb & gutter next to, or on, concrete pavement constructed with expansion joints, then place expansion joints to match the expansion joint locations in the pavements.

(3) Set joints at right angles to the face and top of the curb, and at right angles to the flow line and surface of gutters. Use 3/4-inch wide joint filler conforming to 415.2.3.

601.3.7 Protecting and Curing

(1) Protect as specified for concrete pavement in 415.3.14.

(2) Cure the concrete as specified in 415.3.12.

601.3.8 Protecting in Cold Weather

(1) Conform to 501.3.9 for curb, gutter, or curb & gutter placed during cold weather.

601.3.9 Integral Construction

(1) Unless specified otherwise in the contract, the contractor may construct curb, gutter, or curb & gutter by slip forming integrally with the pavement. Construct to the section the plans show. Extend the transverse joints in the pavement through the integral curb, gutter, or curb & gutter.

(2) Dowel bars are not required within the limits of the integral curb, gutter, or curb & gutter. A tied longitudinal joint may be required to limit panel width to the maximum the plan details specify.

601.4 Measurement

(1) The department will measure the curb, gutter, and curb & gutter bid items under this section by the linear foot acceptably completed.

(2) The length measured equals the distance along the base of the curb face, or along the flow line of the gutter. The department will measure continuously along a line extended across driveway and alley entrance returns or ramps.

(3) The department will not make deductions in length for drainage structures installed in the curbing such as drop inlets, etc.

(4) The department will measure excavation required for and performed during this work, if covered by a bid item in the contract, as specified in the specifications. However, if the contract does not provide a bid item for excavation, it is incidental to the work.

601.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
601.0100 - 0149	Concrete Curb (type)	LF
601.0150 - 0199	Concrete Curb Integral (type)	LF
601.0200 - 0249	Concrete Gutter (inch)	LF
601.0300 - 0339	Concrete Curb & Gutter (inch)	LF
601.0340 - 0349	Concrete Curb & Gutter Integral (inch)	LF
601.0400 - 0449	Concrete Curb & Gutter (inch) (type)	LF
601.0450 - 0499	Concrete Curb & Gutter Integral (inch) (type)	LF
601.0500 - 0549	Concrete Curb & Gutter Integral (inch) Sloped (inch)	LF
601.0550 - 0599	Concrete Curb & Gutter (inch) Sloped (inch) (type)	LF

601.0600	Concrete Curb Pedestrian	LF

(2) The department will adjust pay for crack repairs on concrete built under 601 as specified in 416.5.2 for ancillary concrete.

(3) Payment for the curb, gutter, and curb & gutter bid items under this section is full compensation for foundation excavation and preparation; special construction required at driveway and alley entrances, or curb ramps; for providing materials, including concrete, expansion joints; for placing, finishing, protecting, and curing; for sawing joints; and for disposing of surplus excavation material, and restoring the work site. However, if the contract provides a bid item for excavation, then the department will pay for excavation required for this work as specified in the contract. Payment also includes providing tie bars in unhardened concrete. For tie bars provided in concrete not placed under the contract, the department will pay separately under the Drilled Tie Bars bid item as specified in 416.5.

Section 602 Concrete Sidewalks, Loading Zones, Safety Islands, and Steps

602.1 Description

(1) This section describes constructing sidewalks, loading zones, safety islands, and steps including landings, of concrete, with or without reinforcement.

(2) Unless specifically specified in the contract, sidewalks or steps built integral with and as a part of bridges or culverts are not included.

602.2 Materials

(1) Furnish materials conforming to the following:

Expansion joint filler 415.2.3
Concrete 501
Reinforcement 505
Electrical conduit 652

(2) Provide grade A, A2, A-FA, A-S, A-S2, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class II ancillary concrete as specified in 716.

(3) Furnish cast iron detectable warning fields for curb ramps from the department's APL for the color defined in the Curb Ramp Detectable Warning Field bid items.

602.3 Construction

602.3.1 General

(1) The engineer will inspect concrete built under 602 for transverse cracking as specified in 415.3.17 for ancillary concrete. Repair cracked concrete as the engineer directs.

602.3.2 Sidewalks

602.3.2.1 Preparing the Foundation

(1) Form the foundation by excavating or filling to the required elevation of the concrete bottom, or subbase bottom if specified. Tamp or compact the foundation to ensure stability. In cuts, make the foundation wide enough to allow placing forms and performing concrete placement and finishing. On embankments, construct the foundation at least 2 feet wider than the proposed sidewalk and extend it at least one foot beyond each end of the sidewalk.

(2) Unless specified otherwise, fill holes, ruts, and other depressions in the foundation with materials similar to those in the existing foundation. The contractor may use granular subbase or aggregate base.

(3) If the plans show, place granular subbase or aggregate base to the thickness and section the plans show.

602.3.2.2 Forms

(1) Furnish and use wood or metal forms straight and of sufficient strength to resist springing, tipping, or other displacement during depositing and consolidating the concrete. If using wood forms, provide surfaced planks, at least 2-inch nominal thickness stock except for sharply curved sections. If using metal forms, ensure they are the engineer-approved section with a flat surface on top. Use forms as deep as the depth of the sidewalk. Securely stake, brace, and hold the forms firmly to the required line. Make the forms tight to prevent mortar leakage. Clean and oil before placing concrete against them.

602.3.2.3 Placing and Finishing Concrete

(1) The engineer will check and approve the foundation, forms, and reinforcement if required, before placing the concrete. Place the concrete on a moist foundation, deposit it to the required depth, and consolidate sufficiently to bring the mortar to the surface, then strike-off and finish to a true and even surface. Before the mortar sets, brush or lightly broom the surface. Before performing the final surface finish, check the sidewalk surface with a 10-foot straightedge, and correct areas that vary 1/4 inch from the testing edge by adding or removing concrete while the concrete is still plastic.

(2) If the engineer allows, the contractor may construct concrete sidewalks with suitable, engineer-approved, slip-form equipment. The contractor may omit wood floating if the slip-form equipment produces a suitable finish.

(3) Construct curb ramps at the locations and conforming to the details and dimensions the plans show. Embed detectable warning field arrays in plastic concrete conforming to manufacturer-recommended procedures. Do not install on hardened concrete. Do not field cut plates except where the ends of radial arrays abut ramp edges. Smooth the edges of field cuts.

602.3.2.4 Reinforcement

(1) If required, use reinforcement conforming to, and place it as specified on, the plans.

602.3.2.5 Joints

(1) For sidewalks of uniform width, construct transverse joints at right angles to the sidewalk centerline, and construct longitudinal joints parallel to the centerline, unless specified otherwise. For sidewalks of variable or tapering widths, make the transverse and longitudinal joints at right angles to each other, if possible, and construct the joints as the engineer laid them out the field.

(2) Use contraction joints to divide the sidewalk into sections.

(3) Place 1/2-inch wide transverse expansion joint filler through the sidewalk at uniform intervals not greater than 96 feet apart.

(4) Place 1/2-inch wide expansion joint filler between the sidewalk and back of abutting parallel curb or gutter; and place one-inch wide expansion joint filler between sidewalk and buildings or other rigid structures.

(5) Place 1/2-inch wide expansion joint filler between sidewalk approaches and the back of curb or gutter or edge of pavement.

(6) No joint may deviate more than 5 degrees from perpendicular to the surface of the finished. Ensure that joint axes do not deviate more than 1/2 inch from a straight line, or from the designated alignment at any point. If constructing the joints in sections, do not use offsets or concrete struts between adjacent units.

(7) If constructing the sidewalk in partial width slabs, place transverse joints so they match the like joints in adjacent slabs. If widening existing sidewalks, place transverse joints in line with like joints in the existing sidewalk.

(8) If possible, do not divide sidewalks into sections less than 3 feet, or greater than 12 feet in any dimension. Produce the unit areas by using metal slab division forms extending to the concrete's full depth, or by contraction joints, as specified below.

(9) A contraction joint in sidewalk may consist of a slot or groove, at least one inch deep and 1/4 inch wide. Form them by inserting a metal parting strip in the concrete after striking off and consolidating, and while the concrete is still plastic. As soon as the concrete retains its shape, remove the parting strip and edge-finish the joint.

(10) The contractor may form contraction joints by cutting the concrete not less than 1/4 of the depth through with a pointed trowel or other suitable tool. Edge-finish the joint.

(11) The contractor may saw sidewalk contraction joints at least one inch in depth and approximately 1/8 inch wide. Perform the sawing as soon as possible after the concrete sets sufficiently to prevent raveling during sawing and before shrinkage cracking occurs.

(12) Extend the expansion joint filler to the concrete's full depth and make the top slightly below the finished surface of the sidewalk.

(13) For sidewalk, consolidate the concrete thoroughly at expansion joint faces to fill the voids, and finish the surface smooth and true to grade. Also round sidewalk edges along forms, un-sawed joints, and metal slab division forms with a 1/2-inch radius edger. For all other work under this section, use mechanical vibration at expansion joint faces to fill the voids, and finish the surface smooth and true to grade.

(14) Do not seal joints.

602.3.2.6 Protecting and Curing

(1) Cure the concrete as specified in 415.3.12.

(2) Protect sidewalks as specified for concrete pavement in 415.3.14, except that the engineer may allow the contractor to open sidewalks to pedestrian traffic after the concrete has developed sufficient strength to prevent damage to the surface.

602.3.2.7 Backfilling and Restoring the Site of the Work

(1) If the sidewalk does not touch curb, curb & gutter, pavement, or other structures and if the concrete is cured and the forms removed, then backfill the spaces along the sides with satisfactory soil and thoroughly compact. For the backfill conform to the section the plans show. Dispose of surplus excavation and restore the work site to a neat and orderly condition.

602.3.3 Loading Zones

(1) Construct raised loading zones in streets, if included in the contract, of concrete conforming to the requirements above, and at the locations, and as specified in the details and dimensions the plans

show. If constructing loading zones on bases covered with a wearing surface, place the loading zone directly on base. If constructing loading zones on concrete pavements, place the loading zones on the finished surface. Tie loading zones to the pavement with at least four 3/4-inch diameter dowel or tie bars, 10 inches long. Use construction methods conforming to 602.3.2. Provide openings for traffic signals, if any, as directed.

602.3.4 Steps

(1) If constructing steps, and landings is included in the contract, build them at the locations and as specified in the design, dimensions, and details the plans show. This work includes reinforcement and necessary excavating, backfilling, and disposing of excess excavation material.

(2) Provide a rubbed surface finish on formed surfaces of landings, risers, and sides of steps as specified for concrete bridges in 502.3.7.3.

(3) Furnish and use materials and construction methods conforming to 602.3.1, except as specified otherwise.

602.3.5 Safety Islands

(1) Under the Concrete Safety Islands bid item, construct concrete safety islands conforming to the requirements above and the details and dimensions the plans show. This work includes furnishing, by the contractor, or by others, and installing fixtures, conduits, and other materials, the detailed plans show.

(2) Place concrete between suitable forms accurately set to conform to the design of the island, and anchor securely to preclude movement during placement and finishing operations. Unless directed otherwise, use construction methods conforming to 602.3.1.

(3) Provide or construct openings in the island and in the base as the plans show for installing fixtures, posts, or cables. Install fixtures and materials at the time and in the manner designated on the plans or as the engineer directs.

602.4 Measurement

(1) The department will measure the Concrete Sidewalk bid items by the square foot acceptably completed. Measurement includes the area of the curb ramp and warning field. The department will not measure the area of sidewalk intersecting a driveway if measured as driveway under 416.4.

(2) The department will measure Concrete Loading Zones; Concrete Safety Islands; and the Curb Ramp Detectable Warning Field bid items by the square foot acceptably completed.

(3) The department will measure Concrete Steps by the square foot acceptably completed. The measured area of steps, including landings equals the sum of the areas of the treads and landings, computed by multiplying the tread and landing width by the tread and landing length, out to out of integrally placed wall.

602.5 Payment

602.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
602.0400 - 0499	Concrete Sidewalk (inch)	SF
602.0500 - 0549	Curb Ramp Detectable Warning Field (color)	SF
602.0600 - 0649	Curb Ramp Detectable Warning Field Radial (color)	SF
602.1000	Concrete Loading Zone	SF
602.1500	Concrete Steps	SF
602.2400	Concrete Safety Islands	SF

(2) The department will adjust pay for crack repairs on concrete built under 602 as specified in 416.5.2 for ancillary concrete.

602.5.2 Concrete Sidewalk, Loading Zone, and Steps

(1) Payment for the Concrete Sidewalk bid items, including the area of curb ramp and warning field; Concrete Loading Zone; or Concrete Steps, including landings; is full compensation for providing materials, including concrete, reinforcement, and expansion joints; for excavating and preparing the foundation; backfilling and disposing of surplus material; for placing, finishing, protecting, and curing; and restoring the work site. However, if the contract provides a bid item for excavation, then the department will pay for work required and performed in constructing concrete sidewalks as specified in the contract. Payment also includes providing tie bars and dowel bars in unhardened concrete. For tie

bars and dowel bars provided in concrete not placed under the contract, the department will pay separately under the Drilled Tie Bars and Drilled Dowel Bars bid items as specified in 416.5.

(2) When preparing the foundation the contractor may use granular subbase, or aggregate base, in this case, the department will not make additional compensation for this item.

602.5.3 Concrete Safety Islands

(1) Payment for Concrete Safety Islands is full compensation for providing, placing, finishing and curing concrete; for providing and placing materials, except those that the plans show as furnished by others; for handling and installing fixtures and materials that the plans show as furnished by others; and for required excavating or openings in the base.

602.5.4 Curb Ramp Detectable Warning Fields

(1) Payment for the Curb Ramp Detectable Warning Field bid items is full compensation for providing the warning field arrays of the specified configuration and color.

Section 603 Concrete Barrier

603.1 Description

(1) This section describes providing permanent and temporary concrete barrier and transitions.

603.2 Materials

(1) Furnish materials conforming to the following:

Joint filler 415.2.3
Steel rail, cap rail, and fittings 614.2
Delineator brackets and delineator reflectors 633.2

(2) Provide grade A, A2, A-FA, A-S, A-S2, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. For cast-in-place barrier, provide QMP for class II ancillary concrete as specified in 716.

(3) Provide epoxy-coated steel reinforcement for permanent concrete barrier as specified for coated high-strength bar steel reinforcement in 505.2.4.

(4) Manufacturer precast barrier in a plant listed under precast concrete fabricators on the department's APL. Provide an ordinary surface finish as specified in 502.3.7.2 on exposed precast surfaces unless the forms provide a suitable finish. Cure precast barrier as specified in 415.3.12.2 using a curing compound conforming to 501.2.9. The contractor may steam cure precast barrier, if the engineer approves the temperature and procedure. Apply curing compound after steaming.

(5) Furnish adhesive for concrete anchors conforming to ICC-ES AC308 and capable of providing the strength the plans show. Provide the adhesive manufacturer's installation instructions to the engineer before installing anchors.

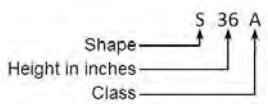
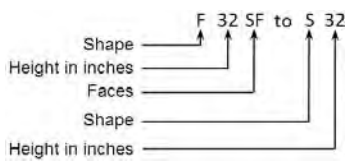
603.3 Construction

603.3.1 Permanent Barrier

603.3.1.1 General

(1) Construct permanent barrier of the type the bid item indicates. Encoded types are defined as follows:

TABLE 603-1 CONCRETE BARRIER BID ITEM ENCODING

BARRIER BID ITEM TYPES	DESCRIPTION		CODE
 *example: Concrete Barrier Type S36A is a 36" single sloped median retaining wall barrier*	SHAPE	New Jersey shape	NJ
		F shape	F
		Vertical	V
		Single slope barrier	S
TRANSITION BID ITEM TYPES  *example: Concrete Barrier Transition Type F32SF to S32 is a transition from 32" single faced F barrier to a 32" single sloped barrier*	CLASS	Standard barrier section	none
		Median retaining wall	A
		Short barrier section	B
		Roadside retaining wall	C
	FACES	Double faced barrier	DF
		Single faced barrier	SF

(2) Excavate for barrier footings as the plans show. Where new barrier penetrates existing pavement, saw out the pavement full depth in the required excavation area. Backfill, dispose of excess material, and restore the grade after placing footings.

(3) Cast permanent barrier and transitions in place. Use construction methods conforming to 502. Use forms or engineer-approved slip form methods for barrier. Use forms for transitions. Construct barrier on horizontal curves as a series of 12-foot or shorter chords.

(4) Install delineators at the spacing the plans show.

603.3.1.2 Anchor Dowels

(1) Anchor dowels are not required if the base and barrier are cast in one pour. If casting separately, cast anchor dowels in the supporting surface, or secure them in drilled holes with adhesive. Clean drilled holes and install dowels according to the adhesive manufacturer's recommendations. Ensure installed dowels develop the strength the plans show.

603.3.1.3 Joints

(1) Place 3/4-inch expansion joints in the barrier and footing matching existing pavement expansion joints and at plan locations. Use filler material sized to conform to the cross-section of the barrier and footing.

603.3.1.4 Curing

(1) Cure permanent concrete barrier as specified in 415.3.12.2. Use PAM as required in 415.3.12.1.

603.3.1.5 Straightedging

(1) While the concrete is still plastic, test the wall surfaces, except vertical surfaces on horizontal curves, for trueness with a 10-foot straightedge. Test the total surface area of the barrier top and face by holding the straightedge in successive positions parallel to the length of the barrier. Straightedge the barrier in successive stages of not more than 1/2 the length of the straightedge.

(2) Immediately, fill any depressions or projections that deviate more than 3/8 inch in 10 feet with freshly mixed concrete or strike-off and refinish the surface.

603.3.1.6 Surface Finish

(1) Broom finish exposed slip-formed surfaces. Except for footings, provide a sack rubbed finish on exposed formed surfaces as specified in 502.3.7.5.

603.3.1.7 Surface Smoothness Tolerance

(1) After the barrier hardens, test the top and upper front face for smoothness with a 10-foot straightedge. Do not straightedge the front face across chord boundaries on horizontal curves. The engineer will accept areas that show high spots or depressions greater than 3/8 inch but not greater than 3/4 inch in 10 feet. The contractor may grind high spots to less than 3/4 inch in 10 feet tolerance. Remove and replace areas that have high spots or depressions in excess of 3/4 inch in 10 feet on the barrier top or face surfaces.

(2) The engineer will evaluate vertical surfaces on horizontal curves to ensure that they are perpendicular to the pavement surface.

603.3.2 Temporary Precast Barrier

603.3.2.1 General

(1) Conform to the quality standards for temporary barrier described in CMM 1-45. Ensure that barrier delivered to the project, both for initial use and for replacing barrier damaged on the project, meets the criteria for acceptable barrier. Maintain barrier on the project at or above the marginal level and replace barrier if its condition becomes unacceptable.

(2) Where temporary barrier abuts permanent barrier, connect temporary to permanent barrier with steel rail and install steel cap rail on the first abutting section of temporary barrier.

603.3.2.2 Delivery, On-The-Project Trucking, and Removal

(1) Under the Concrete Barrier Temporary Precast Delivered bid item, furnish and deliver temporary barrier to work sites within the project and remove it upon project completion.

(2) Deliver temporary barrier to a project work site in one of the following ways:

1. Deliver barrier from outside the project.
2. Load barrier from one work site, truck to another work site on the project, and unload it.

603.3.2.3 Installation

(1) Under the Concrete Barrier Temporary Precast Installed bid item, install temporary barrier in contract-identified locations or as the engineer directs. Also make contract-identified or engineer-directed moves that do not require trucking and reinstall at those new locations.

603.3.2.4 Anchoring Barrier

(1) Anchor barrier on bridge decks where the contract specifies, the engineer directs, and where the design notes of the plan details require. Move and re-anchor as required to continuously protect construction operations. Fill holes as the engineer directs if the bridge deck will remain in service.

603.4 Measurement

(1) The department will measure the Concrete Barrier, Concrete Barrier Single-Faced 32-Inch, Concrete Barrier Double-Faced 32-Inch, Concrete Barrier Transition Section 32-Inch bid items by the linear foot acceptably completed, measured along the base of the barrier.

(2) The department will measure the Concrete Barrier Fixed Object Protection bid items by the linear foot acceptably completed, measured as the centerline length within the pay limits the plans show.

(3) The department will measure the Concrete Barrier Transition bid items as each individual transition acceptably completed.

(4) The department will measure the Concrete Barrier Temporary Precast Delivered by the linear foot acceptably completed, measured as the linear feet of installed length once for each contract-identified work site within the project and other moves the engineer directs. The department will only measure moves requiring a truck haul. The department will not measure moves made solely to accommodate the contractor's means and methods.

(5) The department will measure Concrete Barrier Temporary Precast Installed by the linear foot acceptably completed, measured along the base of the barrier after installation for each contract-identified or engineer directed initial installation. The department will also measure subsequent contract-identified or engineer directed reinstallations. The department will not measure installations made solely to accommodate the contractor's means and methods.

(6) The department will measure Anchoring Concrete Barrier on Bridge Decks by the linear foot acceptably completed, measured after anchoring along the base of the barrier anchored to the deck. The department will measure anchored barrier moved and anchored in a new location on the bridge deck. The department will not measure anchoring required on structural bridge approaches or solely to accommodate the contractor's means and methods.

603.5 Payment

603.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
603.0105	Concrete Barrier Single-Faced 32-Inch	LF
603.0205	Concrete Barrier Double-Faced 32-Inch	LF
603.0405	Concrete Barrier Transition Section 32-Inch	LF
603.1000 - 1999	Concrete Barrier (type)	LF
603.2000 - 2999	Concrete Barrier Fixed Object Protection (type)	LF
603.3000 - 3999	Concrete Barrier Transition (type)	EACH
603.8000	Concrete Barrier Temporary Precast Delivered	LF
603.8125	Concrete Barrier Temporary Precast Installed	LF
603.8505	Anchoring Concrete Barrier on Bridge Decks	LF

603.5.2 Permanent Barrier

(1) Payment for the permanent barrier, fixed object protection, and transition bid items is full compensation for providing barrier or the specified transition; for excavating and backfilling for all types except roadside retaining wall; and for disposing of excess material; for restoring the grade.

(2) The department will pay for permanent barrier deficient in smoothness by more than 3/8 inch but not greater than 3/4 inch, or ground to less than 3/4 inch, at 75 percent of the contract unit price. The department will administer the price adjustment under the Nonconforming Smoothness Concrete Barrier administrative item.

(3) The department will pay separately for associated work as follows:

- Sawing existing concrete or asphalt not placed under the contract, under the Sawing Concrete or Sawing Asphalt bid item as specified in 690.5.
- Excavating and backfilling required for roadside retaining wall barrier, Concrete Barrier Type S(size)C bid items, under the Excavation bid items as specified in 205.5 and under the Backfill Structure bid items as specified in 210.5.
- Providing delineators for permanent barrier, under the Delineator Brackets and Delineator Reflectors bid items as specified in 633.5.

603.5.3 Temporary Barrier

(1) Payment for Concrete Barrier Temporary Precast Delivered is full compensation for providing barrier, initial delivery, trucking between work sites, and removing after contract completion.

(2) Payment for Concrete Barrier Temporary Precast Installed is full compensation for each installation including providing steel rail connections and steel cap rail for installations abutting permanent barrier.

603.5.4 Anchoring Barrier

(1) Payment for Anchoring Concrete Barrier on Bridge Decks is full compensation for providing anchoring devices; for moves required during construction; for coring the bridge deck; for removing anchoring devices; and for filling holes.

(2) The department will pay separately for providing the concrete barrier under the other 603 bid items.

Section 604 Slope Paving

604.1 Description

(1) This section describes paving embankment slopes and waterways with concrete slope paving or crushed aggregate slope paving to control and prevent erosion of the slopes and waterways.

604.2 Materials

(1) Furnish materials conforming to the following:

Water	501.2
Crushed aggregate	501.2
Select crushed material	312.2
Concrete	501
Reinforcement	505
Expansion joint filler	415.2.3
Asphaltic materials	450.2

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

(3) Under the Slope Paving Crushed Aggregate bid item, furnish crushed stone or crushed gravel conforming to coarse concrete aggregate size No. 2 but with the additional requirement that at least 75 percent of the particles, by count, have at least one fractured face. Determine fracture according to ASTM D5821 as modified in CMM 8-60.

(4) Under the Slope Paving Select Crushed Material bid item, furnish crushed rock or concrete conforming to 312.2 except the material need not be from a department-approved source.

(5) The requirements of 501.2.5.4.3 relating to soundness and wear shall not apply to crushed aggregate slope paving.

(6) Furnish emulsified asphalt, type RS 1 or RS 2 conforming to AASHTO M140, or type CRS 1 or CRS 2 conforming to AASHTO M208 for the asphaltic material in crushed aggregate slope paving.

604.3 Construction

604.3.1 General

(1) Prepare the foundation for the paving so that the finished paving surface conforms to the elevation, lines, grades and cross-sections the plans show, and the engineer directs. Prepare the foundation by excavating high places and backfilling and compacting low places until it conforms to the required elevation and slope, and is uniform in density. Dispose of excess excavated material as specified for disposal of surplus or unsuitable material in 205.3.12, or as the engineer directs.

(2) If the plans specify headers, cut-off walls, or similar appurtenances, construct them as the plans show.

(3) Unless directed otherwise, place one-inch expansion joint filler where slope paving abuts piers, abutments, or other solid fixtures.

604.3.2 Crushed Aggregate Slope Paving

(1) Place the crushed aggregate on the prepared foundation. Use mechanical or hand methods to shape and consolidate it to provide a stable, even, and uniform surface.

(2) Apply the asphaltic material uniformly over the surface of the paving at a rate just sufficient to ensure penetration and binding of the particles in the upper 2 inches of the aggregate blanket. Avoid excessive application of asphaltic material and exercise care to prevent material run-off. Protect the surface of the adjacent structure to prevent splattering or discoloration by asphaltic material, and immediately remove material accumulations at the foot of the slope paving.

604.3.3 Select Crushed Material Slope Paving

(1) Place the select crushed material on the prepared foundation. Use mechanical or hand methods to shape and consolidate it to provide a stable, even, and uniform surface. Do not apply asphaltic material binder.

604.3.4 Concrete Slope Paving

604.3.4.1 General

(1) Place the concrete between forms set to grade on the prepared foundation. Make the finished concrete slab a minimum 4 inches thick. Ensure the concrete is a workable consistency when placed, but dry enough to retain its position when struck off. Strike-off the concrete with a straightedge supported on the forms and finish with a wood float.

(2) Cure concrete slope paving as specified in 415.3.12, except substitute type 1-D clear or translucent curing compound otherwise conforming to 415.2.4. During cold weather, protect the concrete as specified in 415.3.13 for concrete pavement.

604.3.4.2 Waterways

(1) Reinforce the concrete slope paving as specified in plan details. Construct joints at locations and as the plans show or as the engineer directs.

604.3.4.3 Structures

(1) Form planes of weakness or false joints in the concrete by scoring the finished surface at least 1/2 inch deep with an appropriate tool. Form blocks or squares approximately the width of the pour. Provide an edge-finish on joints or false joints. The contractor shall not reinforce the slope pavement unless the plans designate otherwise or as the contract provides.

604.4 Measurement

(1) The department will measure the Slope Paving bid items under this section by the square yard acceptably completed. The measured area equals the sum of the pavement areas, measured in the plane of the surface. The department will not measure headers or cut-off walls.

604.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
604.0400	Slope Paving Concrete	SY
604.0500	Slope Paving Crushed Aggregate	SY
604.0600	Slope Paving Select Crushed Material	SY

(2) Payment for the Slope Paving bid items is full compensation for excavating and backfilling required for preparing the paving foundation; for disposing of surplus materials; for providing materials for concrete; for mixing, placing, finishing, curing, and protecting concrete; for providing reinforcement,; for providing, handling, placing, and consolidating the crushed aggregate or select crushed material; and for providing, handling, heating, and applying asphaltic material binder.

Section 606 Riprap

606.1 Description

(1) This section describes furnishing and placing riprap.

606.2 Materials

606.2.1 Riprap Stone

(1) Furnish durable field or quarry stone that is sound, hard, dense, resistant to the action of air and water, and free of seams, cracks, or other structural defects. Use stone pieces with a length and width no more than twice the thickness. Do not place material without the engineer's approval of the stone quality, size, and shape.

(2) The department will determine the average dimension of stone pieces by averaging measurements of thickness, width, and length. Furnish stones conforming to the size requirements for the riprap grade the plans show. Size requirements are expressed as the percent of the gross in-place riprap volume occupied by stones within average dimension size ranges for each riprap grade as follows:

AVERAGE DIMENSION RANGES FOR EACH RIPRAP GRADE				FRACTION OF GROSS
LIGHT RIPRAP inches	MEDIUM RIPRAP inches	HEAVY RIPRAP inches	EXTRA-HEAVY RIPRAP inches	IN-PLACE RIPRAP VOLUME OCCUPIED BY STONES
>16	>20	>25	>30	0%
11 - 13	14 - 16	18 - 20	22 - 25	10% - 14%
9 - 11	11 - 14	14 - 18	18 - 22	15% - 21%
4 - 9	5 - 11	6.5 - 14	8 - 18	20% - 28%
<4	<5	<6.5	<8	5% - 7%
<1	<1	<1	<1	2% or less

(3) The contractor may substitute waste concrete slabs for stone. Furnish sound concrete, free of protruding reinforcement, and conforming to the size requirements specified for stone.

606.2.2 Riprap Grout

(1) Furnish an air-entrained mortar or concrete to fill the voids between riprap stones in grouted riprap. Conform to the physical requirements for component materials as specified in 501.2 except furnish fine aggregate or a combination of fine and coarse aggregate with a gradation that results in a grout with a consistency that allows complete filling of the riprap voids.

(2) Certify that the grout conforms to the following mixture requirements:

- Contains 470 pounds or more of portland cement per cubic yard of grout. The contractor may substitute class C fly ash for up to 30 percent of the required portland cement.
- Contains only enough water to achieve a 3-inch slump. Any additional workability required to completely fill the riprap voids must be achieved with admixture without increasing the w/cm ratio.
- Contains 9 percent or more air for mixes with a nominal top size aggregate less than 3/8 inch or 7 percent or more air for a mix with 3/8 inch or larger aggregate.

606.3 Construction

606.3.1 General

(1) Prepare the bed for the riprap by excavating, shaping the slopes, and constructing the toe for riprap installation. After placing the riprap, restore the surface of adjacent work and dispose of surplus material.

606.3.2 Placing Light Riprap

(1) If laying stone above the waterline, place it by hand. Lay it with close, broken joints and firmly bed it in the slope and against the adjoining stones. Lay the stones perpendicular to the slope with ends in contact. Compact the riprap thoroughly as construction progresses. Make the finished surface even and tight. Place larger stone in lower courses. Chink spaces between stones by firmly ramming spalls into place. If placing riprap over geotextile, use type R and conform to 645.3.1.6.

(2) Unless specified otherwise, make riprap at least one foot thick, measured perpendicular to the slope.

(3) Do not place riprap against, or in contact with, concrete surface before the end of the concrete's curing and protection period.

606.3.3 Placing Medium, Heavy, and Extra-Heavy Riprap

(1) The contractor may place medium, heavy, and extra-heavy riprap by any mechanical means that produce a completed job within reasonable tolerances of the typical section the plans show. Limit

handwork to the quantity necessary to fill large voids or to correct segregated areas. If placing riprap over geotextile, use type HR and conform to 645.3.1.7.

(2) Unless specified otherwise, make medium riprap at least 18 inches thick, heavy riprap at least 24 inches thick, and extra-heavy riprap at least 30 inches thick.

606.3.4 Placing Grouted Riprap

(1) If the plans specify using grouted riprap, lay the stone as specified above under 606.3.2 or 606.3.3. Fill the spaces between the stones with cement mortar. Use sufficient mortar or concrete to completely fill voids, except leave the face surface of the stone exposed.

(2) Place grout from the bottom to the top and then sweep the surface with a stiff broom. After completing the grouting, cure the surface as specified in 415.3.12 except substitute type 1-D curing compound as specified for structures in 502.2.6. During cold weather, protect the concrete as specified in 415.3.13 for concrete pavement.

606.4 Measurement

(1) The department will measure the bid items under this section by the cubic yard acceptably completed, measured as the volume within the limiting dimensions the contract designates or the engineer establishes in the field.

606.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
606.0100	Riprap Light	CY
606.0200	Riprap Medium	CY
606.0300	Riprap Heavy	CY
606.0400	Riprap Extra-Heavy	CY
606.0500	Grouted Riprap Light	CY
606.0600	Grouted Riprap Medium	CY
606.0700	Grouted Riprap Heavy	CY
606.0800	Grouted Riprap Extra-Heavy	CY

(2) Payment for the bid items under this section is full compensation for preparing the bed, providing and placing riprap, restoring adjacent work, and disposing of surplus material. The department will pay for excavation in excess of the approximate volume of earth occupied by the riprap under the Excavation Common bid item as specified under 205.5.

(3) Payment for the Grouted Riprap bid items also includes placing and curing mortar.

Section 608 Storm Sewer

608.1 Description

(1) This section describes providing new storm sewer and relaying existing storm sewer.

608.2 Materials

608.2.1 Pipe

(1) Furnish pipe consistent with the diameter the bid item indicates. Furnish materials for the various classes of pipe as follows:

TABLE 608-1 ALLOWABLE MATERIALS FOR STORM SEWER CLASSES

CLASS	ALLOWABLE MATERIALS
II	Class II reinforced concrete
III	Class III reinforced concrete
III-A	Class II and Class III reinforced concrete, corrugated polyethylene, corrugated polypropylene
III-B	Class III reinforced concrete, corrugated polypropylene
IV	Class IV reinforced concrete
V	Class V reinforced concrete

(2) Furnish materials conforming to the following:

Circular reinforced concrete pipe ..... AASHTO M170
Horizontal elliptical reinforced concrete pipe ..... AASHTO M207
Corrugated polyethylene pipe ..... AASHTO M294 S
Corrugated polypropylene pipe ..... AASHTO M330 S
Composite pipe, couplings, fittings and joint materials ..... ASTM D2680
Joints using rubber gaskets ..... ASTM C443
Joints using preformed flexible joint sealants ..... ASTM C990
External rubber gaskets, mastic, and protective film ..... ASTM C877
Mortar 519.2.3

(3) Manufacture precast reinforced concrete pipe for storm sewer in a plant listed under precast concrete fabricators on the department's APL. Conform to the specified AASHTO materials requirements for the class of pipe specified except as follows:

- Use concrete with 565 pounds or more cementitious material per cubic yard.
- The contractor may use cement conforming to 501.2.1 or may substitute for portland cement at the time of batching conforming to 501.2.6 for fly ash, 501.2.7 for slag, or 501.2.8 for other pozzolans. In either case the maximum total supplementary cementitious content is limited to 30 percent of the total cementitious content by weight.

(4) Furnish an engineer-approved cold-applied bituminous mastic joint sealer with a consistency that enables application to joints with a trowel if air temperatures range from 20 to 100 F.

608.2.2 Backfill

608.2.2.1 General

(1) Furnish virgin materials consisting of either sand-sized particles or sand-sized particles mixed with gravel, crushed gravel, or crushed stone. Do not use materials classified under 301.2.4.3 as crushed concrete, reclaimed asphalt, reprocessed material, and blended material. The contractor may use material from the work site.

(2) Ensure that the material provided has a liquid limit less than or equal to 25 and a plasticity index less than or equal to 6.

(3) The department will sample and test foundation and trench backfill according to the following:

Sampling[1] ..... AASHTO T2
Percent passing the 200 sieve ..... AASHTO T11
Gradation[1] ..... AASHTO T27
Liquid limit ..... AASHTO T89
Plasticity index and plastic limit ..... AASHTO T90

[1] As modified in CMM 8-60.

(4) Submit contractor test results for gradation, liquid limit, and plasticity index testing to the engineer for approval before placing backfill. The engineer may waive contractor testing for known sources.

(5) Submit daily quantities for foundation and trench backfill material requiring department testing to the engineer. Determine quantities at the point of placement by collecting truck tickets as the material is placed or by another engineer-approved method.

(6) Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

608.2.2.2 Foundation Backfill

(1) Furnish foundation backfill conforming to 520.2.5.2.

(2) The contractor may also furnish crushed stone chips conforming to the following:

- A minimum of 85 percent by count of the number of particles have at least one machine-fractured face.
- Gradation conforming AASHTO M43 as follows:

	PERCENT PASSING BY WEIGHT	
SIEVE	AASHTO No. 8 (for pipes <= 18-inch diameter)	AASHTO No. 67 (for pipes > 18-inch diameter)
1-inch	___	100
3/4-inch	___	90 - 100
1/2-inch	100	___
3/8-inch	85 - 100	20 - 55
No. 4	10 - 30	0 - 10
No. 8	0 - 10	0 - 5
No. 16	0 - 5	___

608.2.2.3 Trench Backfill

(1) Furnish trench backfill material conforming to 209.2 or 520.2.5.2.

608.3 Construction

608.3.1 Excavation

608.3.1.1 General

(1) Unless the contract specifies otherwise or the engineer allows, perform sewer construction in open trenches and in a way that protects pipelines or sewers from unusual stresses.

(2) Place and compact the embankment to at least one foot above the elevation of the top of the storm sewer pipe before excavating the trench. Perform trenching, shoring, and excavating according to 29 CFR part 1926, OSHA subpart P. If utilities and other restraints make sloping or benching of the excavation impracticable, employ a shoring system.

http://www.dol.gov/dol/cfr/title_29/

(3) Make trenches wide enough to provide free working space on each side of the pipe. This space shall not exceed 1/2 the nominal diameter of the pipe, and never be less than 6 inches. The required working space shall depend upon the size of the pipe and the character of the material in the excavation; however, always provide sufficient space between the pipe and the sides of the trench to allow for preparing the foundation, laying the pipe, and placing and compacting the backfill. If the height of the proposed embankment or earth cover above the top of the pipe exceeds 6 feet, excavate the trench below the top of the pipe as vertical as possible.

(4) For concrete pipe, make the trench wide enough to allow for preparing the foundation, laying the pipe, and placing and compacting backfill, except that the trench width shall not exceed the pipe's outside diameter by more than 36 inches. For polyethylene and polypropylene pipe, conform to ASTM D2321 and ensure that the trench is as wide or wider than the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches whichever is wider.

(5) Excavate the trenches in reasonably close conformity with the plans and as the engineer laid out in the field. Begin trench excavation at the proposed sewer outlet and proceed toward the upper end.

(6) Keep the trenches dewatered until the joint material sufficiently hardens.

(7) If the contract specifies or the engineer allows, the contractor may construct sewers by tunneling or jacking instead of open trenching. Adhere to the construction details the plans show, the contract specifies or the engineer establishes.

(8) Understand that the inlet and discharge elevations for storm sewers the plans show, are subject to revisions in order to fit field conditions, and the engineer may adjust the profile grades from those the plans show.

(9) If using sheeting or shoring in excavation, remove sheeting and braces in a way that does not disturb the completed work. Backfill displaced areas with material conforming to 608.2.2 and place foundation backfill conforming to 608.3.2 and place trench backfill conforming to 608.3.5.

608.3.1.2 Rock Excavation for Storm Sewer

(1) Classify rock excavation for storm sewer as specified for rock excavation in 205.2.3, except include rock boulders with a volume of 1/2 cubic yard or more.

608.3.1.3 Excavation for Relaid Storm Sewer

(1) Excavate and remove existing storm sewer at the locations the plans show or as the engineer directs. Replace pipe designated for reuse that is made unusable through the contractor's operations. Excavate trenches to reinstall storm sewer conforming to 608.3.1.1 and 608.3.1.2. Backfill conforming to 608.3.5.

608.3.2 Constructing Foundation

(1) Construct the foundation in the trench to prevent subsequent settlement and rupture of the sewer pipe.

(2) Excavate the trench to at least 6 inches below the elevation established for the bottom of the pipe. Backfill to this depth with foundation backfill. Mechanically compact foundation backfill before laying 12 inches above the pipe to provide full and continuous support. Do not place lifts more than 6 inches thick as measured after compaction. Compact the entire layer before placing the next layer. Do not compact by flooding if using foundation backfill with a dense-graded base gradation.

(3) If the engineer determines that existing foundation material for at least 6 inches below the bottom of the pipe conforms to 608.2.2.2; the contractor need not excavate, backfill, or shape the bed under the pipe.

(4) If rock, hardpan, or fragmented material exists, excavate the trench below the pipe to a depth equal to 1/2 inch per foot of proposed embankment above the top of the pipe, but not less than 6 inches. Construct the foundation and backfill to 12 inches above the pipe with foundation backfill as specified above.

(5) Excavate recesses to receive bells if necessary.

(6) Notify the engineer if the proper bearing cannot be obtained 6 inches below the bottom of the pipe. Excavate unsuitable material as the engineer directs and backfill with foundation backfill.

608.3.3 Laying Pipe

(1) Begin laying pipes in finished trenches at the lowest point and proceed towards the upper end, also lay the pipe so the spigot or tongue ends point in the direction of flow.

(2) Thoroughly clean dust, dirt, and other foreign matter from joining surfaces of the bell or groove end of pipe and the spigot or tongue ends before lowering pipes into trenches.

(3) Lower and place the pipes to avoid unnecessary handling in the trench or damage to the pipe. Provide a firm bearing beneath the entire length of each section and make it substantially true to the line and grade required.

(4) Lay pipes with ends abutting. Take care when shoving the pipes together so the joints are properly adjusted and not overly large. Fit and match the pipes so that if set firmly in line and grade they form a sewer with a smooth and uniform invert.

(5) Provide joint ties on concrete storm sewer system infall and outfall pipes. Tie the last 3 sections or, if using apron endwalls, the endwall and the last 2 sections. Ties are not required on installations with masonry endwalls unless the plans show otherwise.

(6) For polyethylene or polypropylene pipe, locate joints in relation to manholes, catch basins, and inlets as the manufacturer recommends. Use full pipe sections except as needed to meet the plan specified length. Place full pipe sections at infall or outfall ends unless the engineer allows otherwise. If a partial pipe section must be used at an infall or outfall end, restrain as the manufacturer recommends, or absent a recommendation, use one or more of the following:

- A manufacturer supplied external mechanical coupling.
- A manufactured coupling with a mastic impregnated geotextile wrap and mechanical fastening bands.
- A concrete collar meeting 520.2.4.

(7) After installing the pipe, seal lift holes with suitable concrete or other engineer-approved plugs.

(8) If it is difficult to obtain the size pipe the plans or the contract specifies, the contractor may, with the engineer's approval, provide a larger size.

(9) Connect to new or existing catch basins, inlets, and manholes conforming to 611.3.2.

Add 608.3.3(10) to clarify locations where pipe collars are needed.

(10) Construct concrete collars using concrete conforming to 520.2.4 where and as the plans show. Also use collars for connections to existing pipe, existing endwalls, or dissimilar pipe materials where the engineer agrees a mortar joint, manufactured joint, coupling, or restraint can not be used.

608.3.4 Joints

608.3.4.1 General

(1) Make joints for concrete pipe with portland cement mortar, annular rubber or plastic gaskets, external rubber gaskets, or engineer-approved mastic joint sealer, as specified below, or by a combination of these types, unless the plans or contract special provisions specify the type to use.

(2) If using mortar or trowelable mastic joint sealer, fill the joint with mortar or mastic sealer and wipe the inside of the joint and finish smooth.

(3) If using annular rubber or plastic gaskets, fit the gasket snugly into the annular space between the surfaces of the connecting parts of the pipe sections to form a flexible, watertight joint.

(4) If using preformed mastic joint sealer, remove sharp edges and protrusions from pipe joint surfaces and clean dust, dirt, and other foreign matter from them. The contractor may use a primer. If using a primer, use the type recommended by the preformed seal manufacturer. After the primer dries, remove the wrapper from one side of the seal only and press the seal to the primed surface. When ready to assemble, remove the remaining wrapper and fit the pipe sections in place. Shove the pipe sections together at the required alignment. Make seals of sufficient size so that after the pipe sections are in their final position a squeeze-out of the seal is evident around the joints exterior circumference. Remove and make flush with the interior pipe wall, any extrusion of the seal inside the pipe.

(5) Place external rubber as the manufacturer specifies and the engineer approves.

(6) Seal joints for composite pipe with standard couplings and solvent cement or with rubber or plastic gaskets. Follow the manufacturer's directions.

608.3.4.2 Relaid Storm Sewer

(1) Use new joint materials for relaid storm sewer.

608.3.5 Backfilling Trenches

(1) Deposit backfill material in all trenches and excavations immediately after placing sewer pipe in a way that causes no damage to the pipe. Fill the trench simultaneously on both sides of the sewer without causing injurious side pressures.

(2) Place trench backfill from 1 foot above the top of the pipe to the top of the subgrade in layers no more than 8 inches thick after compaction. Mechanically compact the entire length of each layer to the same degree as the material next to the trench before placing the next layer.

(3) If puddling or flooding is required or approved for consolidating backfill or crushed stone chips; do not perform the first flooding until after backfilling the trench or excavation to at least 2 feet above the top of the pipe, and after compacting the backfill by tamping. Perform the second flooding after the previous trench filling and after compacting in uniform layers. Avoid excess water to minimize pressure on the pipe. Do not puddle or flood if using 3/4-inch or 1 1/4-inch dense-graded base.

(4) Immediately after backfilling, cushion pipe for at least the trench width with compacted earth. Provide 2 feet or more cover, including backfill depth, above the pipe to prevent damage under construction loads. Maintain this cushion during subsequent operations. Do not walk, travel across, or work near completed pipe until minimum cover is established.

608.3.6 Clean Out

(1) Clean new or re-laid sewers of accumulations of silt, debris, and other foreign matter, and before acceptance, test all installations with water or other engineer-approved methods. These tests must indicate unimpeded flow.

(2) Clean existing sewers of silt, debris, and other foreign matter that accumulated due to the contractor's operations.

608.3.7 Deflection Testing

(1) The department accepts polyethylene and polypropylene pipe based on testing with a department-approved mandrel. Test pipe as the engineer directs after installation but before paving or finish grading.

(2) Provide a mandrel with a diameter equal to 92.5 percent of the pipe's nominal diameter and having cable attachment points on each end of the core. Ensure that the mandrel has nine fins or legs permanently marked to designate the pipe size and the allowable percent deflection.

(3) The engineer will designate at least 10 percent of the installed length of pipe for testing. The mandrel must pass through the entire section in one pass when pulled by hand without using excessive force. If the designated length of pipe fails, engineer may require additional testing.

(4) Relay or replace pipe with deflection greater than 5 percent. Retest all relayed or replaced pipe.

608.3.8 Restoring the Work Site

(1) Restore the work site to its original condition. Provide topsoil and seeding, patch overlying pavements or sidewalk, and perform other related work as the engineer directs.

608.4 Measurement

608.4.1 Pipe Sewers

(1) The department will measure the Storm Sewer Pipe and Relaid Storm Sewer Pipe bid items by the linear foot acceptably completed. This measurement equals the distance along the centerline of the pipe, from the pipe end at a free outlet to the center of the end catch basin, manhole, inlet, junction or other drainage structure; or from center to center of catch basins, end manholes, inlets, other drainage structures or junctions. The department will make no deduction from these measured lengths for intermediate catch basins, manholes, inlets, other drainage structures, junctions, or fittings.

608.4.2 Rock Excavation for Storm Sewer

(1) The department will measure Storm Sewer Rock Excavation by the cubic yard acceptably completed. The department will measure this work in its original position and compute the volume, excluding boulders, by the method of average end areas.

(2) The department will measure boulders of 1/2 cubic yard or more as specified for boulders and surface stone greater than one cubic yard in 205.4.1.

(3) The department will measure this work vertically from the top of the rock to the bottom of the rock, or to an elevation 6 inches below the bottom of the pipe, whichever is higher. The department will measure this work horizontally as the outside diameter of the pipe plus 3 feet, 1 1/2 feet on either side, regardless of actual width required under 608.3.1.1.

608.5 Payment

608.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
608.0005	Storm Sewer Rock Excavation	CY
608.0100 - 0199	Relaid Storm Sewer (size)	LF
608.0200 - 0599	Storm Sewer Pipe Reinforced Concrete (class) (size)	LF
608.2300 - 2499	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical (class) (size)	LF
608.3000 - 3099	Storm Sewer Pipe Class III-A (size)	LF
608.3600 - 3699	Storm Sewer Pipe Class III-B (size)	LF
608.6000 - 6099	Storm Sewer Pipe Composite (size)	LF

(2) Payment for the 608 bid items also includes water for compaction and dust control, except if the contract contains the Water bid item, the department will pay separately for water under 624.5.

(3) The department will pay separately for excavating unsuitable material and backfilling as specified in 608.3.2(6) as extra work.

608.5.2 Pipe for Storm Sewer

Add 608.5.2(1) to clarify payment for connections including concrete collars.

(1) Payment for the Storm Sewer Pipe bid items is full compensation for providing storm sewer; for concrete collars not required under 520.3.1(5) or 608.3.3(10); for excavating, except for rock excavation; for providing and removing sheeting and shoring; for constructing the foundation and backfilling; for cleaning out; and for restoring the work site.

608.5.3 Rock Excavation for Storm Sewer

(1) Payment for Storm Sewer Rock Excavation is full compensation for all rock excavation and disposal. If the contract does not contain the Storm Sewer Rock Excavation bid item, the department will pay for the required excavation as specified for extra work in 109.4.

608.5.4 Relaid Storm Sewer

(1) Payment for the Relaid Storm Sewer bid items is full compensation for providing relaid storm sewer; for excavating, removing, and backfilling existing storm sewer; for replacing pipe made unusable by contractor operations; for excavating new trench, except for rock excavation; for providing and removing sheeting and shoring; for constructing the foundation and backfilling; for cleaning out; and for restoring the work site.

Section 611 Catch Basins, Manholes, and Inlets

611.1 Description

(1) This section describes constructing or reconstructing catch basins, manholes, inlets and similar structures, made of concrete, brick masonry, or concrete brick or block masonry, with necessary reinforcement, metal frames, grates and lids, including required excavating and backfilling.

611.2 Materials

(1) Furnish materials conforming to the following:

Concrete 501
Brick masonry and concrete brick or block masonry 519
Mortar 519.2.3
Reinforcement 505
Structural steel 506.2.2
Miscellaneous metals 506.2.3
Trench backfill 608.2

(2) For cast in place structures furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

(3) For precast structures conform to AASHTO M199 for circular structures and ASTM C913 for square and rectangular structures. Manufacture in a plant listed under precast concrete fabricators on the department's APL. Conform to the specified AASHTO materials requirements for the structure specified except as follows:

- Use concrete with 565 pounds or more cementitious material per cubic yard.
- The contractor may use cement conforming to 501.2.1 or may substitute for portland cement at the time of batching conforming to 501.2.6 for fly ash, 501.2.7 for slag, or 501.2.8 for other pozzolans. In either case the maximum total supplementary cementitious content is limited to 30 percent of the total cementitious content by weight.
- For wet cast use air-entrained concrete with 7.0 percent +/- 1.5 percent air content.

(4) Use castings conforming to AASHTO M105, class 30.

611.3 Construction

611.3.1 General

(1) Excavate and backfill as specified for excavation for structures in 206, except use trench backfill. Do not backfill concrete brick or block masonry, brick masonry, or precast concrete set on mortar beds until at least 3 days after completing the unit.

(2) Construct concrete as specified in 501, and as specified for culverts and retaining walls in 504.

(3) Construct brick masonry and concrete brick or block masonry as specified in 519.

(4) Construct structural steel and miscellaneous metals as specified for steel bridges in 506.

(5) Cure the concrete by one of the methods specified in 502.3.8 for curing concrete in substructure units.

(6) The inlet and discharge elevations for catch basins, manholes, and inlets as indicated on the plans are subject to revisions necessary to fit field conditions. The engineer may increase or decrease the depth of catch basins, manholes, or inlets in order to adjust their inlet or discharge elevations.

(7) Place precast reinforced bases on a 6-inch or thicker bed of uniformly compacted foundation backfill conforming to 608.2.

(8) Secure grade riser rings and adjustment rings with mortar, engineer-approved mastic, or using the manufacturer's recommended method. Do not dry stack adjustment rings.

611.3.2 Connections

(1) Make inlet and outlet sewer pipe, sewers, and conduit for connections with structures the same size, type, and class as the sewer pipe, sewers, and conduit to which connections are made and that they conform to the same pertinent requirements.

(2) For pipe placed in masonry for inlet or outlet connections, make it flush on the inside of the structure wall and extend the pipe through the walls and beyond the outside surfaces of the walls a sufficient distance to allow for connections with conduits or sewers. Carefully construct the masonry around them to prevent leakage around their outer surfaces.

(3) For fiber optic installations, permanently attach support assemblies to the manhole wall and mortar seal around entering conduits.

611.3.3 Frames, Grates, and Lids

(1) Set frames on full mortar beds except as specified for placing concrete in 415.3.6.1, or secure otherwise as the plans show. Fit or secure the grates and lids to the frames to eliminate rocking or chattering.

(2) Set the frames, grates, and lids accurately so the complete installation is at the correct elevation required to fit the adjoining surfaces. If installed in concrete surfaces, set the frames or castings, and grout as necessary, as specified in 415.3.6.1. Make sure the grates or lids are not in place while striking off and finishing the adjoining concrete.

(3) Set frames located in pavement areas so that they comply with the surface requirements specified in 450.3.2.9, Place a 6-foot straightedge over the centerline of each frame parallel to the direction of traffic at the completion of the paving. Make a measurement at each side of the frame, average the 2 measurements. If this average is greater than 5/8 inch, reset the frame to the correct plane and elevation. If this average is 5/8 inch or less but greater than 3/8 inch, the department will allow the frame to remain in place.

(4) If the frame is higher than the adjacent pavement, then make the 2 measurements at each end of the straightedge and average them.

611.3.4 Steps

(1) Install steps in manholes as the plans show.

611.3.5 Reconstructing Catch Basins, Manholes, and Inlets

(1) If the plans show and the contract provides, reconstruct existing catch basins, manholes and inlets to the required lines and elevations the plans show, including the salvaging and resetting of existing covers, unless the contract provides for new covers or other salvaged covers.

(2) Use construction methods conforming to the requirements set forth above for the classes of work involved.

611.3.6 Covers for Catch Basins, Manholes, and Inlets

611.3.6.1 General

(1) Place the frames on full mortar beds, except as specified in 415.3.6.1, and adjust them to bring the complete installation to the required elevation.

(2) Under the Manhole Covers Type M-Communications and Manhole Covers Type Q-Communications bid items, use covers stamped with "WISDOT COMMUNICATIONS" as the plans show.

611.3.6.2 New Covers

(1) If the plans show, the contract provides, or the engineer directs, provide new covers, including frames, grates, or lids, as the plans show, on both new and existing structures.

611.3.6.3 Salvaged Covers

(1) If the plans show and the contract provides, remove, handle, store, and reinstall existing covers in a way that prevents damaging the covers. If the contractor damages covers through its own operations then the contractor shall replace them at no expense to the department.

(2) Use construction methods conforming to the requirements above for these installations.

611.3.7 Adjusting Catch Basin, Manhole, and Inlet Covers

(1) Unless the contract provides otherwise, adjust existing covers, including frames and grates or lids, to the required elevation. Remove the existing fixture, adjust the top of the existing structure, and reinstall the fixture. Support the fixture on a collar of concrete, brick masonry, concrete brick or block masonry, a precast concrete grade riser ring, or a grade adjustment ring from the department's APL, constructed to hold the covers firmly in place.

(2) Instead of adjusting the covers as specified above, the contractor may adjust the lids of covers on resurfacing projects, if the engineer allows, by using engineer-approved adjustment castings designed for the purpose.

(3) A vertical change exceeding one foot in the elevation of a cover, or requiring removal of masonry beyond the shimming or grade adjustment device, is a reconstruction and the contractor must comply with 611 for reconstruction of catch basins, manholes, and inlets.

611.3.8 Clean Out

(1) The contractor shall clean out soil, debris, or other accumulated matter from catch basins, manholes, inlets, or similar structures constructed or reconstructed under the contract before the engineer will accept the work. Remove materials in all of these structures deposited or lodged due to the contractor's operations.

611.4 Measurement

(1) The department will measure the bid items under this section as each individual unit acceptably completed.

611.5 Payment

611.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
611.0410	Reconstructing Catch Basins	EACH
611.0420	Reconstructing Manholes	EACH
611.0430	Reconstructing Inlets	EACH
611.0500 - 0599	Manhole Covers (type)	EACH
611.0600 - 0699	Inlet Covers (type)	EACH
611.1000 - 1999	Catch Basins (dimensions)	EACH
611.2000 - 2099	Manholes (dimensions)	EACH
611.2100 - 2199	Manholes Communications (dimensions)	EACH
611.2500 - 2699	Manholes Variable (type) (dimensions)	EACH
611.3000 - 3499	Inlets (dimensions)	EACH
611.3900 - 3999	Inlets Median (number of grates)	EACH
611.8105	Adjusting Catch Basin Covers	EACH
611.8110	Adjusting Manhole Covers	EACH
611.8115	Adjusting Inlet Covers	EACH
611.9705	Salvaged Manhole Covers	EACH
611.9710	Salvaged Inlet Covers	EACH

611.5.2 Catch Basins, Manholes, and Inlets

(1) Payment for the Catch Basins, Manholes, and Inlets bid items is full compensation for providing materials, including masonry, conduit and sewer connections, steps, and other fittings; for excavating, backfilling, disposing of surplus material, and for cleaning out and restoring the work site; except that the department will pay for covers, including frames, grates and lids separately.

(2) The department will apply contract unit prices without adjustment to the quantities of catch basins, manholes, or inlets constructed to depths not greater than one foot above or below the elevations, the plans show. Catch basins, manholes, or inlets that the engineer orders constructed to depths greater than one foot above or below the elevations the plans show as specified for extra work in 109.4.

611.5.3 Reconstructing Catch Basins, Manholes, and Inlets

(1) Payment for Reconstructing Catch Basins, Reconstructing Manholes, and Reconstructing Inlets is full compensation for providing required materials, including masonry and fittings; for salvaging and reinstalling existing covers, including frames, grates, or lids; for necessary excavation, backfilling, disposing of surplus material, and for cleaning out and restoring the work site.

611.5.4 Manhole Covers and Inlet Covers

(1) Payment for the Manhole Covers and Inlet Covers bid items is full compensation for removing and salvaging the existing covers; and for providing new covers, including frames, grates or lids, and other required materials and for installing and adjusting each cover. Old covers removed remain the municipality's property.

611.5.5 Adjusting Catch Basin, Manhole, and Inlet Covers

(1) Payment for Adjusting Catch Basin Covers, Adjusting Manhole Covers, and Adjusting Inlet Covers is full compensation for providing required materials, exclusive of frames, grates, or lids available and designated for adjusting; and for removing, reinstalling and adjusting the covers. The contractor shall replace covers rendered unusable by the contractor’s operations, at no expense to the department.

611.5.6 Salvaged Manhole Covers and Inlet Covers

(1) Payment for Salvaged Manhole Covers and Salvaged Inlet Covers is full compensation for removing the existing cover including frames, grates, or lids; for cleaning, transporting, and storing; for installing and adjusting; and for providing other required materials.

Section 612 Underdrains

612.1 Description

(1) This section describes providing necessary subsurface drainage by constructing trenches, placing designated pipes or drainage devices, and backfilling the trenches.

612.2 Materials

612.2.1 General

(1) Furnish and use materials conforming to the following requirements. Furnish all pipe as perforated unless the plans show or the special provisions specify unperforated pipe.

(2) The contractor may furnish, unless the contract specifies otherwise, one of the materials specified here in 612.2 under the Pipe Underdrain or Pipe Underdrain Unperforated bid items.

612.2.2 Corrugated Steel Pipe

(1) Provide corrugated steel pipe for underdrains conforming to type III culverts of AASHTO M36. Provide perforations conforming to class I. Use sheets not less than 0.052 inch thick for 6-inch underdrains or 0.064 inch for 8-inch to 21-inch, inclusive, diameter underdrains.

(2) If installing the pipes underground, the contractor may furnish coupling bands that have engineer-approved wedging, clamping, or other fasteners, instead of bolts.

612.2.3 (Vacant)

612.2.4 Corrugated Aluminum Alloy Pipe

(1) Use corrugated aluminum alloy pipe for underdrains conforming to type III pipes of AASHTO M196. Use a sheet not less than 0.060 inch thick. Provide perforations conforming to the requirements for class I.

(2) If installing the pipes underground, the contractor may furnish coupling bands that have engineer-approved wedging, clamping, or other fasteners, instead of bolts.

612.2.5 Corrugated Polyethylene Drainage Pipe

(1) Use corrugated polyethylene drainage pipe for underdrains conforming to AASHTO M252, type CP and AASHTO M294, type CP with class 2 perforations.

612.2.6 Polyvinyl Chloride Drainage Pipe

(1) Use polyvinyl chloride drainage pipe for underdrains conforming to AASHTO M278.

612.2.7 Acrylonitrile-Butadiene-Styrene Drainage Pipe

(1) Use acrylonitrile-butadiene-styrene drainage pipe for underdrains conforming to ASTM D2680, except do not apply the requirements for joint tightness. Use pipe perforated according to AASHTO M278, if perforated pipe is required.

612.2.8 Geotextile

(1) Use a geotextile of knitted, woven, or non-woven fibers of polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Do not use slit film woven fabrics for this work. The fabric must conform to the following requirements:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	35 lb
Apparent opening size	ASTM D4751	No. 30 - 200
Minimum permittivity	___	1.35 s^{-1}

[1] All numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should conform to or exceed the minimum values in the table).

(2) Use knitted fabrics constructed from continuous yarn. Non-woven fabrics may be needle-punched, heat-bonded, resin-bonded, or combinations of these 3 types. Use woven fabrics constructed from monofilament or multifilament yarns.

(3) Use geotextile wraps of knitted construction that form a seamless sleeve and fit tightly over the pipe. If using geotextile wraps constructed from woven or non-woven fabric then tightly wrap and securely fix to the pipe.

(4) Clearly mark the geotextile rolls to identify the type of fabric.

(5) If the engineer determines it is necessary, they can obtain fabric samples for testing from the job site.

(6) If wrapping pipe underdrain, then the pipe shall conform to 612.2.5 for perforated underdrain.

612.2.9 Reinforced Concrete Apron Endwalls for Underdrain

(1) Use material for endwalls conforming to 504 or 522.2.

612.2.10 Backfill

(1) Furnish grade 1 granular backfilll conforming to 209.2.

612.3 Construction

612.3.1 Excavation

(1) Construct trenches for the underdrain as near as possible to the locations, lines, and grades the plans show. However, if necessary, the engineer may alter the locations, lines, and grades to fit existing conditions.

(2) Begin trench excavation at the outlet end of the underdrain and proceed towards the upper end. Make trenches wide enough to provide adequate free working space on each side of the pipe and to allow compacting the backfill around the pipe. Restore all areas excavated below the established grade by adequately compacting and shaping a layer of suitable material.

612.3.2 Wrapping Pipe

(1) Under the Pipe Underdrain Wrapped bid items, provide pipe underdrain wrapped with geotextile.

(2) Wrap the geotextile securely around the pipe underdrain along its entire length in a way that allows no water to enter the underdrain without first passing through the fabric.

(3) Furnish geotextile in a cover that protects the fabric from exposure to sunlight and abrasion due to shipping and hauling. The contractor shall not expose the fabric to the direct rays of the sun for more than 48 hours before covering.

(4) Cover torn or punctured fabric with suitable geotextile extending at least 12 inches in all directions from the edge of the damaged fabric.

(5) Overlap all joints or splices in the fabric a minimum of 18 inches.

612.3.3 Laying Pipe

(1) In general, start laying pipe in the trench at the outlet end and proceed toward the upper end, true to line and grade. Lay pipe with riveted lap joints so the flow is over the lap of the sheets. Make joints between sections by fitting the ends as tightly as possible. Use connecting bands to link the joints of corrugated steel or aluminum alloy pipe, and bolt or clamp firmly in place.

(2) Securely connect sections of corrugated polyethylene pipe with fittings conforming to AASHTO M252 or M 294. The contractor may use solvent-cement joints, or gasketed joints, to join smooth plastic pipe. Secure corrugated polyethylene pipe as necessary to prevent displacement during laying and backfilling.

(3) Unless the engineer directs otherwise, lay perforated drainage pipe with the perforations on the underside of the pipe.

(4) Close the dead ends of pipe securely with concrete plugs, or engineer-approved caps, or plugs fabricated from the same material used in the pipe.

(5) Protect discharge ends of pipes with securely fastened engineer-approved gratings or screens.

(6) Furnish and place engineer-approved connectors to make lateral connections.

612.3.4 Plowing In Pipe

(1) Under the Pipe Underdrain Wrapped and Plowed bid items, place the wrapped pipe underdrain by plowing and replacing the displaced materials in a single operation. Place a wrapped underdrain in one continuous line except as the plans show or the engineer directs. Connect the pipe underdrain with plastic pipe couplers.

(2) Construct the underdrain at the location the plans show, and in a relatively straight line. Make the grade line follow as near as possible the grades the plans show or as the engineer directs to fit existing conditions.

(3) Use equipment capable of installing the underdrains to the required grade and location by plowing and replacing the displaced materials, as determined in the field, all in a single operation. Use equipment that will not damage the existing pavement. Compact materials disturbed by the plowing operations to the engineer's satisfaction.

(4) Reshape and re-compact the existing shoulder materials to the engineer's satisfaction. Use compaction equipment conforming to 301.3.

(5) If using a tracked pull unit, then use rack pads on the track on both pavement and shoulder.

(6) Close upgrade ends of the pipe with suitable caps to prevent backfill from entering.

(7) Install all couplings, tees, and other fittings to prevent the infiltration of backfill material and ensure compatibility with the pipe.

612.3.5 Backfilling

(1) Unless specified otherwise, cover perforated pipe immediately after laying with granular material, as the plans specify, or as the engineer approves, to one foot above the top of the pipe. Make the granular fill a uniform depth on both sides of the pipe, and a minimum of 8 inches wider than the outside diameter of the pipe.

(2) If excavating for installing underdrains across private property, or within the right-of-way beyond the roadway limits, salvage the upper tillable or agricultural soil suitable for supporting vegetation and keep separate from other excavated material. Place this salvaged material in the top layer or layers of the backfill. Restore the entire area involved in the construction in a skilled and satisfactory manner.

(3) Use open-graded material required for trench backfill in the edgedrain system for concrete pavements as the plans show.

612.3.6 Drain Tile Exploration

(1) Under the Drain Tile Exploration bid item, excavate an exploratory trench to locate existing farm drain tile.

(2) Perform the exploratory trenching in sufficient advance of the grading operations to allow uninterrupted progress of these operations.

(3) Construct the trench a minimum 12 inches wide and deep enough to intercept all existing tile lines. Keep the trench open until the engineer orders it backfilled. Use the material obtained from the trench excavation for backfill.

612.3.7 Delivery

(1) Coordinate with the engineer to determine the sizes and lengths of pipe required before ordering or delivering pipe.

612.3.8 Reinforced Concrete Apron Endwalls for Underdrain

(1) Under the Apron Endwalls for Underdrain Reinforced Concrete bid items, provide reinforced concrete apron endwalls at underdrain outlets.

(2) Install endwalls according to plan details, at the locations the plans show.

612.3.9 Trench Underdrains

(1) Under the Underdrain Trench bid item, excavate and backfill underdrain trenches. Backfill with No. 2 coarse aggregate conforming to 501.2.5.4. Before backfilling place geotextile as the plans show.

612.4 Measurement

(1) The department will measure the Pipe Underdrain bid items by the linear foot acceptably completed. The department will measure along the centerline of the pipe, center to center of junctions and fittings.

(2) The department will measure Underdrain Trench by the linear foot acceptably completed, measured along the bottom of the trench. The department will measure geotextile separately.

(3) The department will measure Drain Tile Exploration by the linear foot acceptably completed. The measured quantity equals the number of linear feet of trench opened at the engineer's direction.

(4) The department will measure the Apron Endwalls for Underdrain Reinforced Concrete bid items as each individual apron endwall acceptably completed.

612.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
612.0100 - 0199	Pipe Underdrain (inch)	LF
612.0200 - 0299	Pipe Underdrain Unperforated (inch)	LF
612.0400 - 0499	Pipe Underdrain Wrapped (inch)	LF
612.0500 - 0599	Pipe Underdrain Wrapped and Plowed (inch)	LF
612.0600	Underdrain Trench	LF
612.0700	Drain Tile Exploration	LF
612.0800 - 0899	Apron Endwalls for Underdrain Reinforced Concrete (inch)	EACH

(2) Payment for the Pipe Underdrain bid items is full compensation for providing the underdrain; and for excavating and backfilling. The department will pay separately for open-graded material required for trench backfill in the edgedrain system for concrete pavements under the Base Aggregate Open Graded bid item.

(3) Payment for Underdrain Trench is full compensation for excavating and backfilling the trench The department will pay for geotextile separately.

(4) Payment for Drain Tile Exploration is full compensation for all excavating, backfilling, and for restoring the work site.

(5) Payment for the Apron Endwalls for Underdrain Reinforced Concrete bid items is full compensation for all excavating and backfilling; for concrete and reinforcement at each unit; and for disposing of all surplus material.

Section 614 Semi-rigid Barrier Systems and End Treatments

614.1 Description

(1) This section describes providing steel guardrail systems including rail, terminal and transition treatments, other roadside energy absorbing safety devices, and earthwork for barrier systems. This section also describes providing and removing temporary guardrail, adjusting existing guardrail, salvaging materials from existing installations.

614.2 Materials

614.2.1 General

(1) Furnish materials conforming to the following:

Asphaltic surface 465.2
Non-bituminous joint sealer 502.2
Structural steel and miscellaneous metals 506.2
Steel reinforcement 505.2
Wood posts and offset blocks 507.2
Emulsified asphalt 604.2

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716, except under the Crash Cushions Temporary bid item the contractor may use SHES concrete as specified for SHES concrete repair and replacement in 416.2. Provide QMP for class II ancillary concrete as specified in 716. If crash cushion manufacturer details specify concrete strength for pads or blocks, provide QMP for class I structure concrete as specified in 715. Define class I structure sublots for each crash cushion location, apply the small quantity exceptions specified in 715.1.1.2, base acceptance on individual sublot average strength, and adjust pay under 715.5.3 as specified for lots with less than 4 sublots.

(3) Furnish zinc dust/zinc oxide paint conforming to Federal specification TT-P-641.

(4) Furnish steel nuts conforming to ASTM A563, washers conforming to ASTM F436, grade 1, and bolts conforming to ASTM A307. Ensure that the nuts, washers, and bolts are either hot-dip coated according to AASHTO M232 class C or mechanically coated according to ASTM B695 class 50.

(5) Furnish zinc coated wire rope and fitting conforming to the plans and galvanized according to ASTM A741.

(6) Before installation store galvanized components above ground level and away from surface run off. The department may reject material if the zinc coating is physically damaged or oxidized.

(7) Provide manufacturer's drawings, and installation and maintenance instructions when providing proprietary systems.

(8) Furnish shop-applied type F reflective sheeting from the department's APL.

(9) Furnish object markers conforming to the type 3 object marking pattern shown in the WMUTCD.

Add 614.2.1(10) to specify offset block-mounted guardrail reflectors from the department's approved products list. This change was implemented in ASP 6 effective with the December 2017 letting.

(10) Furnish guardrail reflectors from the department's APL.

614.2.2 Controlled Low-Strength Backfill

(1) Provide controlled low-strength backfill consisting of a contractor-designed cementitious mixture of fine aggregate, fly ash, cement, water, and optional admixtures. Ensure that the resulting mixture hardens with 24 hours to the degree that it will support foot traffic and conforms to the following:

TEST	METHOD	VALUE
Strength	ASTM D4832	40-80 psi in 28 days

(2) Submit design mix along with strength test results to the engineer at least 10 business days before placing material.

614.2.3 Steel Rail and Fittings

(1) Furnish galvanized steel rail conforming to AASHTO M180 class A, type II beam using the single-spot test coating requirements. Furnish steel for retrofit assemblies, anchor post assemblies, plates, anchor plates, post mounting brackets, and other structural steel components conforming to 506.2.2.1 and hot-dip galvanized according to ASTM A123.

(2) For rail requiring bends with a radius less than 150 feet, ensure that the required bends are made in the manufacturer's fabrication shop.

(3) Furnish steel tubes for breakaway posts conforming to ASTM A500, grade B and hot-dip galvanized according to AASHTO M111.

(4) Furnish anchor assemblies fabricated as the bridge parapet details show. Over-tap threaded inserts according to ASTM A563 and electro-galvanize the entire assembly according to ASTM B633 after fabrication. Furnish cap screws hot-dip galvanized as the parapet details show.

614.2.4 Energy Absorbing Terminal

(1) Furnish energy absorbing terminals (EAT's) and EAT marker posts from the department's APL. Furnish reflective sheeting panels constructed from sheet aluminum with shop-applied reflective sheeting conforming to the plan details and 637.3.2.

614.2.5 Posts and Offset Blocks

614.2.5.1 Wood Posts and Offset Blocks

(1) Furnish sawed posts and offset blocks of one of the following species:

Douglas fir	Southern pine	Ponderosa pine	Jack pine	White pine
Red pine	Western hemlock	Western larch	Hem-fir	Oak

(2) Ensure that posts are the size the plans show and conform to the nominal and minimum dimensions tabulated in 507.2.2.3. The contractor does not have to surface the posts. Provide posts of the net length the plans show after setting and cut off.

(3) Use stress graded posts rated at 1200 psi f_b or higher. Determine the stress grade rating for douglas fir, western larch, and southern pine as specified in 507.2.2.4.

(4) For hem-fir, hemlock, red pine, white pine, jack pine, ponderosa pine, and oak conform to the following:

TABLE 614-1 PROPERTIES FOR WOOD POSTS AND BLOCKS

SPECIES			WESTERN HEMLOCK, HEM-FIR, RED PINE, WHITE PINE, JACK PINE, PONDEROSA PINE		OAK	
MAXIMUM SLOPE OF GRAIN			1 in 15		1 in 12	
NOMINAL WIDTH OF FACE			6"	8"	6"	8"
SHAKES, CHECKS, AND SPLITS		GREEN	1"	1 3/8"	2 3/8"	3 1/8"
		SEASONED	1 1/2"	2"	2 5/8"	3 1/2"
MAXIMUM WANE			1"	1 3/8"	1 1/8"	1 5/8"
MAXIMUM ALLOWABLE KNOTS	NARROW FACE	MIDDLE 1/3 OF LENGTH	1 3/8"	1 5/8"	2 1/8"	2 3/8"
		END[1]	2 3/4"	3 1/4"	4 1/4"	4 3/4"
		SUM IN MIDDLE 1/2 OF LENGTH[2]	11"	13"	17"	19
	WIDE FACE	EDGE KNOT N MIDDLE 1/3 OF LENGTH	1 3/8"	1 5/8"		
		EDGE KNOT AT END[1]	2 3/4" 7	3 1/4"		
		CENTERLINE	1 3/8"	1 7/8"	2 1/4"	2 7/8"
		SUM IN MIDDLE 1/2 OF LENGTH	5 1/2"	7 1/2"	9"	11 1/2"

[1] But do not exceed the maximum allowable knot on the centerline of the wide face of the same piece.

[2] But do not exceed 4 times the maximum allowable knot on the centerline of the wide face of the same piece.

(5) Pressure treat posts and offset blocks as specified in 507.2.2.6. Use one of the oil-soluble preservatives or chromated copper arsenate conforming to 507.2.3. Use the same material for offset blocks and posts and treat material used in each continuous installation with the same type of preservative.

614.2.5.2 Steel Posts

(1) Furnish steel posts conforming to AASHTO M270 Grade 36 and galvanized according to AASTHO M111.

614.2.5.3 Plastic Offset Blocks

(1) Furnish plastic offset blocks from the department's APL.

614.2.6 Sand Barrel Arrays

(1) Furnish sand barrels from the department's APL. Use sand conforming to 501.3.6.3 mixed with sodium chloride conforming to AASHTO M143. Apply an object marker to front-most barrel in the array.

614.2.7 Crash Cushions

(1) Furnish permanent and temporary crash cushions from the department's APL. Use cushions as wide or wider than the plan back-width. Submit details of the object being shielded and orientation of traffic to the crash cushion manufacturer. The crash cushion manufacturer is responsible for providing design details for each installation that include their crash cushions as well as connections and transitions to the object being shielded. Ensure that the crash cushion manufacturer's design details are signed and sealed by a professional engineer registered in the state of Wisconsin.

(2) Furnish transitions and connections conforming to the crash cushion manufacturer's design and specifications. Ensure that the transition and connection design includes required modifications to the object being shielded. Submit a copy of the manufacturer's crash cushion, connection, and transition design details to the engineer before installation. Modifications to the object being shielded require the engineer's approval before installation.

(3) Apply an object marker to the nose of the crash cushion of the color and pattern the WMUTCD shows for work zones or permanent installations.

614.2.8 Adhesive Anchors

(1) Furnish adhesive for concrete anchors conforming to ICC-ES AC308 and capable of resisting the bond strength the plans show. Provide the adhesive manufacturer’s installation instructions to the engineer before installing anchors.

614.3 Construction

614.3.1 General

(1) Paint the ends of cut-off galvanized posts, rail, bolts, cut or drilled surfaces of galvanized components, and areas of damaged zinc coating with 2 coats of zinc dust/zinc oxide paint. Clean and deburr the damaged and adjacent areas thoroughly before applying paint.

(2) Apply 2 coats of wood preservative to cut surfaces of wood components. Use the same preservative originally used to treat that component or use copper naphthenate solution containing 2 percent or more copper metal conforming to AWPA P34.

(3) Anchor barrier systems as the plans show or as manufacturer details show. For anchoring to concrete, clean holes and install according to the adhesive manufacturer's recommendations.

614.3.2 Guardrail

614.3.2.1 Installing Posts

(1) Set posts at the required plan locations with the front faces in a straight line or, if on a curve, at a uniform distance from the centerline. Ensure that they are installed plumb, to the required depth, and with adequate lateral stability. The contractor may drive posts or set them in excavated post holes. If rock is encountered, install as the plans show.

(2) If the required plan depth cannot be achieved by driving, set posts in excavated holes. Replace posts damaged during driving. Ensure driving does not damage the shoulders and adjacent slopes.

(3) If installing posts in excavated post holes, excavate to the plan depth and compact the bottom of the holes to provide a stable foundation. Set posts to firm bearing and backfill with engineer-approved material compacted in layers.

Revise 614.3.2.1(4) to clarify that the contractor must verify the post length and embedment before cutting post tops and to provide for department verification of installed guardrail post depths even after installation.

(4) Ensure that posts are at least the minimum length and minimum embedment the plans show before cutting post tops to the finished elevation. After installation, the engineer may direct the contractor to remove and re-install up to 5% of the posts to verify they were placed to the required plan depth. If a post is embedded less than the required plan depth, the engineer may direct additional sampling. Re-install sampled posts at the locations and to the depths the plans show. Replace posts and other components that are damaged during sampling.

Add 614.3.2.1(5) to specify spacing for offset block-mounted guardrail reflectors in the plan general notes. This change was implemented in ASP 6 effective with the December 2017 letting.

(5) Provide offset block-mounted reflectors as the plans show.

614.3.2.2 Installing Rail

(1) Install rail with lap splices in the direction of traffic. Ensure that the number and dimensions of holes and bolts conforms to the plan details for new splices. Place the round head of bolts on the traffic side.

(2) Cut rails to length by shearing or sawing; do not use cutting torches. Drill bolt holes and punch slots; ensure that they are burr free. After installation, cut anchor bolts that project more than one inch from the nut to 1/2 inch from the nut; deburr the threaded end of cut bolts.

614.3.2.3 Guardrail Terminals and Transitions

(1) Attach rail ends to cast in place concrete anchorages, energy absorbing terminals (EAT's) or other terminal types, or transition between rail types at structure approaches as the contract requires for each guardrail system installation.

(2) If concrete anchorages are specified, place concrete without forms filling the entire excavation with concrete to the elevation the plans show. Ensure that steel reinforcement and the rail are secured at their plan locations before placing concrete. Do not apply forces to the rail element embedded in the concrete anchor until after the concrete develops adequate strength to open it to service under 415.3.15.

(3) If anchoring to structures, attach guardrail to the parapets of structures using anchor assemblies cast into the parapets or drill through the parapet whichever the plan details show. Plug anchor assemblies not receiving beam guard using cap screws with anti-seize compound applied to their threads.

(4) Install EAT's according to the manufacturer's instructions and as the plans show. Attach reflective panels to the EAT head with stainless steel self-tapping screws and install EAT markers as the plans show.

614.3.2.4 Mow Strips

(1) Provide mow strips with blockouts for guardrail posts as the plans show. Construct concrete as specified for concrete sidewalk under 602. Construct asphalt as specified for asphaltic surface under 465. Backfill post blockouts after post installation with controlled low-strength backfill.

(2) Apply emulsified asphalt to finished aggregate shoulders following the asphalt manufacturer's recommended procedures. Minimize run-off and overspray during application and remove excessive run-off and over spray from adjacent areas immediately after application.

614.3.2.5 Grading, Shaping, and Finishing for Barrier Systems

(1) Grade, shape, and finish embankment slopes for barrier systems at the locations the plans show. Furnish materials and construct as the plans show and engineer directs conforming to the following:

Common excavation and material disposal 205
Borrow 208
Topsoil 625
Mulching 627
Fertilizer 629
Seeding 630
Construction Staking 650

614.3.2.6 Temporary Guardrail

(1) Provide and maintain temporary guardrail and associated terminals and transitions conforming to the requirements for permanent installations except the contractor may furnish used materials. Replace guardrail components damaged during construction immediately. Remove and dispose of temporary guardrail components when no longer needed.

614.3.3 Sand Barrel Arrays

(1) Provide sand barrel arrays and foundation at each location the plans show. Have the sand barrel manufacturer design the barrel array layout and determine the sand weights for each individual barrel. Ensure that the manufacturer's design at each plan location conforms to the design speed, shields the required obstruction width, and is appropriate for the traffic direction. Submit a copy of the manufacturer's design details stamped and sealed by a professional engineer registered in the state of Wisconsin to the engineer before installation.

(2) Fill the barrels with a homogeneous mixture of 3 parts dry sand to one part granular sodium chloride by volume. Do not use pre-packaged sand. Do not place the mixture into the barrels in a wet condition.

Revise 614.3.3(3) to require ID plaques for permanent sand barrel arrays instead of information painted on the pad.

(3) Construct concrete foundation pads as specified for concrete sidewalk under 602 conforming to dimensions the sand barrel manufacturer specifies. For permanent installations, provide an engineer-

approved non-reflective aluminum plaque that identifies the manufacturer, barrel locations and weights, traffic direction, and the installation date. Coordinate with the engineer to determine location-specific size and material requirements. Attach the plaque to the object being shielded at an engineer-directed height above the grade and secured as the engineer directs.

614.3.4 Crash Cushions

(1) Provide and maintain permanent crash cushions and transitions at the locations the plans show. Conform to the contract design criteria and to manufacturer's specifications. Certify that the installation was done according to manufacturer's recommendations. Install object markers with reflective sheeting to the crash cushion nose piece before opening to public traffic. Replace parts of crash cushions damaged during construction immediately.

(2) Provide and maintain temporary crash cushions and transitions conforming to the requirements for permanent installations except the contractor may furnish used materials. Remove and dispose of crash cushions when no longer needed.

(3) Provide concrete backup blocks and either concrete or asphalt foundation pads conforming to the crash cushion manufacturer's design. Construct concrete components as specified for concrete sidewalk under 602.3 and construct asphalt components as specified for asphaltic surface under 465.

Add 614.3.4(4) to require ID plaques for permanent crash cushions.

(4) For permanent crash cushions, provide an engineer-approved non-reflective aluminum plaque that identifies the crash cushion manufacturer, model designation, and the installation date. Coordinate with the engineer to determine location-specific size and material requirements. Attach the plaque to the object being shielded at an engineer-directed height above the grade and secured as the engineer directs.

614.3.5 Adjusting Guardrail

(1) Adjust existing guardrail to the plan height. The contractor may raise offset blocks up to 3 inches, and only if that is not sufficient to reach the plan elevation, may raise posts an additional 3 inches if the engineer deems that stability is not compromised. Adjustments over 6 inches require placing new posts and backfilling with foundation backfill conforming to 520.2.

(2) Use the existing serviceable guardrail beam, bolts, posts, and offset blocks. Replace existing rail components that are either unserviceable or missing. Straighten existing posts out-of-plumb by 6 inches or more. Straighten existing blocks and reinstall the galvanized nail as the plans show. Replace unstable or deteriorated posts and blocks.

614.3.6 Thrie Beam Structure Approach Retro Fits

(1) Reinforce existing thrie beam by installing thrie beam retrofit assemblies or posts of the type the bid item indicates and as the plans show. Modify existing work conflicting with retrofitting as the plans show or engineer directs.

(2) Install posts, drill holes into existing thrie beam, and repair damaged galvanization on thrie beam conforming to 614.3.2.

614.3.7 Anchor Post Assemblies

(1) Before drilling into concrete, adjust beam guard post locations to avoid placement conflicts. do not relocate post more than 1 foot from the plan location without the engineer's written approval. Set anchor post assemblies with the front faces in a straight line or, if on a curve, at a uniform distance from the centerline.

614.3.8 Replacing Material

(1) Remove and replace unserviceable posts, blocks, rail, rail hardware, and guardrail reflectors at locations within existing guardrail systems where the contract or engineer designates. Take care to avoid damage to adjacent materials remaining in place.

614.3.9 Salvaging Material

(1) Dismantle and remove the rail, guardrail end treatment, or other component the salvaged bid item indicates from the locations the contract designates. Minimize damage to reusable materials. Do not cut material that would be otherwise reusable. Replace contractor-damaged materials that are to remain in place. Remove and dispose of all wooden component parts and unwanted or damaged materials. Restore the site.

(2) Sort by component part and load reusable materials onto separate pallets for each component part. The contractor may place hardware and smaller parts in clearly labeled crates or plastic buckets. Stockpile reusable material in engineer-approved locations on the project.

(3) The contractor may use salvaged materials for temporary installations under the contract.

614.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed except as follows:

- The department will measure terminals as everything required within the system length the plan details show; for type 2 terminals the department will measure rail under the linear foot rail bid items.
- The department will measure Steel Thrie Beam Structure Approach Retrofit as each individual assembly or retrofit post.
- The department will measure Sand Barrel Arrays as each individual sand barrel array, including foundation, measured individually for each required plan location.
- The department will measure Salvaged Sand Barrels as each individual barrel.
- The department will measure Replacing Guardrail Posts and Blocks as each individual post/block unit whether the post, block, or both are replaced.
- The department will measure Barrier System Grading Shaping Finishing as each individual plan location acceptably completed.
- The department will measure Anchor Post Assemblies as each individual post.

(2) The department will measure the LF bid items under this section by the linear foot acceptably completed, measured along the face of the rail element except:

- The department will measure Steel Plate Beam Median Guard along the centerline of the completed installation.
- The department will measure the Short Radius bid items as the length along the curved rail only.

(3) The department will measure the mow strip bid items by the square yard acceptably completed, measured without reduction for the area of the post blockouts.

614.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
614.0010	Barrier System Grading Shaping Finishing	EACH
614.0115 - 0149	Anchorages for Steel Plate Beam Guard (type)	EACH
614.0150	Anchor Assemblies for Steel Plate Beam Guard	EACH
614.0200	Steel Thrie Beam Structure Approach	LF
614.0210 - 0219	Steel Thrie Beam Structure Approach Retrofit (type)	EACH
614.0220	Steel Thrie Beam Bullnose Terminal	EACH
614.0230	Steel Thrie Beam	LF
614.0250	Steel Thrie Beam Structure Approach Temporary	LF
614.0300 - 0339	Steel Plate Beam Guard (class)	LF
614.0340	Steel Plate Beam Guard Over Low-Fill Culverts Class A	LF
614.0345	Steel Plate Beam Guard Short Radius	LF
614.0355	Steel Plate Beam Median Guard	LF
614.0360	Steel Plate Beam Guard Temporary	LF
614.0370	Steel Plate Beam Guard Energy Absorbing Terminal	EACH
614.0380	Steel Plate Beam Guard Energy Absorbing Terminal Temporary	EACH
614.0390	Steel Plate Beam Guard Short Radius Terminal	EACH
614.0395 - 0399	Guardrail Mow Strip (material)	SY
614.0400	Adjusting Steel Plate Beam Guard	LF
614.0500 - 0599	Guardrail Stiffened (type)	LF
614.0700	Sand Barrel Arrays	EACH
614.0800	Crash Cushions Permanent	EACH
614.0805	Crash Cushions Permanent Low Maintenance	EACH
614.0905	Crash Cushions Temporary	EACH
614.0920	Salvaged Rail	LF
614.0925	Salvaged Guardrail End Treatments	EACH
614.0930 - 0939	Salvaged (component)	EACH
614.0950	Replacing Guardrail Posts and Blocks	EACH

614.0951	Replacing Guardrail Rail and Hardware	LF

Revise 614.5(1) to add a bid item for replacing guardrail reflectors.

614.0952	Replacing Guardrail Reflectors	EACH
614.1000	MGS Guardrail Temporary	LF
614.1100	MGS Guardrail Temporary Thrie Beam Transition	LF
614.1200	MGS Guardrail Temporary Terminal EAT	EACH
614.2300	MGS Guardrail 3	LF
614.2310	MGS Guardrail 3 HS	LF
614.2320	MGS Guardrail 3 QS	LF
614.2330	MGS Guardrail 3 K	LF
614.2340	MGS Guardrail 3 L	LF
614.2350	MGS Guardrail Short Radius	LF
614.2500	MGS Thrie Beam Transition	LF
614.2610	MGS Guardrail Terminal EAT	EACH
614.2620	MGS Guardrail Terminal Type 2	EACH
614.2630	MGS Guardrail Short Radius Terminal	EACH
614.8010 - 8019	Anchor Post Assemblies (type)	EACH

(2) Payment for the Anchorages for Steel Plate Beam Guard bid items is full compensation for providing concrete anchorages, including concrete and reinforcement; and for excavating, backfilling, and disposing of excess material.

(3) Payment for Anchor Assemblies for Steel Plate Beam Guard is full compensation for providing anchors in parapet walls.

Revise 614.5(4) to specify that removing and re-installing posts to verify embedment is incidental to the contract.

Also revise 614.5(4) to specify that offset block-mounted guardrail reflectors are incidental; this change was implemented in ASP 6 effective with the December 2017 letting.

(4) Payment for the Steel Thrie Beam, Steel Plate Beam Guard, Guardrail Stiffened, MGS Guardrail, Short Radius, and various transition bid items is full compensation for providing guardrail and transitions; for removing and re-installing posts as required under 614.3.2.1(4) to verify embedment depth; for offset block-mounted reflectors; for repairing damaged zinc coatings; and for excavating, backfilling, and disposing of surplus material.

(5) Payment for the Steel Thrie Beam Structure Approach Retrofit bid items is full compensation for providing retrofit assemblies or posts; for required modifications to existing work; and for drilling and repairing damaged galvanized coated thrie beam.

(6) Payment for the terminal bid items is full compensation for providing terminals required under the selected system; for EAT reflective sheeting panels and marker posts; for railing, except the department will pay separately for railing within type 2 terminals under the MGS Guardrail bid items; and for excavating, backfilling, and disposing of surplus material.

(7) Payment for the Guardrail Mow Strip bid items is full compensation for providing the paved strip adjacent to the guardrail installation; for concrete, asphaltic surface material, or emulsified asphalt; and for controlled low-strength backfill including mix design and testing.

(8) Payment for Adjusting Steel Plate Beam Guard is full compensation for adjusting existing guardrail including backfilling. The department will pay separately for replacing unserviceable posts, blocks, rail, and rail hardware under the replacing guardrail bid items.

(9) Payment for Sand Barrel Arrays is full compensation for providing manufacturer design details for each sand barrel array; for the foundation pad; for providing each system at the plan location including barrels, sand, and sodium chloride; and for ID plaques.

(10) Payment for the Crash Cushions bid items is full compensation for providing crash cushions; for the foundation pads, transitions, and backup blocks; and for ID plaques.

(11) In addition to the work elements enumerated for the various permanent bid items, payment for the temporary bid items also includes removing and disposing of materials when no longer needed.

(12) Payment for the salvaged bid items is full compensation for dismantling and stockpiling reusable rail, guardrail end treatments, or system elements; for replacing contractor-damaged material remaining in place; for removing and disposing of wooden components and unwanted or damaged materials; and for restoring the site.

(13) Payment for Replacing Guardrail Posts and Blocks is full compensation for replacing posts and blocks; and for excavating, backfilling, and disposing of surplus material.

(14) Payment for Replacing Guardrail Rail and Hardware is full compensation for replacing rail and associated hardware.

Add 614.5(15) to specify payment for the Replacing Guardrail Reflectors bid item.

(15) Payment for Replacing Guardrail Reflectors is full compensation for replacing offset block-mounted reflectors.

(16) Payment for Barrier System Grading Shaping Finishing is full compensation for providing embankment at each barrier system plan location including required construction staking, excavation, borrow, topsoil, mulch, fertilizer, and seeding when the barrier system is outside the contract grading limits. If the work specified in 614.3.2.5 falls within the contract grading limits, the department will pay separately for that work under the construction staking, excavation, borrow, topsoil, mulch, fertilizer, and seeding bid items.

(17) Payment for the Anchor Post Assemblies bid items is full compensation for providing anchor post assemblies.

Section 615 Treated Rustic Timber Items and Historical Markers

615.1 Description

(1) This section describes constructing timber rail guard fence, treated timber curbs, timber guard posts, rustic marker posts, and historical markers, appropriate for use in rest areas or waysides.

615.2 Materials

615.2.1 General

(1) Furnish materials conforming to the following:

Lumber and timber 507
Paint 517
Wood preservatives 507.2.3
Structural steel 506.2
Miscellaneous metals 506.2
Reinforcement 505

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

615.2.2 Sawed Posts and Timber Curbs

(1) Furnish timber posts and curbs as specified in 614.2.5 for wood posts and offset blocks.

(2) The contractor may use shims for timber curbs that are one of the following: treated, cold-dip treated, or painted with 2 coats of the preservative used for the curbs.

615.2.3 Round Posts

(1) Conform to the requirements for wooden posts in 616.2.2.6. Treat round posts as specified on the plans or in the contract. Peel, trim, shave, and cut posts to length before treatment.

615.2.4 Timber Rails

(1) Furnish sawed rails from one of the species listed in 614.2.5 for wood posts and offset blocks.

(2) Furnish untreated sawed rails, unless required otherwise on the plans, conforming to the grade the plans specify. Grade sawed rails according to the grading rules and requirements specified in 507.2.2. Furnish unsurfaced sawed rails, or surfaced on all 4 sides (S4S), as the plans specify.

615.2.5 Furnishing Posts

(1) Furnish treated, untreated, or cold-dip treated posts, as the plans, or contract specifies.

(2) If treated posts are specified, then treat posts by the pressure process according to the methods, requirements, and minimum retention and penetration of preservative specified for preservative treatment in 507.2.2.6. Except, do not use creosote-coal tar or pentachlorophenol for treatment.

(3) If the plans or contract specifies cold-dip treatment, then treat posts in the manner specified below in 615.2.6.

615.2.6 Cold-Dip Treatment

(1) This method of preservative treatment consists of immersing the wood in a solution composed of 5 percent pentachlorophenol and a suitable petroleum solvent. Allow the wood to soak in the solution. Ensure the pentachlorophenol and petroleum solvent conforms to the requirements of 507.2.3. Unless directed otherwise, use heavy petroleum solvent. The contractor may use the solution at atmospheric temperatures. The contractor may treat both round wood posts and sawed timber. Remove both the outer and inner bark from round wood. Use sufficiently seasoned material for treatment that allows ready absorption of the preservative solution. Allow wood exposed to moisture to dry before treating.

(2) The soaking period for both round wood and sawed timber is dependent on the type of wood, hardwood or softwood, and if using sawed timber, varies according to the thickness of its least dimension. Unless specified otherwise, adhere to following soaking periods:

- For round hardwood posts: 40 to 48 hours.[1]
- For round softwood posts: 20 to 24 hours.[1]

[1] Depending on the tendency and speed of the wood to absorb the oil.

(3) Soak sawed hardwood timber for 5 hours per inch of thickness, with a maximum of 48 hours.

(4) Soak sawed softwood timber 1/2 the time of sawed hardwood timber.

(5) Treat posts for their full length unless the drawings or special provisions specify butt treatment.

(6) Before using, stack and dry all treated wood after removing from the solution.

(7) Butt treatment of posts consists of performing the cold-dip method of preservative treatment, on the ends of the posts to be set in the ground. Immerse the posts in the preservative solution, for the required time, to a depth equal to the depth the post will set in the ground plus 6 inches.

615.2.7 Bolts, Nuts, and Hardware

(1) Furnish all bolts, nuts, and miscellaneous hardware for the work according to the design and dimensions the plans show. Furnish sufficiently threaded bolts to allow secure fastening and supply with the necessary washers.

(2) Unless specified otherwise, furnish all bolts, nuts, washers and other hardware zinc coated. Except that the contractor may furnish plain hardware for timber guard fence and treated timber curbs. The zinc coating must conform to methods specified in 614.2.

615.3 Construction

615.3.1 General

(1) Under the Guard Fence Timber Rail bid item, support a timber rail on wooden posts.

(2) Under the Guard Posts Timber bid item, furnish and erect sawed wooden posts.

(3) Under the Marker Posts Rustic bid item, furnish and erect round wooden posts.

(4) Construct all work according to the plan details specified for the work. Dig the post holes at the required location and depth, and compact the bottom of the holes to provide a stable foundation. The engineer will allow a tolerance of +/- 3 inches in depth, provided the post length is adequate to obtain the required elevation of the finished top. Set the posts plumb and with the front faces in a straight line or to conform to curves the plans show or as the engineer directs. Backfill the placed posts with engineer-approved material, placed in layers, and compacted in a way that avoids disturbing the position or alignment of the post.

(5) After setting the post, determine the finished elevation of the post top and cut off and trim as the plans show. Treat the cut surfaces of treated posts with 2 brush applications of the same type of preservative used in the original treatment. Bore holes in the set posts to support the rails at the required elevation and grade. Bolt the rails to the posts, unless specified otherwise, with round-headed bolts, with heads facing the rail. Burr the threaded ends of all bolts. If the bolt extends one inch or more through the nut, cut off at 1/2 inch from the nut before burring.

(6) Under the Curbs Treated Timber bid item, anchor and support sawed treated timbers on shims.

(7) Perform the drilling, countersinking and beveling of curbs after pressure treatment; however, apply 2 brush applications of the preservative used for the curbs to the surfaces that result from this operation.

(8) Place timber curbs true to line and grade, with the supporting shims placed on a solid foundation. Secure the curbs in place by driving steel pins to firm seating in holes countersunk in the curbs.

(9) Under the Wisconsin Historical Marker bid items, construct a reinforced concrete base, if required, wood post, concrete or stone supports, and hang the designated department-furnished sign.

(10) Construct historical markers according to the plans and applicable special provisions.

615.3.2 Painting

(1) Unless directed otherwise, paint all untreated wood, rails and posts, including the untreated portions of butt treated posts, with 2 coats of brown wood stain conforming to 517.2.9. Allow at least 48 hours to elapse between coats.

(2) This work shall conform to whatever paint or methods of application the plans or special provisions specify.

615.4 Measurement

(1) The department will measure Guard Fence Timber Rail by the linear foot acceptably completed, measured from end to end of the rail.

(2) The department will measure Curbs Treated Timber, Guard Posts Timber, and Marker Posts Rustic as each individual unit acceptably completed.

(3) The department will measure the Wisconsin Historical Marker bid items as a single lump sum unit for each marker acceptably completed.

615.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
615.0100	Guard Fence Timber Rail	LF

615.0200	Curbs Treated Timber	EACH
615.0300	Guard Posts Timber	EACH
615.0400	Marker Posts Rustic	EACH
615.1000	Wisconsin Historical Marker (project)	LS

(2) Payment for Guard Fence Timber Rail is full compensation for providing materials, including posts, rails, bolts, paint, preservative, and incidentals; for all excavating, erecting, backfilling, and disposing of surplus materials; and for preservative treating and painting.

(3) Payment for Curbs Treated Timber, Guard Posts Timber, or Marker Posts Rustic is full compensation for materials, including posts, curbs, shims, treatment, painting, pins, and incidentals; and for excavating, backfilling, and disposing of excess material.

(4) Payment for the Wisconsin Historical Marker bid items is full compensation for providing materials, including posts, stones, reinforcement and concrete, paint, bolts, and incidentals; for excavating, erecting, backfilling, and disposing of surplus materials; and for preservative treating, and painting.

Section 616 Property and Right-of-Way Fence

616.1 Description

(1) This section describes furnishing and erecting woven wire fence and chain link fence.

616.2 Materials

616.2.1 General

(1) For the given materials, conform to the following:

Concrete 501
Preservatives and preservative treatment 507.2
Structural Steel and miscellaneous metals 506.2

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716, except the engineer may waive the requirements for proportioning by weight, and may allow alternate mixers or mixing methods. Provide QMP for class III ancillary concrete as specified in 716.

616.2.2 Woven Wire Fence Materials

616.2.2.1 Woven Wire Fabric

(1) Furnish woven wire fabric composed of 11 gauge line and stay wires, except the top and bottom horizontal wires shall be 9-gauge. This fabric shall have 10 line wires, a nominal height of 47 inches, and conform to the design the plans show. Run the vertical stay wires from top to bottom line wires, at 6 inch nominal spacing.

(2) If the plans or special provisions do not designate a specific type of woven fence fabric, the contractor may use one of the following:

- Zinc-coated steel conforming to AASHTO M279 class 3.
- Aluminum-coated steel conforming to ASTM A116.

(3) Furnish the same type for all fence fabric required under the contract, unless specified otherwise.

616.2.2.2 Barbed Wire

(1) Furnish 15 1/2 gauge or heavier 2-strand coated steel barbed wire with 4-point coated steel barbs spaced not more than 5 inches apart and conforming to AASHTO M280. If the plans or special provisions do not designate a specific type of barbed wire, the contractor may use one of the following:

- Type Z zinc-coated steel.
- Type ZA zinc-5 percent aluminum-mischmetal alloy coated steel.
- Type A aluminum coated steel.

(2) Furnish the same type for all barbed wire required under the contract, unless specified otherwise.

616.2.2.3 Smooth Wire

(1) Furnish 9-gauge smooth zinc-coated steel wire for bracing and guying conforming to AASHTO M279 class 3.

616.2.2.4 Braces

(1) Furnish zinc-coated steel pipe or steel tubing braces conforming to ASTM A53; or steel angle or channel section braces conforming to ASTM A123. Use a type, minimum size, and minimum weight conforming to one of the following:

- Welded or seamless steel pipe, nominal 1.90 inches outside diameter, weighing 2.72 pounds per linear foot.
- Steel tubing, 1.75 inches outside diameter, 3.13 pounds per linear foot.
- Steel angle section, nominal 1 3/4 x 1 3/4 x 1/4 inch, 2.77 pounds per linear foot.
- Steel channel section, nominal 3 inches, 4.1 pounds per linear foot.
- Other engineer-approved steel sections.

(2) Shape brace ends as the plans show, or furnish with other engineer-approved fittings for anchoring to posts. Furnish fittings, bolts, nuts, washers or other hardware conforming to ASTM A123.

616.2.2.5 Staples

(1) Furnish 1 3/4-inch or longer staples made from 9-gauge or heavier galvanized steel wire.

616.2.2.6 Posts

(1) Furnish round wood posts manufactured from one of the softwood species listed in 614.2.5 for wood posts and offset blocks.

(2) The posts shall conform to the dimensions the plans show with a tolerance of plus 2 inches for length, and a diameter at the top or small end, after peeling, 4 1/2 inches or greater for line posts and 6 inches or greater for corner, bracer, or vertical angle posts.

(3) Use posts free from sap rot, woodpecker holes, plugged holes, pest-eaten areas, and hollow knots. Do not use posts with butt rot exceeding 5 percent of butt area. Ensure post tops are sound, except a 7 inch cedar post may have one pipe or heart rot 3/8 inch or smaller in diameter. Posts shall not have excessive checking or a one-way sweep greater than 3 inches, or short kinks. Posts may have a winding twist unless unsightly and excessive. All knots shall be sound.

(4) Do not use posts with both the maximum crook and maximum butt rot. Not more than 10 percent of the posts required under the contract may have the maximum crook or the maximum butt rot. The engineer will have sufficient grounds to reject posts that contain other defects of any kind that give a post an unsightly appearance.

(5) Use posts seasoned in a department-approved manner and peeled for their entire length, with all outer and inner bark to the white wood completely removed by shaving or by other effective means. Trim knots closely and saw both ends of the post square. If setting the posts by driving, then the larger end may have a blunt point. After peeling, trimming, and cutting to required length, preservative treat the posts by the pressure process specified in 507.2.2.6, except the preservative minimum retention is 6 pounds per cubic foot of wood for creosote-coal tar solution or pentachlorophenol solution.

616.2.3 Chain Link Fence Materials

616.2.3.1 General

(1) Furnish new material for all parts. Do not use used, re-rolled, or open seam material in posts, rails, and braces. Furnish metal parts as follows:

- Use aluminum-coated steel fence fabric conforming to AASHTO M181 type II.
- Use steel tension wire conforming to AASHTO M181 type I zinc-coated or type II aluminum-coated.
- Use hot-dipped zinc-coated steel posts, rails, and braces conforming to ASTM F1043.[1]
- Use hot-dipped zinc-coated steel, or malleable iron hardware, and fittings conforming to ASTM F1043.[1]

[1] The contractor may substitute zinc - 5 percent aluminum-mischmetal alloy conforming to ASTM B750 (type C coating) for hot-dipped zinc (type A coating) specified here in 616.2.3 if applied at the same rate as the hot-dipped zinc coating.

(2) Ensure that hot-dipped coatings are applied to rolled sections after rolling.

(3) Unless specified otherwise, furnish the same type of material for all fence fabric required under the contract. Make all posts, hardware, and fittings used on the contract the same kind, unless specified otherwise.

616.2.3.2 Fence Fabric

(1) Use fence fabric woven of 9-gauge wire in 2-inch diamond pattern mesh with both the top and bottom selvages knuckled. Ensure the furnished fence fabric is the same nominal height as the designated fence height.

616.2.3.3 Posts

(1) Use posts of the type, size, and length the plans show as follows:

- Group IA round steel pipe with a type A coating.
- Group II roll-formed steel C-sections with a type A coating.

616.2.3.4 Post Tops

(1) Fit all posts, except roll formed terminal posts, with ornamental tops of the type the plans show. Ensure ornamental tops are of department-approved design, made of metal, have a flanged base that fits snugly over top and around outside of post, and is securely fastened in place. Provide the base of each line post top with an opening for passage and support of the top tension wire.

(2) For roll-formed line posts, the contractor may use the notched alternate post top the plans show instead of and ornamental post top.

616.2.3.5 Bracing

(1) Use brace rail of the type, size, and weight the plans show for horizontal and diagonal bracing as follows:

- Group IA round steel pipe with a type A coating.
- Group II roll-formed steel C-sections with a type A.

(2) Make horizontal and diagonal pipe, or roll formed braces and diagonal truss rods extend from all terminal, corner, intersection, or intermediate braced posts to the first adjacent line post, and fasten

them securely to the posts with suitable connectors. Use zinc coated 3/8 inch round steel rods equipped with a threaded take-up adapter for diagonal truss rods.

616.2.3.6 Pipe Fittings

(1) Use malleable iron, cast iron, or pressed steel pipe fittings.

616.2.3.7 Fabric Fasteners

(1) Use clips made of 9-gauge zinc coated steel or 0.179-inch diameter aluminum tie wires as fasteners for securing the fence fabric to H column line posts. User 9-gauge zinc coated steel or 0.179-inch diameter aluminum tie wires as fasteners for securing the fence to posts or top tension wires and braces. Use tie wires not smaller than 12-gauge zinc coated steel, or 0.149-inch diameter aluminum wire, as fasteners for securing to bottom tension wires.

616.2.3.8 Tension Bars

(1) Use zinc-coated flat mild or rail steel of the required length.

616.2.3.9 Gates

(1) Conform to the material, design, and dimensional requirements the plans show for chain link fence gates.

616.3 Construction

616.3.1 General

(1) If an area of right-of-way is subject to ingress of cattle or other farm animals, erect the right-of-way fencing before starting other items of work under contract for these areas, or provide a temporary fence to exclude the livestock.

(2) Remove and dispose of all trees, brush, logs, stumps, or other debris that might interfere with fence construction, within approximately 12 inches along each side of the fence line, as specified for clearing and grubbing in 201.3. If the contractor cuts trees or stumps close enough to the ground to prevent interference with correct fence erection, the engineer will not require grubbing of the stumps.

(3) Excavate minor ridges and humps in the ground surface, necessary to correctly erect the fence.

(4) Erect the fence on the right-of-way, parallel to, and 3 feet from the right-of-way line, unless the plans show or the engineer directs otherwise. Where the engineer directs or allows the contractor to leave trees on the fence line, deviate the fence line past the tree as the plans show.

(5) Erect the wire on the far side of the posts with respect to the proposed roadway.

(6) Remove and dispose of all excess excavation and surplus materials from the fence site.

616.3.2 Woven Wire Fence

616.3.2.1 General

(1) Erect woven wire fencing fabric and one line of barbed wire on preservative treated wood posts. Place all end, corner, pull, and vertical angle posts at the locations staked or where the engineer designates.

616.3.2.2 Placing Posts

(1) Set all posts with the large end down to the depth the plans show and make plumb and true to line on the wire side. Unless the plans show otherwise, set line posts at as uniform spacing as possible under local conditions, but the spacing shall not exceed 16 feet center to center of posts. Set additional posts, as required, at abrupt changes in grade. Excavate post holes to the required depth. If the contractor encounters rock, employ necessary drilling, blasting, or other means of excavation. Use suitable material for backfill, and place and compact in layers around the post until firmly embedded, plumb, and true to alignment.

(2) Set all corner, end, pull, vertical angle posts, and posts at stream crossings in concrete. Brace and guy as the plan details show. Use a double strand of 9-gauge zinc-coated, smooth wire for wire guying and stretch between posts as the plans show. Wrap the wire around the posts and staple. Twist the strands of wire taut. Place vertical angle post assemblies at grade change points of more than 2 feet between consecutive posts that result in a wire uplift on the posts.

(3) The contractor may drive posts instead of setting posts in previously dug holes and backfilling, except if placing in concrete. If driving posts, drive them plumb, to the required depth and alignment, and with adequate lateral stability. Remove and replace with a sound post any post not conforming to the above requirements, or damaged below cut-off during driving.

616.3.2.3 Placing Wire

(1) Attach the woven wire to the posts so that the bottom wire is approximately 2 inches above the ground, but not more than 4 inches above the ground at the posts, except on abrupt grade changes as

the plans show. Place one line of barbed wire above the woven wire, as the plans show, and staple the wire at each post.

(2) Secure the woven wire and the barbed wire to all end and corner posts by wrapping each line of wire around the post and tying the wire back on itself with not less than 1 1/2 twists tightly wrapped with tools designed for the purpose, and supplement with staples driven into the posts. Stretch the wire until no slack exists, longitudinal wires are tight, and approximately 50 percent of the factory fabricated fence crimp is removed. Apply tension with an engineer-approved stretcher designed to produce a uniform tension in each wire.

(3) Secure the woven wire to each post with staples at the top and bottom wires and, at least, at 3 intermediate wires. Use additional staples if necessary. Stagger the vertical alignment of staples slightly and do not place parallel with the wood grain. Drive the staples tight at all pull, angle, end, and corner posts, and double staple the wire if required. Drive the staples firmly at other line posts but loose enough to allow lateral movement of the wire. Make splices in the fencing at posts or between posts to the engineer's satisfaction.

(4) Ground the fence as specified in 616.3.5.

616.3.3 Chain Link Fence

616.3.3.1 General

(1) Erect chain link fencing fabric, of the required height, attached at the top and bottom to a tension wire, on driven unbraced metal line posts.

616.3.3.2 Setting Posts

(1) Set or drive posts, in a vertical position, at the required location and alignment, and at as uniform a spacing as local conditions allow. Space posts, center to center, according to the following situations as follows:

- On a tangent or on a curve of 500 feet or more radius; space posts at no more than 10 feet.
- On a curve of from 200 to 500 feet radius, space posts at no more than 8 feet.
- On a curve of from 100 to 200 feet radius, space posts at no more than 6 feet.
- On a curve of less than 100 feet radius, space posts at no more than 5 feet.

(2) Set or drive posts, with their tops at the required elevation to provide a smooth profile at the top wire without abrupt changes. Conform to the general contour of the terrain.

(3) Place an end post at each end of each run of fence. Place a corner post at breaks of 30 degrees or more in the horizontal alignment. Set an intersection post in line with an intersecting chain link fence, and brace with the adjacent post of the intersecting fence.

(4) Place an intermediate braced post if there is over a 5 degrees change in the vertical alignment or a change in the fence line grade of greater than 9 percent that results in wire uplift on the post.

(5) If placing posts on concrete walls, curbs, or other concrete structures, place them in sleeve anchors and grout as the plan details show. Use a non-shrink grout conforming to 506.3.30 for bearings and anchorages. Thoroughly ram the grout into the sleeve anchor while the post is in place. Allow the grout to cure at least 48 hours before stretching the chain link fabric.

(6) Coat the portion of aluminum-coated posts to be set in concrete with a uniform, thin application of asphaltic or other engineer-approved material. Ensure this coating is firmly set before placing the posts.

(7) Set the end, corner, angle, intersection, and intermediate braced posts in concrete footings.

(8) Ensure the top of the concrete footing is approximately 6 inches below the ground line and slopes slightly away from the post. Locate the footing to allow centering of the post. Backfill the top of the footing with topsoil or other suitable material.

(9) In firm ground, excavate holes for the footings to the neat dimensions and place concrete directly in the excavation. Remove rock or other obstructions encountered in the excavation to the required depth.

(10) If unstable soils or other areas prevent making footing excavations to neat dimensions, use forms. Keep the form in place until the concrete cures for at least 24 hours. After removing the form, backfill the footing with suitable material. Ensure the backfill material has the correct moisture content for compacting and place and compact in layers.

(11) Set the posts, anchor the braces in place, and wait at least 24 hours after pouring concrete before placing the top and bottom tension wires.

(12) Place an intermediate braced post midway between end posts and corner posts if the fence run is more than 1000 feet, but not more than 2000 feet. For fence runs greater than 2000 feet, make the maximum spacing of intermediate braced posts 1000 feet.

(13) Set in concrete or drive unbraced line posts, provided the contractor drives them plumb, to the required depth and alignment, and with adequate lateral stability. Remove and replace any post that fails to conform to the above requirements, or that the contractor damages during driving, with an undamaged post. In unstable soils, increase the length of driven posts by multiples of 2 feet, as the engineer directs, to increase the stability of the post.

616.3.3.3 Erecting Fence Fabric

(1) Place, tension, and secure the top and bottom tension wires before erecting the fence fabric. Anchor the tension wires securely to each end, corner, intersection, or intermediate braced post. Fasten the tension wires to each line post.

(2) Attach the end of the fabric to the post with a tension bar threaded through the end loops of the fabric and secured to the post with clamps and bolt. Stretch the fabric with engineer-approved stretching equipment to remove all slack. Secure the stretched fabric to line posts, braces, and tension wires with specified fabric fasteners. Place fabric fasteners on line posts at no greater than 14 inch centers; and on braces and tension wires at no greater than 18 inch centers. Repeat stretching operations at approximately every 100 feet for each run of fence.

(3) Splice fabric by interweaving a wire picket through each end loop of each piece of fabric. Ensure that the splice is neat and secure.

616.3.3.4 Gates

(1) Erect chain-link fence gates as the plans show.

616.3.3.5 Salvaged Chain Link Fence

(1) Remove, handle, store, and re-erect the fence, gates, and all posts, fittings, bases and appurtenant hardware without damaging the parts. Replace contractor-damaged parts and provide all other materials, including concrete, required to re-erect the fence. Dispose of all surplus materials.

(2) Re-erect salvaged chain link fence as specified for chain link fence under 616.3.3.

616.3.4 (Vacant)

616.3.5 Electrical Grounds

(1) Ground woven wire fence. Use 1/2 inch minimum diameter zinc coated or copper clad steel rod at least 8 feet long, driven vertically into the ground along the fence line, near a post, until approximately 6 inches extends above the ground. Securely clamp, bolt, or braze at least 3 fence wires to the ground rod. Electrically ground barbed wire as the plans show.

(2) Install electrical grounds at locations where primary electrical transmission or distribution lines, other than secondary feeder lines for individual service, cross the fence. Install one ground rod along the fence at the point of crossing and one 25 to 50 feet in each direction from the crossing.

(3) Install additional ground rods in each fence spaced approximately every 500 feet. Install at least one ground rod on each electrically isolated section of fence, defined as a run with no interruptions in electrical continuity.

616.4 Measurement

(1) The department will measure the Fence Woven Wire bid items by the linear foot acceptably completed, measured from center to center of end posts, along the fence line at the ground line. The department will deduct for openings.

(2) The department will measure the Fence Chain Link bid items by the linear foot acceptably completed, measured from center to center of end posts, along the top tension wire. The department will deduct for gates and other openings.

(3) The department will measure the Gates Chain Link bid items as each individual gate acceptably completed.

(4) The department will measure the Fence Chain Link Salvaged bid items by the linear foot acceptably completed, measured from center to center of end posts, including gates, along the top rail or tension wire.

616.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT

616.0100	Fence Woven Wire (height)	LF
616.0200 - 0299	Fence Chain Link (height)	LF
616.0329	Gates Chain Link (width)	EACH
616.0400 - 0499	Fence Chain Link Salvaged (height)	LF

(2) Payment for all bid items under this section includes erecting temporary fence to keep farm animals off the right-of-way.

(3) Payment for all the fence bid items under this section is full compensation for clearing and grubbing the fence line; for excavating; for setting posts including placing concrete; for erecting and tensioning all fencing components; for installing grounds; and for removing and disposing of all debris, excess excavation, and surplus materials.

(4) Payment for the Fence Chain Link bid items also includes providing longer posts driven in unstable soils at no additional cost to the department.

(5) Payment for the Fence Chain Link Salvaged bid items also includes removing, handling, and storing existing fence materials; for re-erecting gates; for replacing all contractor-damaged parts; and for providing all other materials required to re-erect the fence.

(6) Payment for the Gates Chain Link bid items is full compensation for providing the gate.

Section 617 Hauling

617.1 Description

(1) This section describes transporting materials from the point of supply to the work site.

617.2 (Vacant)

617.3 Construction

(1) Haul materials from the pit, crushing plant, quarry, railroad car, or other material source to the work site in an engineer-approved vehicle. The engineer may approve any size or type of vehicle for hauling provided that vehicle conforms to the following:

1. Applicable legal restrictions imposed by other jurisdictions as specified in 107.1.
2. For material specified for measurement by volume in the vehicle, the provisions of 109.1.3.

(2) Conform to additional hauling requirements specified under the individual bid items for the material being hauled.

(3) Unless the contract specifies otherwise, build and maintain private roads, bridges, culverts, and structures as necessary to reach the work site from the material source. Also, maintain, repair, and restore previously constructed private roads, bridges, culverts, and structures used to pre-hauling condition.

617.4 Measurement

(1) The department will measure the Hauling bid items by the cubic yard mile acceptably completed. The department will determine the total quantity for payment by multiplying the number of cubic yards hauled and placed in each zone by the mile number of the zone. The department will determine mile zones along the shortest and most practicable line of haul from the loading point to and along the project. The department will only measure hauling of materials specifically included in a Hauling bid item.

617.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
617.0100	Hauling (material)	CYMI

(2) Payment for the Hauling bid items is full compensation for hauling the specified materials and, unless the contract specifies otherwise, costs associated with private roads, bridges, culverts, and structures used to haul material under this bid item.

(3) If the contract does not include the Hauling bid item, all hauling is incidental to the related work. Hauling materials not specifically included in a Hauling bid item is also incidental to related work.

Section 618 Maintenance and Repair of Haul Roads

618.1 Description

(1) This section describes maintaining, repairing, and restoring all public roads, streets, drainage facilities, and other components used for hauling by contractor, subcontractor, or supplier to support work for a department contract to its pre-haul condition. Public roads and streets shall be limited to those not a part of the State Trunk Highway System and from now on called haul roads.

(2) The contractor's obligation under this bid item does not authorize the use of haul roads for transporting loads exceeding statutory size and weight limitations.

618.2 Materials

(1) Furnish and use materials in the work at least equal in quality and serviceability to those existing in the road before its use as a haul road. The engineer will determine the quantity, quality, and acceptability of materials.

618.3 Construction

618.3.1 General

(1) The engineer will determine the type and quality of maintenance and repair required, including the quality of materials used. If 2 or more contractors having contracts with the department transport materials over the same haul road at the same time, or at about the same time, the engineer will determine the repair and restoration obligations of the respective contractors.

618.3.2 Maintenance

(1) The engineer has the authority to order maintenance and repair work on haul roads, including dust abatement, at any time during hauling operations, as necessary to ensure reasonable service to other users of the road.

(2) To prevent or minimize damage to haul roads the contractor may stabilize, reinforce, or strengthen existing facilities before hauling starts; and may condition the surface and perform repairs during hauling operations.

618.3.3 Restoration

(1) Upon termination of hauling operations and before conditional final acceptance, restore all haul roads, including drainage facilities and other components, to the equivalent of pre-hauling conditions.

(2) The final repair of a haul road is subject to the engineer's approval.

618.4 Measurement

(1) The department will measure Maintenance and Repair of Haul Roads for each individual project acceptably completed, measured only if the condition of the haul road after work is complete is better than or equal to the condition before work began. The department will measure the item even if no hauling was done on the road and even if no maintenance or repair work was required.

618.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
618.0100	Maintenance and Repair of Haul Roads (project)	EACH

(2) Payment for the Maintenance and Repair of Haul Roads bid items is full compensation for providing, hauling, and placing required materials; and for other costs incurred by the contractor to prevent or minimize damage to the haul roads.

(3) The department will pay for this item upon completion of all work under the contract, except the engineer may make partial payment for work performed.

Section 619 Mobilization

619.1 Description

(1) This section describes the work and operations necessary to move personnel, equipment, supplies, and incidentals to the project site and to establish all of the contractor's offices, buildings, sanitary accommodations, and other facilities necessary to work on the project. It also includes all other work and operations whose performance is required, or for costs necessarily incurred before beginning work on various items on the project site.

619.2 (Vacant)

619.3 (Vacant)

619.4 Measurement

(1) The department will measure Mobilization once for the contract acceptably completed.

619.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
619.1000	Mobilization	EACH

(2) Payment for Mobilization is full compensation for supplying and providing materials, facilities, and services, and for performing all work necessary to complete this contract bid item. The department will make incremental payments as determined using department form WS6191 available at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/estimating/ws6191.xls

(3) If the contract does not include a separate Mobilization bid item, the work necessary for mobilization is incidental to work included under other contract bid items.

Section 620 Concrete Corrugated Median and Concrete Median Nose

620.1 Description

(1) This section describes constructing a concrete corrugated median or concrete median nose placed in one course on a prepared foundation.

620.2 Materials

(1) Use materials conforming to the following:

Concrete 501
Joint filler 415.2.3
Reinforcement 505

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class II ancillary concrete as specified in 716.

620.3 Construction

(1) The engineer will inspect concrete built under 620 for transverse cracking as specified in 415.3.17 for ancillary concrete. Repair cracked concrete as the engineer directs.

(2) Under the Concrete Corrugated Median bid item, construct concrete corrugated median including nose section, placed in one course on a prepared foundation.

(3) Under the Concrete Median Blunt Nose bid item, construct a blunt concrete median nose section.

(4) Under the Concrete Median Sloped Nose bid item, construct a sloped concrete median nose section.

620.3.1 Preparing the Foundation

(1) Prepare the foundation for the median by excavating to the lines, grade, and cross-section the plans show and required for placing the concrete. Remove and replace any soft or unsuitable material encountered with suitable material and thoroughly compact and finish the foundation to a firm surface. Ensure the foundation is moist when placing the concrete.

620.3.2 Placing Concrete

(1) If forms are required, set them to line and grade and secure in place before placing the concrete.

(2) Deposit the concrete to the proper depth, consolidate by spading or vibrating, and strike off at the required elevation and crown. Form the required corrugations with tools and equipment appropriate for the purpose, according to the plan details.

(3) If constructing the median adjacent to concrete pavement, place tie bars as specified for longitudinal joints in concrete pavement under 415.3.7.2.

(4) Broom finish the surface of the median unless specified otherwise. Draw the broom transversely across the full width of the median surface with adjacent strokes slightly overlapping. Perform brooming in a way that produces corrugations uniform in appearance and not greater than 1/8 inch deep. Complete the brooming before the concrete's condition causes the surface to tear or become rough from the operation. Provide a finished surface free from rough or porous areas, irregularities, and depressions resulting from improper broom handling. Ensure brooms are the quality, size, and construction appropriate for the job and operated to produce a surface finish meeting the engineer's approval.

(5) Cure the concrete as specified in 415.3.12. If constructing concrete median during cold weather then conform to 415.3.13 for cold weather concreting. Conform to 415.3.14 for protection of concrete median.

(6) Remove and dispose of all excavation and surplus materials in the manner specified for in 205.3.12.

620.4 Measurement

(1) The department will measure Concrete Corrugated Median by the square foot acceptably completed, including the nose section.

(2) The department will measure Concrete Median Blunt Nose and Concrete Median Sloped Nose by the square foot acceptably completed, for the nose section only.

620.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
620.0100	Concrete Corrugated Median	SF
620.0200	Concrete Median Blunt Nose	SF

620.0300	Concrete median Sloped Nose	SF

(2) The department will adjust pay for crack repairs on concrete built under 620 as specified in 416.5.2 for ancillary concrete.

(3) Payment for Concrete Corrugated Median, Concrete Median Blunt Nose, or Concrete Median Sloped Nose is full compensation for preparing the foundation; for providing materials, including concrete, joint filler and tie bars; for hauling, placing, consolidating, shaping, finishing, curing, and protecting the concrete; and for disposing of surplus materials.

Section 621 Landmark Reference Monuments

621.1 Description

(1) This section describes constructing landmark reference monuments, with or without covers.

621.2 Materials

(1) Furnish materials conforming to the following:

Concrete	501
Reinforcement	505.2
Miscellaneous metals	506.2.3
Brick and concrete brick or block masonry	519.2
Mortar	519.2.3
Foundation backfill	520.2

(2) Use castings used for cast iron covers conforming to 611.2 for castings.

(3) Make aluminum monuments and monument covers from an aluminum and magnesium alloy as the manufacturer determines.

(4) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

621.3 Construction

621.3.1 Monument Location

(1) Preserve in their original position all landmarks within the construction limits of the work under contract and that require reference monuments until construction and marking of the landmark reference monuments.

(2) In general, construct monuments in the landmark's near vicinity, outside the construction limits of the work under contract, and at the exact locations, the engineer determines. However, if the contract specifies or the engineer directs, construct monuments at the exact locations of, and to replace, landmarks disturbed by the construction.

621.3.2 Placing Monuments

621.3.2.1 General

(1) Under the Landmark Reference Monuments bid item, construct cast in place or precast reinforced concrete monuments or aluminum monuments in holes excavated in the ground or, in the case of type C aluminum monuments, driven into the ground.

(2) Place a department-furnished metal marker on all monuments, except aluminum monuments. Place a contractor-furnished metal marker, conforming to plan details, on all aluminum monuments.

(3) Except if driving aluminum monuments, place or construct the monuments in holes excavated in the ground. Make the holes the size and depth the plans show or as the engineer directs.

(4) Remove and dispose of all surplus excavation and materials as specified in 205.3.12.

621.3.2.2 Cast In Place Concrete Monuments

(1) Fill holes with concrete and strike off flush with the ground surface. Place a steel reinforcement rod in the concrete as the plans show. Place the metal marker while the concrete is still plastic.

621.3.2.3 Precast Concrete and Non-Driven Aluminum Monuments

(1) Level and thoroughly compact the bottom of the holes at the proper elevation. Place the monument and backfill with suitable material and thoroughly compact in 6-inch layers.

621.3.2.4 Aluminum Drive-In Monuments

(1) If the plans or the engineer specifies aluminum drive-in monuments for use in unstable soils, drive the monuments into the ground to the minimum depth the plans show and drive the top flush with the surface.

(2) Increase the depth as the engineer directs to obtain a suitable foundation for the monument.

621.3.2.5 Monument and Cover

(1) Under the Landmark Reference Monuments and Cast Iron Covers and Landmark Reference Monuments and Aluminum Covers bid items, construct cast in place or precast reinforced concrete monuments in holes excavated in the ground and covered with cast iron covers or, if specified, aluminum monuments excavated or driven into the ground and covered with aluminum covers.

(2) Construct cast in place or precast concrete monuments or aluminum monuments as specified in the above subsections, except as follows:

- Place 12 inches of granular backfill to an elevation at least 3 inches below the top of concrete monuments according to plan details.
- If using cast in place concrete monuments, form at least the top 3 inches of the monument.

(3) Place and adjust the cover as specified in 611.

621.3.3 Protecting and Curing

(1) Cure exposed portions of cast in place concrete monuments as specified in 415.3.12 except the contractor may use curing compound conforming to 501.2.9. Wait at least 72 hours before loading.

(2) Protect placed concrete monuments as specified for concrete pavement in 415.3.14

(3) Protect cast in place concrete monuments from freezing for 7 days.

621.4 Measurement

(1) The department will measure bid items under this section as each individual monument acceptably completed.

621.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
621.0100	Landmark Reference Monuments	EACH
621.1100	Landmark Reference Monuments and Cast Iron Covers	EACH
621.1200	Landmark Reference Monuments and Aluminum Covers	EACH

(2) Payment for the Landmark Reference bid items is full compensation for excavating; for providing concrete; for providing aluminum monuments, including markers; for providing steel rod; for placing department-furnished markers; for providing and adjusting iron or aluminum covers; for backfilling; and for disposing of surplus materials.

(3) The department will not pay for the increased depth of monument if the engineer directs this to obtain suitable foundation.

Section 623 Dust Control Surface Treatment

623.1 Description

(1) This section describes applying dust control surface treatment to aggregate bases, shoulders, and other drivable surfaces.

623.2 Materials

623.2.1 General

(1) Furnish either magnesium chloride or calcium chloride in either a liquid or a solid state. Furnish stable solutions with less than 1 percent sediment falling out of solution below 0 F.

(2) Provide a certified report of test or analysis from the manufacturer or supplier certifying chemical composition. The department will accept material based on those certifications as specified in 106.3.3.

623.2.2 Magnesium Chloride

(1) Furnish liquid solutions containing 30 percent or more magnesium chloride by weight, less than 1 percent calcium chloride by weight, and less than 1 percent sodium chloride by weight.

(2) Furnish solid containing 47 percent or more magnesium chloride by weight, less than 1 percent calcium chloride by weight, and less than 1 percent sodium chloride by weight.

623.2.3 Calcium Chloride

(1) Furnish liquid solutions containing 38 percent or more calcium chloride by weight, less than 1 percent magnesium chloride by weight, and less than 1 percent sodium chloride by weight.

(2) Furnish solid containing 77 percent or more calcium chloride by weight, less than 1 percent magnesium chloride by weight, and less than 1 percent sodium chloride by weight.

623.3 Construction

(1) The contractor is responsible for dust control on the project as specified in 107.18. Treat vulnerable areas of the project as necessary to control dust from construction equipment and public traffic. Consult with engineer before applying dust control chemical. Apply chemical treatment as the engineer directs.

(2) Arrange to have available, within 24 hours of receiving notice from the engineer, a sufficient supply of dust control chemical to treat those areas of the project vulnerable at any time during construction. Also, provide, within the same 24 hours, sufficient spreading equipment to apply the chemical. Provide spreading equipment capable of applying the dust control chemical, uniformly and without runoff, over the treated surface at the specified application rate.

(3) After shaping and compacting the surface to be treated, apply a sufficient quantity of water to penetrate at least 2 inches. After this pre-wetting and while the surface is still moist but not muddy, apply the required quantity of chemical uniformly over that surface at the following rate:

1. For liquids, 0.33 gallons or more/square yard. Do not exceed 0.50 gallons/square yard.
2. For solids, 1.5 pounds or more/square yard. Do not exceed 2 pounds/square yard.

(4) Do not apply dust control chemical in the rain, when the official weather bureau forecasts rain within 24 hours, or under other conditions that might result in a significant loss of material.

623.4 Measurement

(1) The department will measure Dust Control Surface Treatment by the square yard acceptably completed. The engineer may calculate the yardage using volume or weight and applying a conversion factor.

623.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
623.0200	Dust Control Surface Treatment	SY

(2) Payment for Dust Control Surface Treatment is full compensation for providing the dust control treatment and pre-wetting water.

Section 624 Water

624.1 Description

(1) This section describes furnishing, hauling, and applying water to compact embankments and base, re-compacting existing base, or dust control within the right-of-way.

624.2 Materials

(1) Use water that is reasonably clean and free of harmful materials.

624.3 Construction

(1) Haul and apply water using vehicles equipped with watertight tanks. Equip the tanks with a suitable pressure-type distributor device that allows uniform application over the specified area. Use tanks with a minimum capacity of 1000 gallons and equipped with positive shut-off valves controlled while the vehicle is in motion.

(2) Uniformly apply the water and incorporate in the manner and quantities, at the times, locations, and purposes that the engineer orders or allows. Load and unload the tank and operate the equipment in a way that does not waterlog or damage the subgrade or base.

624.4 Measurement

(1) The department will measure Water by the thousand gallon units (MGAL). The quantity measured equals the volume of water furnished and applied as the engineer directs according to the contract. The department will determine the volume by engineer-approved meters, or from tanks of known capacity.

624.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
624.0100	Water	MGAL

(2) Payment for Water is full compensation for providing, hauling, and applying or incorporating the water.

(3) If the contract does not contain the bid item Water, then furnishing and applying water is incidental to other items of work.

Section 625 Topsoil and Salvaged Topsoil

625.1 Description

(1) This section describes furnishing, placing, spreading, and finishing humus-bearing soil, adapted to sustain plant life, commonly known as topsoil, from locations the contractor furnishes beyond the limits of the right-of-way.

(2) This section also describes removing topsoil from the sites of proposed roadway excavations and embankments in quantities and depths available and necessary to cover the work slopes. This work also includes reclamation, placing, spreading, and finishing of this topsoil.

625.2 Materials

(1) Topsoil consists of loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils adapted to sustain plant life, and ensure this topsoil is in a pH range of 6.0 to 7.0.

(2) Salvaged topsoil consists of the loam, sandy loam, silt loam, silty clay loam or clay loam humus-bearing soils available from overlying portions of areas to be occupied by the completed roadway.

625.3 Construction

625.3.1 Preparing the Roadway for Topsoil

(1) Undercut or underfill all areas designated to receive topsoil to a degree that if covered to the required depth with topsoil the finished work conforms to the required lines, grades, slopes and cross-sections the plans and drawings show.

625.3.2 Processing Topsoil or Salvaged Topsoil

(1) Mow topsoil procurement areas to a height of approximately 6 inches. Remove litter such as brush, rock, and other materials that will interfere with subsequent vegetation establishment.

(2) Strip off the humus-bearing soil. Take care to minimize removing the underlying sterile soil. Then stockpile the topsoil on the right-of-way or place it directly on the designated areas.

(3) Under the Salvaged Topsoil bid item, remove topsoil from excavation areas and the roadway foundation up to the quantity necessary to cover the slopes for the bid items of Salvaged Topsoil and Topsoil. Salvage topsoil from embankment areas outside the roadway foundation only if that additional material is required to cover the slopes.

(4) Use Salvaged Topsoil in excess of the plan quantity to replace plan quantities of Topsoil. Utilize excess topsoil on the project or dispose of as specified in 205.3.12.

625.3.3 Placing

(1) After preparing and finishing the areas designated for topsoil to the required lines, grades, slopes and cross-section, place and spread the topsoil to a uniform depth as the plans show or the contract requires. If no depth is shown, place and spread the topsoil to a minimum depth of 4 inches in rural areas and a minimum depth of 6 inches in urban areas, or as the engineer designates.

(2) Break down all clods and lumps using the appropriate equipment to provide a uniformly textured soil.

(3) Where using either sod or seed mixture 40 ensure that, for the upper 2 inches, 100 percent of the material passes a one-inch sieve and at least 90 percent passes the No. 10 sieve.

(4) Remove rocks, twigs, foreign material, and clods that cannot be broken down. Dress the entire surface to present a uniform appearance. The engineer will not require rolling.

(5) If light sandy soils are covered with heavier clay bearing loam topsoil, then mix or blend the 2 types of soils to a more or less homogeneous mixture by using the appropriate equipment.

625.4 Measurement

625.4.1 Topsoil

(1) The department will measure Topsoil acceptably completed by the square yard or by the cubic yard, whichever the contract specifies.

(2) If the department measures by the square yard, the measured quantity shall equal the actual number of square yards of topsoiled area to the depth specified within the limits of construction designated on the plans, or in the contract, or as the engineer directs.

(3) If measured by the cubic yard, the department will measure material in the vehicle. If the contractor transports the material in vehicles not adapted for measurement, then the department will measure the material in cubic yards of volume in its original position computed by the method of average end areas with no correction for curvature; or if the engineer elects, by the method of truncated prisms.

625.4.2 Salvaged Topsoil

(1) The department will measure Salvaged Topsoil by the square yard acceptably completed. The quantity measured for payment shall equal the actual number of square yards of area topsoiled to the depth specified within the limits of construction designated on the plans or in the contract, or as the engineer directs.

625.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
625.0100	Topsoil	SY
625.0105	Topsoil	CY
625.0500	Salvaged Topsoil	SY

625.5.1 Topsoil

(1) Payment for Topsoil is full compensation for providing, excavating, loading, hauling, and placing this material; and for undercutting excavations, or underfilling embankments necessary to receive this material. The department will make no allowance, adjustment, or measurement for payment under the Excavation bid items for undercutting cut sections, or underfilling embankments.

625.5.2 Salvaged Topsoil

(1) Payment for Salvaged Topsoil is full compensation for removing, stockpiling, reclaiming, hauling, and placing this material; and for undercutting excavations, or underfilling embankments necessary to receive this material. The department will make no deductions from the Excavation bid items for the quantities of Salvaged Topsoil material obtained from areas of cut sections. Additionally, the department will not measure or pay for the volumes of Salvaged Topsoil removed from sites of proposed embankments under the Excavation bid items, or make any allowance, adjustment, or measurement for payment under the Excavation bid items for undercutting cut sections, or underfilling embankments.

(2) If an area is damaged by erosion after partial acceptance, the department will pay for restoring topsoil in these areas at a unit price determined by multiplying the contract unit price bid for Salvaged Topsoil by 3, or absent that bid item in the contract, as the contract unit price bid for Topsoil multiplied by 3, The department will pay for restoration under the Restoration Post Acceptance Topsoil administrative item.

(3) The department will not pay for removing topsoil from outside the roadway foundation in embankment areas unless that material is necessary to cover the slopes.

Section 626 Peat Humus

626.1 Description

(1) This section describes selecting portions of the material obtained under the Excavation Marsh bid item under the contract, or stored under a previous contract, and incorporating it into the surfaces of portions of the roadway.

626.2 Materials

626.2.1 If Marsh Excavation is an Item in the Contract

(1) Select those portions of material encountered under the Excavation Marsh bid item that contain the more fibrous material consisting of decomposed vegetable matter, moss, etc. from the muck-like substances. Take this material from marshes the plans or the contract indicates as having suitable material, to the extent that it is available or necessary for the work intended. Place the selected material into piles separate and apart from the waste materials encountered. Locate and size these piles of selected material to ensure proper drainage, and ready and convenient handling when incorporating into the work.

626.2.2 If Marsh Excavation is Not an Item in the Contract

(1) If stored under a previous contract, this material consists of the available quantities and character of material stored and made available to the contractor under the contract.

626.3 Construction

626.3.1 General

(1) Produce a layer approximately 6 inches deep of a uniform mixture of the native soil and the material previously designated. Cover the selected areas with a layer of marsh excavation material approximately 3 to 4 inches deep, dependent upon its consistency and moisture content, and incorporate it into the native soil by the appropriate equipment to accomplish the above-required results. After completing mixing operations, smooth and dress the surfaces to restore them to the required lines, grades, slopes, and cross-section.

626.3.2 Disposing of Surplus Material

(1) Dispose of any remaining stockpiled material as specified in 205.3.7 for marsh excavation and disposal.

626.4 Measurement

(1) The department will measure Peat Humus by the square yard acceptably completed. The quantity measured shall equal the actual number of square yards of area this material was placed on, and incorporated into, according to the contract, within the limits of the construction the plans show, or in the contract, or as the engineer directed.

626.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
626.0200	Peat Humus	SY

(2) Payment for Peat Humus is full compensation for selecting, stockpiling, reclaiming, loading, hauling, placing, and incorporating in the soil; for subsequent restoring of the surface, and disposing of surplus material; provided, that the department makes no deductions from the Excavation Marsh bid item for the quantities of materials salvaged or reclaimed from for the bid item of Peat Humus.

Section 627 Mulching

627.1 Description

(1) This section describes furnishing, placing, and anchoring a mulch cover, usually in connection with seeding the surfaces of the roadway.

627.2 Materials

(1) Mulching material consists of straw or hay in an air-dry condition, wood excelsior fiber, wood chips, or other suitable material of a similar nature that the engineer approves, and is substantially free of noxious weed seeds and objectionable foreign matter.

(2) If using tackifier, the department will prequalify it before use. Select tackifiers from the department's erosion control product acceptability list (PAL). The contractor may obtain a copy of the department's PAL and the prequalification procedure for products not on the department's PAL.

627.3 Construction

627.3.1 General

(1) Unless directed otherwise, place the mulch on the specified area within 2 days after completing the seeding.

(2) The contractor shall not perform mulching during periods of excessively high winds that might preclude proper mulch placement.

(3) Place the mulch loosely or open enough to allow some sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, conserve soil moisture, and prevent or reduce erosion.

(4) Maintain the mulched areas and repair all areas damaged by wind, erosion, traffic, fire or other causes.

627.3.2 Placing

(1) The contractor may perform the work as specified in one of the following ways: Method A, Method B, or Method C, or a combination of the 3, unless a specific method is specified in the contract.

627.3.2.1 Method A, Netting

(1) Uniformly spread the mulching material over the designated areas to a loose depth of 1/2 to 1 1/2 inches. Use a specific rate of application; dependent on the character of the material, that results in a cover conforming to the requirements specified above in 627.3.1. Loosen or make fluffy the mulch material from compacted bales before spreading in place. Unless directed otherwise, begin mulching at the top of the slopes and proceed downward.

(2) Securely anchor straw or hay mulch by using engineer-approved netting anchored to the ground with pegs or staples to prevent it from floating as the vegetation grows. Instead of this anchorage, the contractor may secure mulch by heavy biodegradable twine fastened by pegs or staples to form a grid with 6 to 10 feet spacing.

(3) The contractor may use department-approved erosion control mats, listed in the department's PAL, instead of separately applying mulch and netting.

627.3.2.2 Method B, Tackifier

(1) Treat straw or hay with a tackifier, blow from a machine, and uniformly deposit over designated areas in one operation. Place straw or hay uniformly over the area 1/2 to 1 inch deep, using 1/2 to 3 tons of mulch per acre. Mix and place tackifier according to the department's PAL. Within the above limits, the engineer will determine, on the job, the application rate of the mulch and the tackifier, and the engineer may vary the rates during mulching to produce the desired results. Use an engineer-approved machine to place the mulch that blows or ejects by constant air stream a controlled quantity of mulch and applies a spray of tackifier to partially coat the straw or hay, sufficient to hold together and keep in place the deposited straw or hay. The contractor may apply the tackifier as an overspray in a separate operation after placing the straw or hay.

(2) Apply wood fiber, wood chips, or similar material with engineer-approved blowing machines, or other engineer-approved methods, that place a controlled quantity of mulch uniformly over the area 1/2 to 1 1/2 inches deep. Treat areas receiving wood chip mulch, with one pound of available nitrogen per 1000 square feet before or after applying the chips.

(3) Throughout the process, feed the mulch material into the blowing machine to produce a constant and uniform ejection from the discharge spout, and operate in a position to produce mulch of uniform depth and coverage.

627.3.2.3 Method C, Crimping

(1) Spread the straw or hay mulch uniformly over the designated areas to a loose depth of 1/2 to 1 1/2 inches, using 1/2 to 3 tons of mulch per acre, by blowing from a machine, as specified in Method B, or by other engineer-approved methods.

(2) Immediately after spreading, anchor the mulch in the soil by using a mulch crimper consisting of a series of dull, flat discs with notched edges. Space the 20 inch diameter discs at about 8 inch centers. Equip the crimper with a ballast compartment to allow adjusting the weight for depth control.

(3) Impress the mulch into the soil 1 1/2 to 2 1/2 inches deep in one pass of the crimper. The department will not allow mulch crimpers to operate on slopes so steep that damage to the mulch, seedbed, or soil occurs. Anchor the mulch on these areas by one of the following methods: Method A or Method B. Equip and operate tractors to minimize disturbing or displacing the soil. This process may require more than one pass of the crimper to ensure adequate anchoring of the mulch.

(4) The contractor shall not use Method C if it cannot impress the mulch to a minimum of 1 1/2 inch.

627.4 Measurement

(1) The department will measure Mulching acceptably completed by the square yard or by the ton, whichever the contract specifies.

(2) If measured by the square yard, the measured quantity equals the number of square yards of surface area that the contractor applied the mulch.

(3) If measured by the ton, the measured quantity equals the number of tons of mulch provided, placed, and acceptably completed.

(4) Tackifiers or nitrogen used for treating mulch are incidental to the cost of the work.

627.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
627.0200	Mulching	SY
627.0205	Mulching	TON

(2) Payment for Mulching is full compensation for providing materials, including tackifiers or nitrogen; for all hauling, treating, placing, spreading, and anchoring of the mulch material; and for maintaining the work and repairing all damaged areas.

(3) If the contractor opts to use department-approved erosion control mats instead of separately applying mulch and netting, the department will pay for it at the contract unit price for Mulching only.

Section 628 Erosion Control

628.1 Description

(1) This section describes providing erosion control mats, bale checks or dikes, fences, screens, blankets, and other erosion control devices.

(2) This section also describes cleaning sediment basins and mobilizations for erosion control.

628.2 Materials

628.2.1 General

628.2.1.1 Acronyms

(1) Interpret acronyms used throughout this section as follows:

ECRM Class I, II, and IIIA erosion control revegetative mats.

TRM Class III B, C, and D turf reinforcement mats.

628.2.1.2 Product Acceptability

(1) The department prequalifies selected erosion control products in the department's PAL. If the contract specifies, furnish products of the class, type, and subject to the seasonal limitations the department's PAL designates. Before installing a product from the department's PAL, submit to the engineer a written copy of the manufacturer's specifications for installing that product on slopes, channels, shorelines, high wind locations, and next to live traffic lanes as applicable to the contract installation. Install products from the department's PAL conforming to those manufacturer's specifications. The department may specify modifications to the manufacturer's procedures for individual materials here within 628.

(2) The department may sample and test products supplied in the field to verify that they conform to the department's PAL prequalification requirements. Provide samples as the engineer directs.

628.2.2 Erosion Mat

(1) The department must prequalify all erosion mat products before use. Furnish erosion mat products from the department's PAL.

(2) The department's PAL identifies prequalified erosion mat products by class and type. Use the required class and type of erosion mat the plans show or the engineer specifies. The contractor may furnish any prequalified erosion mat product of the class and type the plans show or that the engineer specifies.

(3) If using jute fabric for a Class II Type A erosion mat, use a woven fabric of a uniform open weave of single jute yarn. Use a jute yarn of loosely twisted construction with an average twist of not less than 1 1/2 turns per one inch. Ensure the average size of the warp and weft yarns are approximately the same. Furnish the woven fabric in rolled strips. Submit a certificate of compliance certifying that the jute fabric erosion mat conforms to the following:

- Is a minimum 48 inches wide with a tolerance of minus one inch.
- Has 78 warp ends, +/- one for each 48 inches of width. Has 45 weft yarns, +/- 2, per linear yard of length.
- Weighs 92 pounds per 100 square yards +/- 10 percent, measured under average atmospheric conditions.
- Is non-toxic to vegetation.

628.2.3 Staples

(1) Furnish U-shaped staples, made of No. 11 or larger diameter steel wire, or other engineer-approved material, are one to 2 inches wide, and not less than 6 inches long for firm soils and not less than 12 inches for loose soils. The contractor may use anchors the staple gun manufacturer recommends, either lighter gage staples or equivalent, for engineer-approved staple gun systems.

628.2.4 Bales

(1) For bales, use straw, hay, or other engineer-approved material, in good condition, of the dimensions the plans show.

628.2.5 Stakes

(1) Furnish wood or metal stakes of the dimensions the plans show.

628.2.6 Silt Fence

628.2.6.1 Geotextile

(1) Furnish one of the following geotextiles: woven or non-woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. For non-woven fabric the contractor may use needle punched, heat bonded, resin bonded, or combinations of all 3. Submit a certificate of compliance certifying that the geotextile conforms to the following:

TEST REQUIREMENT	METHOD	VALUE[1]
Minimum grab tensile strength (machine direction)	ASTM D4632	120 lb
Minimum grab tensile strength (cross machine direction)	ASTM D4632	100 lb
Maximum apparent opening size (equivalent standard sieve)	ASTM D4751	No. 30
Minimum Permittivity	ASTM D4491	0.05 s^{-1}
Minimum ultraviolet stability (strength retained at 500 hrs of exposure)	ASTM D4355	70%

[1] All numerical values represent minimum or maximum average roll values. Average test results from all rolls in a lot must conform the tabulated values.

628.2.6.2 Fence Support System

(1) Conform to plan requirements.

628.2.7 Silt Screen

(1) Furnish fabric and submit a certificate of compliance certifying that the fabric conforms to the following:

Thickness ..... 15 mils
Minimum grab tensile strength ..... 120 lb
Minimum equivalent opening ..... No.170 sieve

(2) Heat seal or sew all fabric seams.

(3) For flotation, use an 8-inch diameter solid expanded polystyrene log, or engineer-approved equal, with a buoyancy of approximately 20 pounds per foot. Do not use polystyrene beads or chips.

(4) For the main load line, use 5/16-inch cable. For ballast, use a 1/4-inch chain.

628.2.8 Sand Bags

(1) Furnish bags made of canvas, burlap, nylon, or other engineer-approved material filled with concrete sand or other engineer-approved granular material.

628.2.9 Polyethylene Sheeting

(1) Furnish 6 mil or thicker polyethylene sheeting conforming to ASTM D4397.

628.2.10 Turbidity Barriers

(1) Furnish barrier made of coated impervious fabric capable of containing all sediment at the location placed. It shall have a cable, with a 5/16 inch or larger diameter, capable of supporting the barrier at the required height above the water. It shall have a self-contained ballast that weighs at least 0.7 pound per foot. The ballast may be either chain or flexible cable. Barrier ends shall have grommets to lace together adjoining sections. For anchor posts use one of the following: steel fence posts, steel pipes, or steel channels.

(2) Submit a certificate of compliance certifying that the turbidity barrier fabric conforms to the following:

TEST REQUIREMENT	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	200 lb
Minimum puncture strength	ASTM D4833	90 lb
Maximum permeability	ASTM D4491	$1x10^{-7}$ cm/s
Minimum ultraviolet stability (strength retained at 500 hrs of exposure)	ASTM D4355	70%

[1] All numerical values represent minimum or maximum average roll values. Average test results from all rolls in a lot must conform the tabulated values.

628.2.11 Soil Stabilizer

(1) Soil stabilizer type A is one of the following: a cementitious soil binder added to wood cellulose fiber mulch, or a bonded fiber matrix. Soil stabilizer type B is a polyacrylimide.

(2) Furnish soil stabilizer products from the department's PAL.

628.2.12 Inlet Protection

(1) Use a type FF geotextile conforming to 645.2.2.1 except use a woven polypropylene fabric. Furnish type FF geotextiles, or bags manufactured from type FF geotextiles, from the department's PAL.

628.2.13 Rock Bags

(1) Furnish rock bags made of a porous, ultraviolet resistant, high-density polyethylene or geotextile that will retain 70 percent of its original strength after 500 hours of exposure according to ASTM D4355 and a minimum in-place filled size of 18 inches long by 12 inches wide by 6 inches high. Ensure that the fabric conforms to the following:

TEST REQUIREMENT	METHOD	VALUE
Minimum Tensile	ASTM D4632	
Machine direction		70 lb minimum
Cross direction		40 lb minimum
Elongation	ASTM D4632	
Machine direction		20% minimum
Cross direction		10% min
Puncture	ASTM D4833	65 lbs minimum
Minimum Apparent Opening		0.0234 inches (No. 30 sieve)
Maximum Apparent Opening		0.0787 inches (No. 10 sieve)

(2) Fill the bags with a clean, sound, hard, durable, engineer-approved coarse aggregate conforming by visual inspection to the gradation specified for No. 2 coarse aggregate for concrete in 501.2.5.4.5.

628.2.14 Tracking Pads

(1) Furnish tracking pad aggregate conforming to 312.2 for select crushed material except the material shall be substantially free of particles passing the No. 10 sieve. Furnish type R geotextile conforming to 645.2.2.6.

628.3 Construction

628.3.1 General

(1) Arrange to have available a sufficient quantity of contract-required temporary erosion control materials to protect the project site from erosion at all times during construction. Include erosion mat, erosion bales, silt fence, manufactured alternative materials for temporary ditch checks, and other temporary erosion control materials the contract requires.

(2) Ensure that erosion control products selected from the department's PAL are properly installed and maintained to remain in place and functioning as the contract specifies.

628.3.2 Erosion Mat

(1) Provide protective covering mats or soil retention mats for erosion control on prepared planting areas of slopes, ditches, channels, or shorelines, at locations the plans show or the engineer directs. Conform to the seasonal limitations designated in the department's PAL for photodegradable products.

(2) Install as the manufacturer specifies except as follows:

1. Do not use single roll material less than 6 feet wide in channels.
2. Entrench mats approximately 3 inches deep along the edge facing traffic for all installations within 5 feet of active traffic lanes.
3. Overlap mats by 3 inches or less and anchor with anchoring devices selected from the department's PAL for all mats the department's PAL designates as urban.

(3) Cover TRM's immediately after installation with materials from the department's PAL as follows:

1. On slopes use either an ECRM or a type A soil stabilizer. If using a soil stabilizer, apply at the manufacturer’s recommended rate unless the contract or engineer specifies otherwise.
2. In channels use an ECRM of a class and type the department's PAL allows for channel applications.

(4) Remove all stones, clods, roots, sticks, or other foreign material that prevent the mat from bearing completely on the surface before placing the mat.

(5) Reseed any seeded areas damaged or destroyed during placement of the erosion mat as specified for the original seeding.

(6) Dispose of all surplus excavation or materials, and all stones, clods, or other foreign material removed in preparing for placing the mat.

(7) Apply water uniformly after placing the mat over a seeded area to sufficiently moisten the seedbed to a depth of 2 inches and in a way that precludes washing or erosion.

(8) Maintain the erosion mat and repair any damaged areas until the work is accepted.

(9) The contractor shall not overlap type urban erosion mat with type urban or other type erosion mat.

628.3.3 Erosion Bales

(1) Furnish bales of straw, hay, or other suitable baled material to form erosion control structures other than ditch checks. Install at locations the plans show or as the engineer directs.

(2) Maintain the bales as required including removing and disposing of sediment deposits. Remove erosion bales after slopes and ditches are stable and turf develops enough to make future erosion unlikely. The engineer will determine when the contractor meets these criteria satisfactorily. The contractor may use bales as mulch. Dispose of bales not used as mulch in a manner acceptable to the engineer. Reshape ditches; fill sumps and trenches; dispose of excess eroded material; and topsoil, fertilize, and seed the affected area.

628.3.4 Silt Fence

628.3.4.1 Installation and Removal

(1) Erect the silt fence before starting a construction operation that might cause sedimentation or siltation at the site of the proposed silt fence.

(2) If possible, construct the silt fence in an arc or horseshoe shape with its ends pointing up slope. Construct the silt fence to the dimensions, and according to the details the plans show. Remove silt fences, as the engineer determines, after stabilizing the slopes and ditches and developing the turf to the extent that future erosion is unlikely. Clean up and restore the surface after removal. The contractor owns all materials remaining after removal and is responsible for their disposal off the right-of-way.

628.3.4.2 Inspection and Maintenance

(1) Inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Correct any deficiencies immediately. Additionally, review the locations for silt fences and filter barriers in areas that construction activity changed the earth contour and drainage runoff on a daily basis to ensure that the silt fences are properly and effectively located. If deficiencies exist, install additional silt fences as the engineer directs or approves.

(2) Remove sediment deposits when the build-up exceeds approximately 1/2 the volume capacity of the silt fence. The engineer may order the contractor to remove deposits if the engineer determines deposits exceed 1/2 the volume capacity of the silt fence. The contractor shall dress, to the existing grade, sediment deposits remaining in place after the silt fence is no longer required, this includes topsoiling, fertilizing, and seeding the affected area.

628.3.5 Silt Screen

(1) Install the silt screen to prevent drift shoreward or downstream. Securely attach the flotation log to the fabric in both the horizontal and vertical direction.

(2) Attach the 5/16-inch cable at the flotation members and extend along the entire length of each section of silt screen. Seal a 1/4-inch chain in the lower hem for ballast.

(3) Use connectors to join the main load line and ballast chain to carry all tensile pressure. Join the fabric for its entire height with grommets and lacing rope.

(4) Ensure the silt screen extends from the water surface to a maximum 10 foot depth.

(5) Install anchorages or stakes on both shore and stream side to maintain stability. Use a post with deadman or engineer-approved equal for shore anchors. Ensure stream anchors are of sufficient size, type, and strength to stabilize the barrier beyond the construction area.

(6) Buoy anchors to prevent pulling the barrier under water. Use Danforth-type anchors in sandy bottom and heavy kedge type or mushroom anchors on mud bottoms.

(7) Maintain the barrier throughout construction operations.

(8) After completing the work, remove the barrier in a way that prevents siltation of the river.

628.3.6 Cleaning Sediment Basins

(1) Clean sediment basins when the engineer determines the sediment has accumulated to an extent that impairs the effectiveness of the sediment basin.

(2) Dispose of the surplus material according to 205.3.12 for disposal of surplus or unsuitable material.

628.3.7 Mobilizations for Erosion Control

(1) Move personnel, equipment, and materials to the project site for constructing erosion control items at the stages the contract indicates or the engineer directs.

(2) Submit for approval an ECIP required in 107.20 for accomplishing temporary and permanent erosion control work. Stage the ECIP erosion control work to conform to the number of Mobilizations Erosion Control bid items the contract plans show. The department will not allow any deviation from approved

staging without the engineer's written approval. The engineer will direct each of the mobilizations. Mobilize with sufficient personnel, equipment, supplies, and incidentals, within 72 hours of the engineer's written order.

628.3.8 Mobilizations Emergency Erosion Control

(1) Move personnel, equipment, and materials to the project site to install temporary erosion control items on an emergency basis as the engineer directs.

(2) Mobilize with sufficient personnel, equipment, materials, and incidentals on the job site within 8 hours the engineer's written order to install temporary erosion control items on an emergency basis.

(3) An emergency is a sudden occurrence of a serious and urgent nature, beyond normal maintenance of erosion control items and mobilizations the ECIP includes. Under this definition, an emergency mobilization requires immediate action to move necessary personnel, equipment, and materials to the emergency site followed by immediate installation of temporary erosion control measures.

(4) Unless the engineer directs otherwise, replenish stockpiled material delivered as specified for plan quantities in 628.3.1 and subsequently used for emergency erosion control to the pre-emergency totals of these stockpiles.

628.3.9 Polyethylene Sheeting

(1) Install polyethylene sheeting at locations the plans show or as the engineer directs.

(2) Secure the sheeting from wind and water dislocation. Before placing, remove stones, roots, sticks, and other materials that interfere with the sheeting bearing completely on the soil. Overlap adjacent sheets a minimum of 3 feet in the direction of flow; and seal the edges with waterproof tape or other engineer-approved method. Patch damaged areas with sheeting overlapped a minimum of 3 feet and seal the joints with waterproof tape or other engineer-approved method. Maintain the sheeting and make satisfactory repairs of damaged areas.

(3) Upon completing the work, remove the polyethylene sheeting. The contractor shall assume ownership of all removed material.

628.3.10 Turbidity Barriers

(1) Install turbidity barriers at locations the plans show or as the engineer directs.

(2) Place all barriers, before beginning adjacent construction, in a way that causes minimum disturbance of the streambed and banks. Extend the barrier into the stream banks far enough to preclude washing out or erosion around the ends. Drive posts securely into the streambed at 10 foot intervals along the line of the barrier installation. Fasten the barrier to the posts and securely anchor the barrier load lines at the barrier ends and at 10 foot intervals between the barrier ends, unless the engineer directs otherwise. Provide additional anchoring if necessary to maintain the barrier location during construction operations. Install sand bags as the plans show to anchor the barrier to the streambed. The engineer may require additional sand bags to ensure adequate performance. The contractor, as required by permit under 107.19, shall provide and anchor both danger buoys and navigational markers.

(3) Maintain the integrity of the barrier as necessary to contain erosion from adjacent construction operations. Promptly correct all deficiencies. Barrier maintenance includes removing and disposing of accumulations of soil and other detrimental material.

(4) Remove the barrier after completing the adjacent work. Delay removal until removing and disposing of accumulated soils and other suspended materials, and all suspended materials settle. Minimize disturbing the streambed and banks during removal operations.

(5) If the engineer approves, the contractor may substitute sheet pile installed as a part of their construction operation for all or part of the turbidity barrier the plans show.

628.3.11 (Vacant)

628.3.12 Soil Stabilizer

628.3.12.1 General

(1) Provide soil stabilizer as a soil bonding agent to prevent or minimize erosion. Install on exposed soil surfaces of temporary or permanent slopes as the plans show or as the engineer directs.

628.3.12.2 Soil Stabilizer Type A

(1) Apply soil stabilizer with conventional hydraulic seeding equipment. Ensure that surrounding surfaces, structures, signs, trees, and shrubs are not over-sprayed. The engineer will not accept the work until the contractor cleans over-sprayed surfaces. Provide a finished application 3/16 to 1/4 inches thick.

(2) For permanent slope applications, sow seed separately, before applying the soil stabilizer, to ensure that the seed has direct contact with the soil.

628.3.12.3 Soil Stabilizer Type B

(1) Apply soil stabilizer with conventional hydraulic seeding equipment or by dry spreading. Apply the material at the manufacturer's recommended rate unless the engineer directs otherwise.

(2) For permanent slope applications, apply a department-approved mulch when applying the soil stabilizer or after applying it to protect the seed.

628.3.13 Inlet Protection

(1) Furnish, install, maintain, and remove type FF geotextile, and fabric hold down and support systems for inlet protection where the plans show or the engineer directs. The contractor may provide manufactured alternatives selected from the department's PAL.

(2) For type A inlet protection, install around field inlets until establishing permanent soil stabilization; and around pavement inlets before placing curb, gutter, or curb & gutter.

(3) For type B inlet protection, install on curb, gutter, curb & gutter, and pavement inlets after placing the surrounding pavement surfaces.

(4) For type C inlet protection use a wooden 2 x 4, wrapped and secured in type FF geotextile, installed in front of the curb head as the plans show. The wood shall not block the entire opening of the curb box.

(5) For type D inlet protection, the contractor may make the bag from type FF geotextile or choose a manufactured type FF bag from the department's PAL. Ensure that the device is designed to fit the size and shape of the inlet. At a minimum, inspect and maintain after every precipitation event.

628.3.14 Temporary Ditch Checks

(1) Provide suitable ditch check materials, installed and maintained at locations the plans show or as the engineer directs.

(2) Construct temporary ditch checks using a double row of erosion bales or a manufactured alternative from the department's PAL. Place temporary ditch checks across ditches at locations the plans show or as the engineer directs immediately after shaping the ditches or slopes. Excavate upstream sumps as the engineer directs.

(3) Remove sediment deposits when the build-up exceeds approximately 1/2 the erosion bale structures volume capacity. The engineer may order the contractor to remove deposits if the engineer determines that sediment deposits exceed 1/2 the erosion bale structures volume capacity. Dispose of excess sediment as the engineer directs.

(4) Remove ditch checks after the slopes and ditches are stable and the turf develops enough to make future erosion unlikely. The engineer will determine when the contractor meets these criteria. The contractor may use bales as mulch. Dispose of bales not used as mulch in a manner acceptable to the engineer. Reshape the ditch; fill sumps and trenches; dispose of excess eroded material; and topsoil, fertilize, and seed the affected area.

628.3.15 Culvert Pipe Checks

(1) Install rock bag culvert pipe checks as the plans show and as the engineer directs. Place bags immediately after installing new culverts and before beginning earth disturbing activities in areas drained by existing culverts. Place rock bags on the inlet end of the culvert only. Leave rock bags in place until slopes and ditches are stable and turf develops enough to make future erosion unlikely. Periodically remove sediment to maintain effective function. Remove and dispose of the bags and rock filler when they are no longer needed to control erosion. Dispose of accumulated sediment and restore the site. The contractor may spread accumulated sediment to form a surface suitable for seeding.

628.3.16 Tracking Pads

(1) Install tracking pads at the locations the plans show, locations consistent with an engineer-approved ECIP, or where the engineer directs before allowing construction traffic to leave the site. Ensure that the pad is wide enough to cover the full width of the egress point. Design the installation to divert surface water flow away from the pad and, if field conditions dictate, provide a culvert to channel flow under the pad.

(2) Replace or rework material in the surface of the pad to minimize material tracked onto public roads. Maintain the driving surface in a clean and safe operating condition. Remove the pad and restore the site upon completion of contract work.

628.3.17 Rock Bags

(1) Install rock bags as the plans show or the engineer directs either in conjunction with work done under other contract bid items or as stand-alone erosion control devices. Periodically remove sediment to maintain effective function. Remove and dispose of the bags and rock filler when they are no longer needed to control erosion. Dispose of accumulated sediment and restore the site. The contractor may spread accumulated sediment to form a surface suitable for seeding.

628.4 Measurement

628.4.1 General

628.4.1.1 Borrow Sites and Material Disposal Sites

(1) The department will measure work acceptably completed under selected bid items placed on borrow sites and material disposal sites if that work is consistent with an engineer-approved ECIP. The department will measure only the following bid items using the methods described in their respective measurement subsections:

Erosion Mat (type)	Soil Stabilizer (type)	Mulching
Erosion Bales	Culvert Pipe Checks	Seeding
Temporary Ditch Checks	Polyethylene Sheeting	Seeding Temporary
Silt Fence	Tracking Pads	Fertilizer Type (type)
Silt Fence Maintenance	Rock Bags	
Inlet Protection (type)	Mobilizations Emergency Erosion Control	

628.4.1.2 Sand Bags

(1) The department will not measure sand bags. Sand bags are incidental to the bid items that use sand bags.

628.4.2 Erosion Mat

(1) The department will measure the Erosion Mat bid items by the square yard acceptably completed. The department will not make allowance for portions of the mat that must be entrenched in the soil for any end or junction slot, or for required overlaps.

628.4.3 (Vacant)

628.4.4 Erosion Bales

(1) The department will measure Erosion Bales as each individual bale acceptably completed.

628.4.5 (Vacant)

628.4.6 Silt Fence

(1) The department will measure Silt Fence by the linear foot acceptably completed. The department will measure along the base of the fence, center-to-center of end post, for each section of fence.

628.4.7 (Vacant)

628.4.8 Silt Fence Maintenance

(1) The department will measure Silt Fence Maintenance by the linear foot acceptably completed. The department will measure along the base of the fence, end-to-end of the section maintained, for each time a section of fence is cleaned and repaired.

628.4.9 Silt Screen

(1) The department will measure Silt Screen by the linear foot acceptably completed.

628.4.10 Cleaning Sediment Basins

(1) The department will measure Cleaning Sediment Basins by the cubic yard acceptably completed, measured in the vehicle.

628.4.11 Mobilizations Erosion Control

(1) The department will measure Mobilizations Erosion Control by each individual mobilization acceptably completed. The department will not include the following:

1. Delivering and installing materials provided for in specific contract bid items.
2. Work specified under the Mobilizations Emergency Erosion Control bid item, or the work and operations necessary for normal contractor maintenance of erosion control items.
3. The movement of personnel, equipment, and materials to the work site to accomplish installing additional erosion control items the engineer deems necessary to control erosion between the stages contained in the department-approved plan of operations, unless the engineer directs otherwise in writing.

628.4.12 Mobilizations Emergency Erosion Control

(1) The department will measure Mobilizations Emergency Erosion Control by each individual mobilization acceptably completed. The department will not include delivering and installing temporary erosion control materials provided for in specific contract bid items.

628.4.13 Polyethylene Sheeting

(1) The department will measure Polyethylene Sheeting by the square yard acceptably completed.

628.4.14 Turbidity Barriers

(1) The department will measure Turbidity Barrier by the square yard acceptably completed. The department will make no allowance for portions of the turbidity barrier considered as part of the anchorages, required overlaps, or having a bottom flap greater than 48 inches.

(2) If the contractor substitutes sheet pile for turbidity barrier as allowed in 628.3.10, the department will measure that turbidity barrier as the plan quantity in square yards of material replaced.

628.4.15 Soil Stabilizer

(1) The department will measure the Soil Stabilizer bid items by the acre acceptably completed within the limits the contract designates or as the engineer directs.

628.4.16 Inlet Protection

(1) The department will measure the Inlet Protection bid items as each individual location and type acceptably completed.

628.4.17 Temporary Ditch Checks

(1) The department will measure Temporary Ditch Checks by the linear foot acceptably completed. If using erosion bales, the department will only measure the length across the ditch, not the length of each row of bales. The department will not measure ditch checks constructed with a single row of bales.

628.4.18 (Vacant)

628.4.19 Culvert Pipe Checks

(1) The department will measure Culvert Pipe Checks as each individual rock bag acceptably completed.

628.4.20 Tracking Pads

(1) The department will measure Tracking Pads as each individual location acceptably completed measured only at the locations the plans show, consistent with an engineer-approved ECIP, and where the engineer directs.

628.4.21 Rock Bags

(1) The department will measure Rock Bags as each individual bag acceptably completed.

628.5 Payment

628.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
628.1104	Erosion Bales	EACH
628.1504	Silt Fence	LF
628.1520	Silt Fence Maintenance	LF
628.1550	Silt Screen	LF
628.1905	Mobilizations Erosion Control	EACH
628.1910	Mobilizations Emergency Erosion Control	EACH
628.1920	Cleaning Sediment Basins	CY
628.2000 - 2099	Erosion Mat (class) (type)	SY
628.5505	Polyethylene Sheeting	SY
628.6005	Turbidity Barriers	SY
628.6500 - 6599	Soil Stabilizer (type)	ACRE
628.7000 - 7099	Inlet Protection (type)	EACH
628.7504	Temporary Ditch Checks	LF
628.7555	Culvert Pipe Checks	EACH
628.7560	Tracking Pads	EACH

628.7570	Rock Bags	EACH

(2) The department will pay for measured quantities at the contract unit price under selected bid items placed on borrow sites and material disposal sites if that work is consistent with an engineer-approved ECIP. The department will pay for only the following bid items using the methods described in their respective payment subsections:

Erosion Mat (type)	Soil Stabilizer (type)	Mulching
Erosion Bales	Culvert Pipe Checks	Seeding
Temporary Ditch Checks	Polyethylene Sheeting	Seeding Temporary
Silt Fence	Tracking Pads	Fertilizer Type (type)
Silt Fence Maintenance	Rock Bags	
Inlet Protection (type)	Mobilizations Emergency Erosion Control	

628.5.2 Erosion Mat

(1) Payment for the Erosion Mat bid items is full compensation for providing, protecting, and storing erosion mat materials on the project; for placing and anchoring the mat, including staples; for preparing the seeded areas; for installing end and junction slots; for repairing and reseeding damaged areas; for providing and applying water; and for disposing of all surplus and waste materials.

(2) The department will pay separately for covering class III types B, C, and D mats with an ECRM under the applicable Erosion Mat bid item, or with type A soil stabilizer under the Soil Stabilizer Type A bid item.

628.5.3 (Vacant)

628.5.4 Erosion Bales

(1) Payment for Erosion Bales is full compensation for providing, protecting, and storing erosion bales on the project; for placing materials, including stakes; for anchoring the bales; for all excavating, including trenches and sumps; for removing excess sediment during construction; for removing and disposing of the bales and all waste or surplus materials, including eroded materials; and for shaping and restoring ditches.

(2) The department will pay separately for any required topsoiling, fertilizing, or seeding under the applicable bid item.

628.5.5 (Vacant)

628.5.6 Silt Fence

(1) Payment for Silt Fence is full compensation for providing, protecting, and storing silt fence on the project; for erecting fence, including all excavating, placing posts, backfilling, and attaching geotextile; and for removing the fence at project completion.

628.5.7 (Vacant)

628.5.8 Silt Fence Maintenance

(1) Payment for Silt Fence Maintenance is full compensation for all required cleaning and repairing; for removing or spreading the accumulated sediment to form a surface suitable for seeding; and for replacing silt fence and all damages caused by overloading sediment material or ponding water adjacent to the silt fence.

628.5.9 Silt Screen

(1) Payment for Silt Screen is full compensation for providing, assembling, erecting, maintaining, and removing the silt screen barrier.

628.5.10 Cleaning Sediment Basins

(1) Payment for Cleaning Sediment Basins is full compensation for all excavating; and for disposing of surplus material.

628.5.11 Mobilizations Erosion Control

(1) Payment for Mobilizations Erosion Control is full compensation for the staged moving of personnel, moving equipment, and moving materials. The department will pay separately for delivery and installation of erosion control devices under the other bid items in this section.

(2) Failure to mobilize within 72 hours of the engineer’s written order will result in a $300 per calendar day deduction from money due under the contract, for each calendar day of delay. The engineer may extend the 72-hour period for delays not the contractor's fault.

628.5.12 Mobilizations Emergency Erosion Control

(1) Payment for Mobilizations Emergency Erosion Control is full compensation for the staged moving of personnel, moving equipment, and moving materials. The department will pay separately for delivery and installation of temporary erosion control devices under the other bid items in this section.

(2) Failure to mobilize within 8 hours, will result in a $300 per calendar day deduction from money due under the contract, for each calendar day of delay. The engineer may extend the 8-hour period for delays not the contractor's fault.

628.5.13 Polyethylene Sheeting

(1) Payment for Polyethylene Sheeting is full compensation for furnishing and delivering the polyethylene sheeting to the project site; for storing on the project; for installing the sheeting; for all excavating and backfilling; for securing the sheeting and sealing the edges of the sheeting; and for removing and disposing of the sheeting and surplus materials.

628.5.14 Turbidity Barriers

(1) Payment for Turbidity Barriers is full compensation for furnishing, assembling, installing, maintaining, and removing the turbidity barrier; and for sandbags, buoys, navigational markers, anchors, and anchor ropes.

(2) If the contractor substitutes sheet pile for turbidity barrier as allowed in 628.3.10, the department will pay for the plan quantity of turbidity barrier replaced.

628.5.15 Soil Stabilizer

(1) Payment for the Soil Stabilizer bid items is full compensation for furnishing, mixing, and applying soil stabilizer.

628.5.16 Inlet Protection

(1) Payment for the Inlet Protection bid items is full compensation for furnishing, transporting, and installing materials; and for maintaining and removing the inlet protection devices.

628.5.17 Temporary Ditch Checks

(1) Payment for Temporary Ditch Checks is full compensation for providing, protecting, and storing ditch check materials on the project; for installing and removing ditch checks at project completion or as the engineer directs; for repairing and reseeding damaged areas; and for disposing of all surplus and waste material.

(2) The department will not pay for installing ditch checks if constructed of a single row of erosion bales.

628.5.18 (Vacant)

628.5.19 Culvert Pipe Checks

(1) Payment for Culvert Pipe Checks is full compensation for providing rock bags; for periodic sediment removal; for removing and disposing of rock bags and rock filler; for disposing of surplus eroded materials; and for restoring the site.

628.5.20 Tracking Pads

(1) Payment for Tracking Pads is full compensation for providing tracking pads including aggregate and geotextile; for replacing or reworking material as required to maintain performance; and for removing the pad and restoring the site.

628.5.21 Rock Bags

(1) Payment for Rock Bags is full compensation for providing rock bags; for periodic sediment removal; for removing and disposing of rock bags and rock filler; for disposing of surplus eroded materials; and for restoring the site.

Section 629 Fertilizer and Agricultural Limestone

629.1 Description

(1) This section describes furnishing and incorporating fertilizing material in the soil on areas of proposed seeding or proposed sodding.

(2) This section also describes furnishing and incorporating agricultural limestone in the soil.

629.2 Materials

629.2.1 Fertilizers

629.2.1.1 General

(1) Use fertilizers for seeding, sodding, or other planting that are standard commercial packaged or bulk products in granular or liquid form conforming to Wisconsin statutes and the Wisconsin administrative code chapter ATCP 40. Ensure that each container of packaged fertilizer is plainly marked with the analysis of the contents showing minimum percentages of total nitrogen, available phosphoric acid, and soluble potash. If furnishing the fertilizer in bulk, include an invoice in each shipment indicating the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash in the contents.

http://docs.legis.wi.gov/statutes/statutes/

http://docs.legis.wi.gov/code/admin_code/atcp/020/40.pdf

(2) If using fertilizer with a total of nitrogen, phosphoric acid, and potash greater than 32 percent for type A or 50 percent for type B, apply them at a rate that provides equal nitrogen, phosphoric acid, and potash.

629.2.1.2 Type A

(1) Type A fertilizer shall conform to the following minimum requirements:

Nitrogen, not less than 16%
Phosphoric Acid, not less than 6%
Potash, not less than 6%

(2) The total of nitrogen, phosphoric acid, and potash shall equal at least 32 percent.

(3) Total nitrogen shall at least equal the sum of the phosphoric acid and soluble potash.

629.2.1.3 Type B

(1) Type B fertilizer shall conform to the following minimum requirements:

Nitrogen, not less than 16%
Phosphoric Acid, not less than 6%
Potash, not less than 24%

(2) The total of nitrogen, phosphoric acid, and potash shall equal at least 50 percent.

629.2.2 Agricultural Limestone

(1) Conform to chapter 94.66 of the Wisconsin statutes and of the Wisconsin administrative code chapter ATCP 41. Furnish limestone with a neutralizing index of not less than 40 or more than 109.

http://docs.legis.wi.gov/statutes/statutes/94

http://docs.legis.wi.gov/code/admin_code/atcp/020/41.pdf

(2) Before using, furnish a statement to the engineer indicating the index zone or grade of the limestone for each deposit.

629.3 Construction

629.3.1 Fertilizer

629.3.1.1 General

(1) Uniformly apply the fertilizer selected for the seeding areas and incorporate into the soil by light discing or harrowing. If applying granular fertilizer, ensure it is well pulverized and free from lumps.

(2) If incorporating fertilizer into topsoiled areas, the contractor may apply it just before, and in conjunction with, final discing or harrowing, or if hand manipulating the topsoil, apply it just before final raking and leveling.

(3) If placing fertilizer on surfaces with no topsoil, prepare the soil by discing or harrowing to at least 6 inches deep and then incorporate the fertilizer as specified above.

(4) If sowing seeding areas by pressure sprayer, then fertilize by placing the required quantity of fertilizer in the tank, mixing with the water and the seed, agitating constantly, and apply during the seeding operation. If applying fertilizer this way then the department will not require discing and harrowing after placement.

(5) If fertilizing areas to receive sod, spread the fertilizer uniformly over the soil before sodding at the rate specified below, and then work the fertilizer into the soil while preparing as specified for preparing the earth bed in 631.3.1.

(6) If applying fertilizer for work specified under 632, then apply the fertilizer as specified in that section.

629.3.1.2 Type A

(1) Apply fertilizer containing 32 percent total of nitrogen, phosphoric acid, and potash at 7 pounds per 1000 square feet, unless the contract specifies otherwise. For type A fertilizer that contains a different percentage of components, determine the new application rate by multiplying the specified rate by a dimensionless conversion factor determined as follows:

Conversion Factor = 32 / New Percentage of Components

629.3.1.3 Type B

(1) Apply fertilizer containing 50 percent total of nitrogen, phosphoric acid, and potash at 7 pounds per 1000 square feet, unless the contract specifies otherwise. For type B fertilizer that contains a different percentage of components, determine the new application rate by multiplying the specified rate by a dimensionless conversion factor determined as follows:

Conversion Factor = 50 / New Percentage of Components

629.3.2 Agricultural Limestone Treatment

(1) Unless the contract specifies otherwise, spread agricultural limestone over the contract-designated areas at a uniform rate, measured in pounds per 1000 square feet, as follows:

INDEX ZONES	40-49	50-59	60-69	70-79	80-89	90-99	100-109
RATE	140	120	100	90	80	70	60

(2) To conveniently check the required application rate, the contractor may measure materials used on a volumetric basis, providing the conversion from weight to volume is determined from representative samples of materials used.

(3) Incorporate the agricultural limestone with the required fertilizers into the soils in the designated areas. The construction requirements applicable to fertilizers shall apply to those materials also.

629.4 Measurement

(1) The department will measure the Fertilizer bid items by the hundred pounds (CWT) acceptably completed, measured based on an application rate of 7 pounds per 1000 square feet. The department will not measure fertilizer used for the bid items under 632. The measured quantity equals the number of hundred-weight (CWT) of material determined by multiplying the actual number of cwt. of material incorporated by the ratio of the actual percentage of fertilizer components used to 32 percent for type A and to 50 percent for Type B.

(2) The department will measure Agricultural Limestone Treatment by the ton acceptably completed, measured based on an application rate of 100 pounds per 1000 square feet and an index zone of 60-69. The measured quantity equals the number of tons of material determined by multiplying the actual number of tons of material incorporated by 100 and dividing by the application rate required for the index zone of the material used.

629.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
629.0200 - 0299	Fertilizer (type)	CWT
629.1100	Agricultural Limestone Treatment	TON

(2) Payment for the Fertilizer bid items is full compensation for providing, hauling, placing, and incorporating in the work.

(3) Payment for Agricultural Limestone Treatment is full compensation for furnishing, hauling, placing, and incorporating the required materials in the soil.

Section 630 Seeding

630.1 Description

(1) This section describes preparing seed beds and furnishing and sowing the required seed on slopes, appurtenances, and other areas, and on borrow pits and material disposal sites.

(2) This section also describes furnishing and sowing temporary seed mixture on the slopes and appurtenances of temporary embankments and roadways.

630.2 Materials

630.2.1 Seed

630.2.1.1 General Requirements

(1) Conform to the Wisconsin statutes and Wisconsin administrative code chapter ATCP 20 regarding noxious weed seed content and labeling.

http://docs.legis.wi.gov/statutes/statutes/

http://docs.legis.wi.gov/code/admin_code/atcp/020/20.pdf

(2) Use seed within one year of the test date appearing on the label.

(3) Seed mixtures 70, 70A, 75, and 80 contain wild type forbs and grasses. Wild type is defined as seed that is derived directly from native, wild stock, including seed that was wild collected and placed into production or has been harvested directly from native stands.

630.2.1.2 Purity and Germination

(1) Test seed according to the methods and procedures used for sampling and analyzing seed for purity, germination, and noxious weed seed content specified in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

630.2.1.3 Inoculation

(1) Inoculate legume seed (white clover, red clover, ladino clover, alsike clover, alfalfa, partridge pea, purple prairie clover, Canada tick-trefoil, and lupine) unless it has been pre-inoculated by the vendor. Follow the inoculation instructions that come with the culture purchases. If applying the seed according to method B, 630.3.3.2, treat seeds requiring inoculation with 5 times the quantity of inoculant recommended in the instructions.

(2) Avoid exposure of the culture or inoculated seed to the sunlight, and in no case shall any exposure exceed 1/2 hour.

630.2.1.4 Storing Seed

(1) Store any seed delivered before use in a way that protects it from damage by heat, moisture, rodents, or other causes. Discard and replace any previously tested and accepted seed that becomes damaged.

630.2.1.5 Seed Mixtures

630.2.1.5.1 Right-of-Way

630.2.1.5.1.1 Permanent

630.2.1.5.1.1.1 Composition

(1) Seed mixtures for use on the right-of-way and easements shall, unless specified otherwise, be composed of seeds of the purity, germination, and proportions, by weight, as given in the Table of Highway Seed Mixtures and the Table of Native Seed Mixtures.

(2) Use seed of the species and varieties listed below. If no variety is listed, there will be no restriction on the variety furnished, except as follows:

1. Species composed of pure live seed (PLS) shall contain no named or improved varieties. PLS shall be grown in Wisconsin or northern Illinois, northeastern Iowa, or eastern Minnesota. Seed produced out-of-state must be grown in one of the following counties:

1.1 From northern Illinois:

Boone	Bureau	Carroll	Cook	De Kalb	Du Page	Grundy
Henry	Jo Daviess	Kane	Kendall	Lake	La Salle	Lee
McHenry	Ogle	Putnam	Rock Island	Stevenson	Whiteside	Will
Winnebago						

1.2 From northeastern Iowa:

Allamakee	Benton	Black Hawk	Bremer	Buchanan	Cedar	
Chickasaw						
Clayton	Clinton	Delaware	Dubuque	Fayette	Floyd	Howard

Jackson	Johnson	Jones	Linn	Mitchell	Muscatine	Scott
Winneshiek						

1.3 From eastern Minnesota:

Aitkin	Anoka	Carlton	Carver	Chisago	Dakota	Dodge
Fillmore	Goodhue	Hennepin	Houston	Isanti	Kanabec	La Sueur
Mille Lacs	Mower	Olmsted	Pine	Ramsey	Rice	Scott
Sherburne	Steele	Wabasha	Washington	Winona	Wright	

2. PLS for seed mixtures 70, 70A, 75, and 80 shall be packaged separately by species and clearly labeled with the vendor's name, species common and botanical names, gross weight, percent PLS, year of harvest and any specialized treatments that have been applied to ensure or enhance germination. If PLS is not listed, determine PLS by multiplying the percent germination times the percent purity.
3. Minimum percent purity for native for species is 90 percent. If a listed species is not available, substitutions may be made with engineer's approval and must be documented.

(3) Mix native species at the project site. Clean and debeard seeds having awns or excessive hairs before mixing.

SPECIES COMMON NAME	SPECIES BOTANICAL NAME	ACCEPTABLE VARIETIES
Kentucky Bluegrass	Poa pratensis	Low Maintenance
Red Fescue	Festuca rubra	Creeping
Hard Fescue	Festuca ovina var. duriuscula	Improved
Tall Fescue	Festuca arundinacea	Improved turf type
Salt Grass	Puccinella distans	Fult's
	Puccinella distans	Salty
Redtop	Agrostis alba	
Timothy	Phleum pratense	
Canada Wild Rye[1]	Elymus canadensis	
Perennial Ryegrass	Lolium perenne	
Perennial Ryegrass	Lolium perenne	Improved Fine
Annual Ryegrass	Lolium multiflorum	
Alsike Clover	Trifolium hybridum	
Red Clover	Trifolium pratense	
White Clover	Trifolium repens	
Japanese Millet	Echinochola crusgalli var. frumentacea	
Annual Oats	Avena sativa	
Alfalfa	Medicago sativa	
Bromegrass	Bromus inermis	
Orchardgrass	Dactylis glomerata	
Ladino Clover	Trifolium repens var. latum	Ladino
Agricultural Rye	Secale cereale	
Winter Wheat	Triticum aestivum	

[1] Pure live seed

TABLE 630-1 HIGHWAY SEED MIXTURES

SPECIES	PURITY minimum %	GERMINATION minimum %	MIXTURE PROPORTIONS in percent				
			NO.10	NO.20	NO.30	NO.40	NO.60
Kentucky Bluegrass	98	85	40	6	10	35	
Red Fescue	97	85	25		30	20	
Hard Fescue	97	85		24	25	20	
Tall Fescue	98	85		40			
Salt Grass	98	85			15		
Redtop	92	85	5				
Timothy	98	90					12
Canada Wild Rye		PLS[1]					10
Perennial Ryegrass	97	90	20	30			
Improved Fine Perennial Ryegrass	96	85			20	25	
Annual Ryegrass	97	90					30
Alsike Clover	97	90					4
Red Clover	98	90					4
White Clover	95	90	10				
Japanese Millet	97	85					20
Annual Oats	98	90[1]					20

[1] Substitute winter wheat for annual oats in fall plantings started after September 1.

TABLE 630-2 NATIVE SEED MIXTURES

SPECIES		SPECIES BOTANICAL NAME	PURITY & GERMINATION minimum %	MIXTURE PROPORTIONS in percent			
				NO. 70	NO. 70A	NO. 75	NO. 80
FORBES	Canada Anemone	*Anemone canadensis*	PLS	2			
	Butterflyweed	*Asclepias tuberosa*	PLS		2		
	New England Aster	*Aster novae-angliae*	PLS	2	2		
	Partridge-pea	*Chamaecrista (Cassia) fasciculata*	PLS		2		
	Purple Prairie Clover	*Dalea (Petalostemum) purpurea*	PLS	2	2	4	
	Canada Tick-trefoil	*Desmodium canadense*	PLS	2			
	Flowering Spurge	*Euphorbia corollata*	PLS		2		
	Wild Geranium	*Geranium maculatum*	PLS	2			
	Western Sunflower	*Helianthus occidentalis*	PLS	3	2		
	Rough Blazingstar	*Liatris aspera*	PLS		2		
	Prairie Blazingstar	*Liatris pycnostachya*	PLS	2			
	Lupine	*Lupinus perennis*	PLS		3		
	Wild Bergamot	*Monarda fistulosa*	PLS	2			
	Horse Mint	*Monarda punctata*	PLS		2		
	Yellow Coneflower	*Ratibida pinnata*	PLS	2	2		
	Blackeyed Susan	*Rudbeckia hirta*	PLS			1	
	Showy Goldenrod	*Solidago speciosa*	PLS	2	2		
	Spiderwort	*Tradescantia ohiensis*	PLS	2	2		
	Golden Alexanders	*Zizia aurea*	PLS	2			
GRASSES	Big Bluestem	*Andropogon gerardi*	PLS	15	15	10	
	Sideoats Grama	*Bouteloua curtipendula*	PLS	15	20	20	25
	Canada Wildrye	*Elymus Canadensis*	PLS	15	15	35	23
	Slender Wheatgrass	*Elymus trachycaulus*	PLS				20
	Junegrass	*Koeleria macrantha*	PLS		5		
	Annual Ryegrass	*Lolium multiflorum*	[1]			10	10
	Switchgrass	*Panicum virgatum*	PLS				10
	Salt Grass	*Puccinella distans*	[1]				2
	Little Bluestem	*Schizachyrium (Andropogon) scoparium*	PLS	15	20	10	10
	Indiangrass	*Sorgastrum nutans*	PLS	15		10	
ALTERNATE FORBES	Sky Blue Aster	*Aster azureus*	PLS	[2]	[2]		
	White Wild Indigo	*Baptisia leucantha*	PLS	[2]	[2]		
	Pale Purple Coneflower	*Echinacea pallida*	PLS	[2]	[2]		
	White Prairie Clover	*Petalostemum candidum*	PLS	[2]	[2]		
	Stiff Goldenrod	*Solidago rigida*	PLS	[2]	[2]		
	Hoary Vervain	*Verbena stricta*	PLS	[2]	[2]		

[1] Provide the minimum purity and germination specified in 630.2.1.5.1.1.1(3) in the table of highway seed mixtures.

[2] The contractor may, if the engineer approves, substitute an alternate forb for a required forb that is not available using the same percentage as specified for the required forb. Use a different alternate forb for each

unavailable required forb. Provide documentation showing that a required forb is not available before using an alternate.

630.2.1.5.1.1.2 Mixture

(1) The contractor shall select a seed mixture or mixtures that meet with the engineer's approval, and unless specified otherwise in the contract, shall conform to the following:

1. Use seed mixture No. 10 where average loam, heavy clay, or moist soils predominate.
2. Use seed mixture No. 20 where light, dry, well-drained, sandy, or gravelly soils predominate and for all high cut and fill slopes generally exceeding 6 to 8 feet, except where using No. 70.
3. Use seed mixture No. 10 or No. 20 on all ditches, inslopes, median areas, and low fills, except where using No. 30 or No. 70.
4. Use seed mixture No. 30 for medians and on slopes or ditches generally within 15 feet of the shoulder where a salt-tolerant turf is preferred.
5. Use seed mixture No. 40 in urban or other areas where a lawn type turf is preferred.
6. Use seed mixture No. 60 only on areas, the contract designates or the engineer specifies. Use it as a cover seeding for newly graded wet areas or as a nurse crop for specified wetland seed mixtures. The contractor shall not apply it to flooded areas.
7. Use seed mixture Nos. 70 and 70A on slopes and upland areas the contract designates or the engineer specifies. Use seed mixture No. 70 on loamy soils and seed mixture No. 70A on sandy soils.
8. Use seed mixture No. 75 where native grasses are desired for erosion control.
9. Use seed mixture No. 80 on inslopes where a salt tolerant seed mix containing native grasses is desired.

630.2.1.5.1.2 Temporary

(1) Under the Seeding Temporary bid item, use a temporary seed mixture conforming to 630.2.1.5.1.4. Use oats in spring and summer plantings. Use winter wheat or rye for fall plantings started after September 1.

630.2.1.5.1.3 Nurse Crop

(1) If seeding bare soil with either mixture 70, 70A, 75, or 80, include the Seeding Nurse Crop bid item.

630.2.1.5.1.4 Borrow Pits and Material Disposal Sites

(1) For seeding borrow pits and material disposal sites beyond the right-of-way, use seed mixtures conforming to seed mixture 10, 20, 70, 70A, or 75 of 630.2.1.5.1.1 or a borrow pit mixture composed of seeds of the species, purity, germination and proportions, by weight as given below:

PERMANENT

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Alfalfa	98	90
Bromegrass	85	85
Orchardgrass	80	85
Timothy	98	90
Red Clover	98	90
Alsike Clover	97	90
Ladino Clover	95	90
Kentucky Bluegrass	98	85

TEMPORARY

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Annual Oats	98	90
Agricultural Rye	97	85
Winter Wheat	95	90

NURSE CROP

SPECIES	% MINIMUM PURITY	% MINIMUM GERMINATION
Annual Oats	98	90
Annual Ryegrass	97	90
Winter Wheat	95	90

(2) For the borrow pit mixture use, by weight, 60 percent temporary species seeds and 40 percent permanent species seeds.

(3) For the temporary component, use any combination of temporary seeds listed in the table above.

(4) For the permanent component, use seeds from not more than 4 of the permanent species listed in the table above in any combination.

(5) When nurse crop is required for spring seeding before June 15, use annual oats. For fall seeding after October 15, use winter wheat, or annual ryegrass.

630.3 Construction

630.3.1 General

(1) If not protecting with a mulch cover, perform seeding, except Nos. 60, 70 and 70A mixtures at times of the year when temperature and moisture conditions are suitable for seeding, except during midsummer.

(2) Perform seeding, except Nos. 60, 70 and 70A mixtures, in conjunction with mulching as specified in 627 at any time the engineer allows.

(3) The contractor may perform seeding of Nos. 60, 70 and 70A mixtures at any time soil conditions are suitable, except between June 15 and October 15, unless the engineer allows otherwise.

(4) Perform seeding with the selected seed mixture, sown at the specified rate.

630.3.2 Preparation of Seed Bed

(1) Complete grading, shouldering, topsoiling, and fertilizing, if part of the work under contract, before permanent seeding, except the contractor may place the fertilizer and seed mixture in one operation if using equipment designed for the purpose.

(2) Just before seeding, work the area being seeded with discs, harrows, or other appropriate equipment to obtain a reasonably even and loose seedbed. Place topsoil as specified in 625.3.3.

630.3.3 Sowing

(1) Select the method of sowing from either method A, method B, method C, or an appropriate combination of methods A, B, and C. Obtain the engineer's approval for the sowing method and specific procedures used for each seed mixture used before sowing that mixture.

630.3.3.1 Method A

(1) Sow the selected seed mixture using equipment adapted to the purpose, or by scattering it uniformly over the areas to be seeded. Lightly rake or drag to cover the seed with approximately 1/4 inch of soil. After seeding, lightly roll or compact the areas using suitable equipment, preferably the cultipacker type, when the engineer judges the seedbed too loose, or if the seedbed contains clods that might reduce seed germination. The contractor shall not roll slopes steeper than 1:3.

(2) If scattering seed by hand, perform this work with satisfactory hand seeders and only when the air is calm enough to prevent seeds from blowing away.

630.3.3.2 Method B

(1) Sow or spread the seed upon the prepared bed using a stream or spray of water under pressure and operated from an engineer-approved machine designed for that purpose. Place the selected seed mixture and water into a tank, provided within the machine, in sufficient quantities that when spraying the seed on a given area it is uniformly spread at the required application rate. During this process, keep the tank contents stirred or agitated to provide uniform distribution. Spread the tank contents within one hour after adding the seed to the tank. The engineer will reject seed that remains mixed with the water for longer than one hour. The engineer will not require dragging or rolling.

630.3.3.3 Method C

(1) For spring seeding of seed mixtures 70 and 70A into existing ground cover, mow existing vegetation to 4 inches or less in height 2 to 4 weeks before seeding. Ten to 14 days after mowing, spray with vegetation control herbicide conforming to 632.2.12.

(2) For fall seeding of seed mixtures 70 and 70A into existing ground cover, mow existing vegetation to 4 inches or less in height 4 to 6 weeks before seeding. Ten to 14 days after mowing, spray with vegetation control herbicide conforming to 632.2.12. Retreat with vegetation control herbicide 10 to 14 days after initial application if live vegetation persists.

(3) Seed with a rangeland type drill with one or more seed boxes that can be calibrated independently to deliver different sized seeds uniformly at the required rate and equipped with a rear-mounted press wheel for each seed drop tube. If seeding into existing vegetation or thatch, use a rangeland type drill equipped with a no-till attachment that can cut through the vegetation or thatch in front of the V disc and seed drop tube. If the configuration of the area to be seeded allows, apply seed at 1/2 the specified seed rate and apply the second 1/2 in a perpendicular direction.

630.3.3.4 Borrow Pits and Material Disposal Sites

(1) Seed borrow pits, and material disposal sites off the right-of-way, with the selected seed mixture specified in 630.2.1.5.1.4. Consult with the landowner or the landowner's agent when selecting the seed mixture.

630.3.3.5 Seeding Rates

630.3.3.5.1 Right-of-Way

(1) Use the following sowing rate for seeds in pounds per 1000 square feet:

- Seed mixture No. 10 at 1.5 pounds
- Seed mixture No. 20 at 3 pounds
- Seed mixture No. 30 at 2 pounds
- Seed mixture No. 40 at 2 pounds
- Seed mixture No. 60 at an equivalent seeding rate of 1.5 pounds[1]
- Seed mixture No. 70 or 70A at 0.4 pounds
- Seed mixture No. 75 at an equivalent seeding rate of 0.7 pounds[1]
- Seed mixture No. 80 at an equivalent seeding rate of 0.8 pounds[1]
- Temporary seeding at 3 pounds
- Nurse crop seeding at 0.8 pounds

[1] Determine the actual seeding rate by multiplying the equivalent seeding rate by the sum of the unadjusted and adjusted percentages of the various species in the seed mixtures as sown.

(2) The unadjusted percentage equals the minimum percent of purity and germination specified in the table of seed mixtures contained in 630.2.1.5.1.1.1 for the applicable species.

(3) Obtain the adjusted percentage for each of the PLS species by dividing the specified percentage of the species by the product of the percent of purity and the percent of germination for each of the PLS species as delivered.

630.3.3.5.2 Borrow Pits and Material Disposal Areas

(1) For seeding borrow pits and material disposal off the right-of-way, sow the seed mixtures specified in 630.2.1.5.1.4 at the following rates per pound per 1000 square feet:

- Seed mixture No. 10 at 0.75 pound
- Seed mixture No. 20 at 1 pound
- Seed mixture No. 70 or 70A at 0.4 pounds
- Seed mixture No 75 at 0.7 pounds
- Borrow pit mixture at 1.5 pounds

630.3.3.6 Establishment Period for Native Seeding

(1) During the growing season after planting seed mixture 70 or 70A, mow all seeded areas twice as the engineer directs. Mow vegetation back to 6 inches when it has reached a height of at least 12 inches.

(2) During the growing season after planting seed mixture 70 or 70A, eradicate the following species from the seeded areas as soon as they become evident:

SPECIES COMMON NAME	SPECIES BOTANICAL NAME
Musk thistle	Carduus nutans
Spotted knapweed	Centaurea maculosa
Canada thistle	Cirsium arvense
Bull thistle	Cirsium vulgare
Field bindweed	Convolvulus arvensis
Leafy spurge	Euphorbia esula
Sweetclover	Melilotus species
Wild parsnip	Pastinaca sativa

(3) Eradicate by hand pulling or by applying a vegetation control herbicide conforming to 632.2.12 to individual plants.

630.4 Measurement

(1) The department will measure the Seeding bid items by the pound acceptably completed.

(2) The department will measure quantities based on net weights of seed shipments, or on quantities weighed on department-approved scales the contractor furnishes.

(3) The department will make deductions for all quantities wasted or not actually incorporated in the work according to the contract.

(4) The department will determine the equivalent pounds of seed furnished and applied by dividing the actual pounds of seed applied by the sum of the unadjusted and adjusted percentages of the various species in the seed mixture sown.

(5) The department will use the unadjusted and adjusted percentages determined in 630.3.3.5.1.

630.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
630.0100 - 0199	Seeding (mixture)	LB
630.0200	Seeding Temporary	LB
630.0300	Seeding Borrow Pit	LB
630.0400	Seeding Nurse Crop	LB

(2) Payment for the Seeding bid items is full compensation for providing, handling, and storing all seed; for providing the required culture and inoculating seed as specified; and for preparing the seed bed, sowing, covering and firming the seed. If the landowner does not want the pit or material disposal site seeded, or seeded with any of the mixtures allowed, the department will not pay for fertilization or seeding of those areas.

Section 631 Sodding

631.1 Description

(1) This section describes furnishing and laying live sod on the shoulders, slopes, ditches, or at other designated locations, and constructing sod ditch checks or similar structures as the plans show, the contract specifies or as the engineer directs.

631.2 Materials

631.2.1 Sod

(1) The sod shall consist of a dense, well-rooted growth of permanent and desirable grasses, indigenous to the general locality it is to be placed, that is practicably free from weeds or undesirable grasses. When cutting the sod, the grass should be approximately 2 inches long. If longer, cut the grass to approximately this length and rake the sod free of debris.

(2) Cut the sod in uniform commercial size strips.

(3) Make the sod thickness as uniform as possible, approximately 3/4 inch or more, depending on the nature of the sod, so that practicably all of the dense root system is retained, but exposed, in the sod strip and so that handling the sod causes no undue tearing or breaking.

(4) If the sod is in a dry condition such that cutting it causes crumbling or breaking, the contractor shall, at least 12 hours before cutting, apply water to it in sufficient quantities to provide a well-moistened sod throughout the depth it is cut.

(5) Sod provided under the Sod Lawn bid item shall have a lush appearance, be dense, have a uniform texture, and be bright in color throughout. The sod shall not contain blade widths of 1/4 inch or greater. Provide a weed free sod that contains no more than 3/8 inch of thatch over the base soil. The sod shall consist of a blend or mix of at least 4 fine-leafed turf grasses. At least 2/3 of the grasses by weight, as determined by initial seeding proportions, consists of improved/elite type Kentucky bluegrass varieties.

(6) Under the Sod Erosion Control bid item, provide a low maintenance type, dense, and of uniform texture. Provide a sod free of noxious weeds and that contains a combined total of 3 percent or less grassy weeds, sedges, broadleaf weeds, or coarse grasses. The sod shall consist of a blend or mix of at least 4 fine-leafed turf grasses. At least 70 percent of the grasses by weight, as determined by initial seeding proportions, shall consist of acceptable low maintenance varieties or species as listed by the UW Extension. The contractor may obtain this list from the UW Madison, horticulture department, turf grass extension.

(7) The Sod Erosion Control Sandy Soil bid item shall conform to all requirements for Sod Erosion Control and shall be commercially produced on soil having 10 percent or less organic matter by mass.

631.2.2 Water

(1) When watering sodded areas, use clean water, free of impurities or substances that might injure the sod.

631.3 Construction

(1) The contractor shall provide the type of sod the plan designates or the engineer directs consistent with the following criteria:

1. Under the Sod Lawn bid item, use in areas where the property owner provides all necessary maintenance, including mowing, fertilizing, and watering, and where the primary objective is for aesthetics. Do not use in urban or suburban areas where maintenance is limited to mowing by the property owner or municipality.
2. Under the Sod Erosion Control bid item, use on limited areas of a project where a quick stand of vegetation is needed for erosion control purposes, or in urban or suburban areas where the primary objective is aesthetics, but where maintenance is limited to mowing.
3. Under the Sod Erosion Control Sandy Soil bid item, use in the same areas as Sod Erosion Control, but where sandy or gravelly soils predominate.

631.3.1 Preparing the Earth Bed

(1) Before sodding, construct the proposed area to the required cross-section and contour, and round the tops and bottoms of the slopes to a minimum 4-foot radius curve. Ensure that the sodded areas are free from stones, roots, or other undesirable foreign material. Loosen the soil on the sodded area to at least one inch deep and bring it to a reasonably fine granular texture by equipment or hand methods adapted to the purpose.

631.3.2 Placing the Sod

(1) Moisten the earth bed that the sod is being placed on to the loosened depth, if not naturally sufficiently moist. Do not place frozen sod, nor place sod on frozen soil. Place the sod on the bed within

approximately 24 hours after cutting. Lay the sod so that the joints at abutting ends of sod strips are not continuous. Lay each sod strip to abut snugly against the previously laid strip.

(2) Lay sod in strips of commercial size where possible. Do not lay partial-size strips of sod smaller than 18 inches by 24 inches. When laying the sod, roll it or firmly but lightly tamp with suitable wooden or metal tampers to set or press the sod into the underlying soil.

(3) At points where water will flow over a sodded area, turn the upper edges of the sod strips into the soil below the adjacent area and place a layer of earth over this juncture. Compact the earth thoroughly so surface water flows over the upper edge of the sod.

(4) At the limits of sodded areas, if possible, place the end strips to achieve a broken line, and turn the ends of the strips in and treat as described above.

631.3.3 Staking and Cleanup

(1) On all slopes steeper than one unit vertical to 4 units horizontal (1:4), stake the sod, or peg with pieces of plasterers' lath or equivalent stakes, at least 6 inches long, spaced as the soil nature and slope steepness dictate, from 18 to 36 inches apart along the length of the sod strip. If possible, place stakes near the top edge of the sod strip and drive plumb through the sod. After installing, stakes should hold the sod firmly in place and present no danger to pedestrians or mowing crews.

(2) Stake all sod placed in ditches, flumes, or other drainage components, where a concentrated flow of water is expected, regardless of the slope. After completing the surface staking, clear the surface of loose sod, excess soil, or other foreign material.

631.3.4 Fertilizer

(1) If the contract contains the bid item Fertilizer, then fertilize areas receiving sod according to 629.3.1.1 unless otherwise specified.

631.3.5 Watering

(1) Under the Sod Water bid item, furnish and apply water to sodded areas. After staking and cleanup, moisten the sod thoroughly by sprinkling with water. Keep all sodded areas thoroughly moist by watering or sprinkling if rainfall is not sufficient to achieve sod rooting to the earth bed. Water for 30 days after placement or as the engineer directs. Apply water in a manner to preclude washing or erosion.

631.4 Measurement

(1) The department will measure Sod Lawn, Sod Erosion Control, and Sod Erosion Control Sandy Soil by the square yard acceptably completed.

(2) The department will measure Sod Water by volume in gallons acceptably completed. The department will determine volume by engineer-approved meters or from tanks of known capacity.

631.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
631.0300	Sod Water	MGAL
631.1000	Sod Lawn	SY
631.1100	Sod Erosion Control	SY
631.1200	Sod Erosion Control Sandy Soil	SY

(2) Payment for Sod Lawn, Sod Erosion Control, and Sod Erosion Control Sandy Soil is full compensation for preparing the earth bed; and for furnishing, placing, staking, and rolling the sod. Payment also includes watering if the contract does not contain the Sod Water bid item.

(3) Payment for Sod Water is full compensation for providing, hauling, and applying the water.

Section 632 Furnishing and Planting Plant Materials

632.1 Description

(1) This section describes furnishing and planting plants of the species, varieties and sizes specified, and includes furnishing all necessary materials, excavating plant holes, salvaging topsoil, transplanting, backfilling, pruning, mulching, watering, heeling in, fertilizing, wrapping, guying and bracing, protecting against rodents and applying anti-desiccant, disposing of surplus and waste materials, and necessary care and required replacements pending acceptance.

632.2 Materials

632.2.1 General

(1) Unless specified otherwise, or the engineer approves, use materials conforming to the requirements below.

632.2.2 Plant Materials

632.2.2.1 General

(1) Unless specified otherwise, for all plants use nursery grown stock, transplanted or root-trimmed 2 or more times according to the kind and size of plants.

(2) Ensure all plants are typical of their species, have well formed tops and root systems, and are free from injurious insects, plant diseases, or other plant pests. Use plants hardy under the climatic conditions at the work site. Furnish plants free from the following defects:

1. Damage to top, branches, trunk, bark, or roots.
2. Dried out roots.
3. Prematurely opened buds.
4. Thin or poor tops or root systems.
5. Evidence of mold.
6. Dry, loose, or broken ball of earth in B&B stock.
7. Dried out or damaged soil mass in B&P or CG stock.

632.2.2.2 Collected and Plantation Grown Stock

(1) Collected and plantation grown stock shall conform to the current edition of the American Standard for Nursery Stock recommended for general use and adoption by the American Association of Nurserymen, Inc.

(2) The contractor shall furnish collected and plantation grown plant stock only if specified. If the contract allows collected plant stock, the contractor shall notify the engineer of the source of supply or growing site at least 10 days before digging the plants. Dig all collected plants with a root spread, or ball of earth, at least 1/3 greater than that required for nursery-grown plants of the same species, variety, and size.

(3) If collected stock is furnished, leave at least 50 percent of the species undisturbed at the collection site unless the engineer approves otherwise.

632.2.2.3 Lining Out Stock

(1) Lining out stock and seedling trees shall conform to the current edition of the American Standard for Nursery Stock.

632.2.2.4 Substitution

(1) If the contractor submits written documentation that a specified plant is not obtainable it may make substitution, only with the engineer's approval. The engineer may approve the use of larger plants than those specified. The ball or container size or the root spread of the larger size shall be increased proportionally, relative to the specified size.

632.2.2.5 Grading Standards

(1) Plant stock shall conform to the current edition of the American Standard for Nursery Stock.

632.2.2.6 Plant Inspection and Legal Requirements

(1) All plant material shipments and deliveries shall comply with State and Federal laws and regulations including Wisconsin administrative code, chapter ATCP 21 governing the inspection, shipping, selling, and handling of plant stock. Attach a tag or label bearing the name and address of the licensed dealer or nurseryman and a certification that the material is from an officially inspected source to each shipment or delivery of plant material. File it with the engineer upon arrival of the plant material at the project site.

632.2.2.7 Plant Names and Labels

(1) The names and labels used in the plans and specifications conforms, with few exceptions, to the current edition of Standardized Plant Names as adopted by the American Joint Committee on Horticultural Nomenclature.

(2) Ensure all plants are true to name, and secure a legible label to each bundle or plant indicating the name and size of the plant material.

632.2.2.8 Plant Approval

(1) The contractor shall furnish to the engineer a written list of the sources from which the contractor proposes to obtain plant materials. Furnish this list to the engineer within 15 days of the award of the contract. Do not alter this list without the engineer's approval.

(2) The engineer shall approve all plants. The engineer may inspect plants at the grower's nursery or at the place of collection, or at the collector's holding site. The engineer may tag representative plants at the grower's nursery. Although the engineer may approve plants at the source, they may still reject plants at the project site.

(3) Replace all rejected plants with acceptable plants of the same species, variety, and size, unless the engineer directs otherwise.

632.2.2.9 Digging, Handling, and Packing Plant Stock

632.2.2.9.1 General

(1) The contractor shall dig all plant stock and handle with care and skill to prevent injuries to the trunk, branches, and roots, and shall pack in an engineer-approved manner to ensure the plants arrival at the project site undamaged and in good condition.

(2) Transport the plant stock in enclosed vehicles or in a way that protects the plant tops from drying.

(3) Handle all plants furnished with earth balls or in containers by the ball or container.

632.2.2.9.2 Bare Root Stock (BR)

(1) If furnishing plant stock BR protect the roots against drying out during moving by using moist sphagnum moss, straw, or other suitable material, and cover with canvas or other suitable covering in an engineer-approved manner.

632.2.2.9.3 Balled and Burlapped Stock (B&B)

(1) If furnishing plant stock B&B, move the plant with a freshly dug ball of earth so firmly wrapped in burlap that on delivery the soil ball is still firm and compact around the small feeding roots. Ensure each ball is large enough to encompass all the fibrous feeding roots necessary to ensure successful recovery and development of the plant. The minimum sizes of balls, ball depth, and diameters, and increased ball sizes for collected stock shall conform to recommended balling and burlapping specifications, in the current edition of the American Standard for Nursery.

632.2.2.9.4 Balled and Potted Stock (B&P)

(1) If furnishing plant stock B&P, furnish plants dug from the growing site with the roots contained in a compact unbroken ball of earth and placed in a plantable fiber container. The size and shape of the earth ball shall conform to the approximate size and shape of the container. Place the stock in the container so that the plant root collar is approximately one inch below the top of the container. Fill all voids at potting time with native soil. The minimum ball size shall equal the ball size for B&B stock in the current American Standard for Nursery Stock for the plant specified.

632.2.2.9.5 Container Grown Stock (CG)

(1) If furnishing plant stock CG, furnish well-rooted stock established in containers. This means that when the container is removed the root soil mass shall retain its shape but shall not have grown in the container long enough to become container bound. Use sufficiently rigid containers that retain their shape and protect the plant root system during shipping and handling. For container size, conform to the specifications for CG stock as stated in the current edition of the American Standard for Nursery Stock.

632.2.2.9.6 Machine Transplanted Stock (MT)

(1) For plants furnished or transplanted as MT stock, the contractor shall move plants from the growing site to selected sites within the right-of-way using a tree-transplanting machine. Use a machine capable of digging and removing from the ground an unbroken mass of earth of the specified size and shape. It shall also lift and transport the mass of earth supporting the specified size plant and containing its roots in an undisturbed condition. The machine shall hold the soil mass and roots in the

undisturbed condition until the tree is lowered into position in a planting hole pre-dug by the same machine.

632.2.3 Backfill Material

632.2.3.1 Compost

(1) Provide an engineer-approved standard commercial compost of cattle, sheep, or poultry manure or other organic material.

632.2.3.2 Peat Moss

(1) Peat moss shall consist of at least 75 percent of partially decomposed stems and leaves of sphagnum, hypnum, polytrichum, and other mosses in which the fibrous and cellular structure is still recognizable. Provide peat moss that is brown to black in color and nearly free of decomposed colloidal residue, wood, and other foreign matter. The engineer will not accept humus peat. Peat moss shall have the following characteristics:

1. Moisture content shall not exceed 60 percent by weight.
2. Ash content shall not exceed 20 percent, based on the oven dry weight of the material.
3. The pH value shall not exceed 7.0 or be less than 3.2 at 77 F.
4. Water holding capacity shall at least equal 400 percent, by weight, on an oven dry basis.

(2) Upon request, the contractor shall furnish the engineer with a representative sample of peat moss for testing according to the Federal specification Q-P-166e for peat moss, peat humus, and peat reed-sedge.

(3) The contractor shall furnish the engineer with a certificate stating the type of peat moss, the brand name and the country or place of origin. If packed in bales and if using bale size to determine quantities for mixing, the certificate shall also contain the cubic feet of compressed bale size, the compression ratio, and the approximate weight of the bales. The engineer will not require a certificate if this information is marked on the bales.

632.2.3.3 Topsoil

(1) For topsoil, conform to the topsoil specified in 625.2 and to the gradation requirements specified in 625.3.3.

(2) Salvage topsoil from the plant hole excavation if it conforms to the above requirements. The contractor may use the sod from the plant hole excavation for backfill, together with topsoil, provided it is thoroughly broken into small pieces and used in limited quantities near the bottom of the plant hole in a way that does not place it in contact with the small feeder roots.

632.2.3.4 Planting Mixture

(1) The planting mixture consists of a blend of peat moss, topsoil, and sand in a ratio of 1:1:1 by volume. Blend fertilizer into the mixture at the rate of 4 pounds of fertilizer to each cubic yard of mixture.

(2) The peat moss shall conform to 632.2.3.2 and topsoil to 632.2.3.3. and have 100 percent passing a 3/8-inch sieve. Obtain the engineer's approval for the sand.

632.2.4 Fertilizer

(1) Fertilizer shall conform to 629 and to the following:

632.2.4.1 Fertilizer for Planting Mixtures

(1) Unless specified otherwise, use a superphosphate fertilizer conforming to the following minimum requirements:

Nitrogen 0%
Phosphoric Acid 20%
Potash 0%

632.2.4.2 Fertilizer for Plant Holes

(1) For fertilizer used in plant holes, provide water soluble fertilizer contained in a micropore slow release polyethylene packet. Each packet shall contain a minimum of one ounce of fertilizer.

(2) The fertilizer shall conform to the following minimum requirements:

Nitrogen, not less than 16%
Phosphoric Acid, not less than 8%
Potash, not less than 16%

632.2.4.3 Fertilizer for Wood Chip Mulch

(1) If using fertilizer on areas receiving wood chip mulch, use a slow release ureaform fertilizer having at least 38 percent nitrogen.

632.2.5 Water

(1) Provide water that is free from impurities or substances that might injure the plant.

632.2.6 Mulch

(1) Mulch, if specified, consists of shredded bark, wood chips, peat moss, or other suitable material, that is substantially free of noxious weed seeds and objectionable foreign material. Wood chips are the type obtained from any standard wood or brush-chipping machine. Obtain the engineer's approval for the type of mulch used.

632.2.7 Wrapping

(1) Wrapping, if specified, consists of a 2-ply waterproofed crepe tree wrapping paper, laminated with a layer of pliable asphaltic material.

632.2.8 Wound Dressing

(1) Wound dressing, if required, consists of asphalt base tree paint or other acceptable material suitable for applying by brushing, or spraying on bruised or cut surfaces of plants.

632.2.9 Rodent Protection

(1) Rodent protection consists of aluminum or other metal commercial window screening material.

632.2.10 Bracing and Guying Materials

(1) If specified, these materials consist of the wood or steel stakes, wire, soft rope or straps, turnbuckles, and other material needed to perform the work. Provide stakes of solid durable wood approximately 2 inches by 2 inches and of the required length, except that the contractor may use engineer-approved steel posts of the required length for bracing stakes.

(2) For trees of 4 inches or less in diameter use a good quality 11 or 12 gauge diameter steel wire and 9 or 10 gauge diameter steel wire for trees over 4 inches in diameter. Use a suitable turnbuckle for adjusting the wire tension with the larger wire.

632.2.11 Anti-Desiccant

(1) Anti-desiccant, if specified, shall consist of an engineer-approved emulsion that provides a film over plant surfaces permeable enough to allow transpiration.

632.2.12 Vegetation Control Herbicide

(1) Vegetation control herbicide, if specified, consists of a post-emergence herbicide that, if applied to leaves and stems of vegetation, is absorbed and translocated to all parts of the plant including roots and underground stems and is by this means capable of killing the entire plant. Provide a water-soluble herbicide that deactivates on contact with soil, and leaves no harmful residue.

632.2.13 Selective Pre-emergence Herbicide

(1) The selective pre-emergence herbicide, if specified, shall control plants emerging from seed, but have no harmful effect on established plants if applied at recommended rates. The material shall resist leaching and remain effective throughout one growing season. Provide the selective pre-emergence herbicide in liquid or wettable powder form.

632.2.14 Weed Barrier Fabric

(1) Furnish geotextile for weed barrier conforming to the following:

TEST	METHOD	VALUE
Minimum weight	ASTM D3776	0.328 oz/ft^2
Minimum grab tensile strength	ASTM D4632	80 lb
Minimum apparent breaking elongation	ASTM D4632	45%
Minimum puncture strength	ASTM D4833	35 lb
Minimum trapezoid tear strength	ASTM D4533	27 lb
Maximum apparent opening size	ASTM D4751	No. 40 sieve
Minimum permittivity,s^{-1}	ASTM D4491	1.97

(2) The geotextile, if specified, consists of a material that allows moisture and air permeability, but prevents the growth of weeds and grasses. The fabric shall consist of non-woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. All shall have the minimum strength values in the weakest principal direction.

(3) The contractor shall not use a needle punched non-woven geotextile.

632.2.15 Equipment

(1) The contractor shall provide sufficient watering equipment, including tanks, pumps, hoses, and accessories to fully perform all the watering required for care in 632.3.19. The contractor shall determine the capacity and adequacy of this equipment based on supplying approximately 20 gallons of water per large tree, 10 gallons per small tree, 5 gallons per shrub, and 2 1/2 gallons per vine or sumac plant for each required watering. Provide a source of water capable of supplying the required volume of water.

632.3 Construction

632.3.1 General

(1) The normal spring planting season for all plants shall extend to June 1. The normal fall planting season for all plants except evergreens begins on October 1. Perform fall evergreen planting between September 1 and October 1. Unless approved otherwise, the contractor shall not plant if the ground is frozen or if the soil is unsatisfactory for planting. The contractor shall not plant if the temperature is below freezing unless protecting the plant roots to prevent damage.

(2) Do not drag, lift, or pull balled and burlapped plants by the trunk, branches, or foliage. Do not drop or handle in any manner that damages the ball or the plant.

632.3.2 Delivery and Temporary Storage

(1) At least 3 days before each delivery of plant material to the holding or project site, the contractor shall notify the engineer of this delivery.

(2) If possible, plant the plants on the day of delivery at the project site. If this is not possible, temporarily store the plant stock by heeling-in or by placing in a well-ventilated, cool, moist storage place and adequately protect against drying by using moist sphagnum moss, straw, or other suitable covering around the roots of BR stock and the balls of B&B stock.

(3) Space all plants growing in pots or containers to provide for air circulation and reasonably unrestricted top spread. Water and otherwise care for potted and container-grown plants as necessary to keep them in a healthy growing condition while in storage.

(4) If heeling-in, place bare root plants in a spade depth trench, fully cover their roots with damp topsoil, and protect from the sun and wind. The contractor shall properly care for all heeled-in plants. Plants shall not remain heeled-in from one planting season until the next.

632.3.3 Layout of Planting

(1) Unless specified otherwise, the engineer will stake out the location of plant holes or beds.

632.3.4 Excavation of Plant Holes

(1) Center the plant holes at the location stake, unless the engineer allows otherwise.

(2) Excavate the plant hole, except for MT stock, to at least the minimum dimensions the plant data chart included in the plans show or as the engineer directs. However, the minimum diameter of the plant hole must be at least twenty-four inches greater than the diameter of the ball, container, or roots, for the full depth of the plant hole. The depth of hole shall equal the height of the ball, pot, or container, so that the plant root collar is at ground level when the plant is in its final position and resting on undisturbed ground. Except, if placing the plant in heavy soils, then make the hole deep enough so that the plant root collar is 2 inches above the ground level after planting.

(3) Unless soil conditions make it impossible, dig the planting holes for MT plants by the tree-moving machine and make them approximately the same size and shape as the soil mass containing the root system of the machine moved plant.

(4) Keep the sod and topsoil suitable for backfilling separate from the excavated subsoil.

(5) If planting on a slope, measure the minimum depth of the plant hole from the downward side of the slope at the hole.

(6) If it is necessary to suspend planting operations until the following planting season, backfill any open plant holes before suspending the work.

632.3.5 Pruning

(1) Perform pruning according to ANSI A300 standard practices for tree care operations-tree, shrub, and other woody plant maintenance. Prune so that the plant retains its natural form. Make all cuts immediately above the bark ridge and branch collar to leave the ridge and collar intact for healing. The contractor shall not prune evergreen plants except to remove dead or broken branches, or multiple leaders. Treat cut surfaces on oak trees as specified for cut surfaces and abrasions in 201.3.

(2) Cut off smoothly the bruised or broken parts of large or fleshy roots and branches dead, broken, or damaged otherwise, before planting. Perform all other pruning near the end of the plant establishment period in mid-to-late August, but before the final inspection. Unless specified otherwise, or the engineer directs, prune deciduous trees by removing branches that compete with the dominant central leader, and thin all deciduous plants as necessary to improve the branch structure of the plant.

632.3.6 Anti-Desiccant

(1) If specified, apply anti-desiccant to evergreen plants before or at the time of planting, and to BRP plants before shipping from the storage place. Apply it to plants being transplanted before they are transplanted. Apply the emulsion at the rate and method the manufacturer recommends.

632.3.7 Planting

(1) Plant all BR, B&B, BRP, B&P, CG, and MT plants, unless directed otherwise, according to the method specified below. If possible, protect BR plants against drying by keeping the roots covered with a canvas or other suitable covering until planted.

(2) Place the plant in the plant hole with its most desirable face towards the most prominent view and hold it in a vertical position. Spread the roots of BR plants to their approximate natural position and prune as required. Place B&B plants while in their wrapped ball. Move and handle only by the ball. Set the plant so that, after settling, the plant root collar is at or 2 inches above the surrounding ground level, as specified above in 632.3.4.

(3) Unless specified otherwise, backfill the plant hole with topsoil composed of 6 parts soil to one part compost by volume. Place this soil compost mixture in layers around the roots or ball. Carefully tamp each layer in place in a way that avoids injuring the roots or ball or disturbing the plant position. Remove the burlap and other wrapping materials from the top one-half of B&B plants. Once approximately 2/3 of the plant hole is backfilled, fill the hole with water and allow the soil to settle around the roots. After the water is absorbed, fill the plant hole with topsoil and tamp lightly to grade. Bring any settlement to grade with the topsoil.

(4) Fill holes made for MT plants to about 1/2 the hole depth with slurry made from a 1:1 mixture of water and compost by volume. Place the slurry in the hole just before placing the tree in the hole. After removing the machine, backfill any voids remaining with topsoil. To facilitate watering, auger vertical holes around the periphery of the tree just inside the ball limits. Space the holes equally a maximum of 4 feet apart. Make each hole deep enough and large enough to accept a perforated pipe 42 inches long with a 2 inch inside diameter. Insert the perforated pipes into the holes immediately after augering. Make the top of the pipe flush with the top of the mulch once in its final position. Leave the pipes in place after the tree is established.

(5) After the plantings are in place at least 2 days, but not more than 5, inspect the plantings. Adjust plant depth and plumb as necessary, and place all additional required backfill. During the inspection period, thoroughly water all inspected plants and remove all twine or rope and labels attached to trunks or branches.

632.3.8 Fertilizing

(1) Use fertilizer, if specified, as follows:

632.3.8.1 Fertilizer for Planting Mixtures

(1) Add fertilizer to the planting mixtures in a way that uniformly incorporates it at the rate of 4 pounds of fertilizer per cubic yard of mixture.

632.3.8.2 Fertilizer for Plant Holes

(1) Uniformly space the number of packets specified on the plans in each plant hole around the outside of the plant hole during backfilling. Place the packets as the planting detail sheet shows after partially completing the backfilling. Place them at least 6 inches below the final grade of the backfill material.

(2) If specified for MT plants, equally space the packets around the hole in niches dug into the plant hole wall between 9 and 18 inches below the soil surface.

632.3.8.3 Fertilizer for Wood Chip Mulch

(1) If specified, uniformly spread fertilizer for wood chip mulch over the mulch, or soil surfaces to be mulched, at the rate of 4 pounds per 1000 square feet.

632.3.9 Mulching

(1) Place approximately 3 inches of mulch, if specified, over the backfilled plant hole or plant bed within the specified area after performing all necessary backfilling and adjustment, unless specified otherwise. Pull mulch back 3 to 6 inches from tree trunk. Place mulching material within 5 days of the

second watering required for planting under 632.3.7. Ensure areas receiving mulch are free of living weeds and grasses before applying mulch.

632.3.10 Vegetation Control Herbicide

(1) If specified, apply vegetation control herbicide according to manufacturer's instructions to unwanted weeds and grasses and in plant bed areas as the plans designate. Allow a minimum of 10 days between the application and seeding or digging. The engineer may require mowing the areas before treating, or may vary the above requirements to obtain the best results if in the engineer's judgment temperature, rainfall, and other conditions warrant this action. The contractor may use the herbicide to control or destroy weeds and grasses in other mulched areas at the contractor's discretion with the engineer's approval.

632.3.11 Selective Pre-Emergence Herbicide

(1) Apply selective pre-emergence herbicide, if specified, according to manufacturer's instructions for surface application to plant bed areas the plans show just before applying the mulch.

632.3.12 Wrapping

(1) If wrapping is specified, wrap the tree trunks with wrapping material overlapping 1 1/2 inches, wound from the ground line to the lowest main branches. Secure the wrapping in at least 3 places, including the top, middle, and bottom, with a biodegradable tie or tape. Wrapping plants as soon as practicable after planting.

632.3.13 Rodent Protection

(1) If required, apply the materials specified in 632.2.8 for rodent protection to the plants. Place rodent protection material around each tree trunk, with the bottom of the material resting on the soil surface, and the top a minimum of 4 feet above the surrounding earth surface, or up to the lowest branches on small trees. Wrap the rodent protection loosely around the tree trunk and staple to itself with 3 rows of staples. Space the staples within each row at maximum 6 inch intervals along the seam.

632.3.14 Bracing

(1) If specified, brace trees with a stake driven into the ground near the base of the tree to a depth of 2 or 3 feet, or until sufficiently solid to support the tree. Stakes shall extend upward to about 6 inches below the lowest main branches. Fasten the tree to the stake using a soft rope or strap in a way that avoids injuring the tree. Allow 1 to 3 inches of movement by the trunk.

632.3.15 Guying

(1) If specified, guy the trees with 3 wires whose upper ends are attached to soft ropes or straps that encircle the tree trunk, just above the lowest main branches of deciduous trees and at a point above the ground line of 2/3 the height of evergreen trees. Anchor the lower ends to stakes set in the ground around the tree, equal distance apart and at a distance from the tree of approximately 3/4 the distance from the ground to the upper point of fastening. Notch the anchor stakes to prevent the wire from slipping and drive them into the ground, at a slight angle away from the tree, to a depth of 18 inches or more until solid. Stakes shall extend 3 inches above the ground.

(2) Draw the wires taut to equal tension by twisting or using turnbuckles, and fasten securely, with the trunk of the tree remaining in a vertical position. Allow 1 to 3 inches of movement by the trunk.

632.3.16 Disposal of Excess and Waste Material

(1) Remove and dispose of all excess excavation, waste materials, or other debris.

632.3.17 Weed Barrier Fabric

(1) Place geotextile on areas the plans show or the engineer designates before placing the mulch. Lay the fabric flat on the smoothed soil and fit as close to the plants as possible. Provide a 4-inch overlap at adjoining sheets. On all slopes, secure the fabric with T-shaped steel pin anchors sufficiently long to prevent the fabric from moving.

632.3.18 Establishing and Replacing Plants

632.3.18.1 Plant Establishment Period

632.3.18.1.1 General

(1) A plant establishment period of 2 years shall follow the completion of planting, unless the special provisions specify a one-year period.

632.3.18.1.2 Two Growing Season Plant Establishment Period

(1) The plant establishment period shall extend until October 15 of the second full growing season.

632.3.18.1.3 One Growing Season Plant Establishment Period

(1) The plant establishment period for material planted in the spring shall extend until October 15 of the same year. If planting in the fall, extend this period until October 15 of the succeeding year.

632.3.19 Landscape Planting Surveillance and Care

632.3.19.1 General

(1) Properly care for all plants from the time of planting until final acceptance of the work.

(2) Proper care of plants consists of watering, weeding, cultivating, pruning, spraying, tightening braces and guys, retying wrapping, re-mulching, and other work necessary to keep the plants in a neat appearance and healthy growing condition. Between May 15 and October 15, in addition to watering required for planting under 632.3.7, water completely at a 10-day to 14-day interval defined as a care cycle. Care cycle length can be extended beyond 14 days if weather and soil moisture conditions allow. The engineer may order additional watering at any time during the plant establishment period if conditions require.

(3) Water each plant hole sufficiently at each watering to keep the topsoil backfill material in a moist condition and to keep the plant in a healthy growing condition.

(4) Remove and dispose of all evergreens and deciduous trees that die during the course of the plant establishment period as their dead condition becomes evident.

(5) Keep all mulched areas free of all vegetation, except the specified plants, by hoeing, hand weeding, or by using herbicides if the engineer approves.

(6) String all vines to fences and direct runners toward retaining walls or structures during the plant establishment period.

(7) Apply pesticides as required to control insects and diseases and to keep the plants in a healthy condition.

(8) Replace all plants that die or show evidence of dying during the plant establishment period at the earliest appropriate planting time after this condition becomes apparent. The engineer will allow replacements until June 1 of the year in which making the final inspection.

(9) Remove and dispose of all bracing and guying materials after the final inspection of the plantings.

(10) Provide one person, called the care specialist, responsible for inspecting and performing the required care. Also provide other personnel, vehicles, equipment, tools, and materials needed to accomplish the inspection and care. Have the care specialist do the following:

1. Perform care requirements to the satisfaction of the engineer a minimum of once every two weeks.
2. Notify the engineer at least two days before the beginning of each care cycle.
3. Submit a written report to the engineer after each care cycle. Ensure that the report documents the work performed during the care cycle; the number, type, and location of each plant that was removed or marginal; and other information the engineer or the specialist deems appropriate.

632.3.19.2 Damages for Failing to Perform

(1) If the care specialist fails to perform any of the required care cycles as specified 632.3.19.1, the department will assess daily damages in an amount the special provisions specify to cover the cost of performing the work with other forces. The department will assess these damages for each day the requirements of the care cycle remain incomplete, except when the engineer extends the required time period.

632.3.20 Acceptance or Replacement of Plant Material

(1) Near the end of the applicable plant establishment period, but not later than September 15, the engineer will make final inspection of the planting and approve only those plants in a healthy growing condition and conforming to the following minimum requirements:

- Plant sizes and standards shall adhere to the American Standards for Nursery Stock.
- All plants are the species specified unless the engineer approves changes. Conform to 632.3.19, for proper care of plants.
- Deciduous trees shall exceed the minimum size of the specified size range and shall have fully matured, average-sized, healthy leaves distributed throughout the branch system as is typical of the species.
- Deciduous shrubs shall exceed the requirements of the specified size range and have mature, average-sized leaves typically distributed throughout the branch system.
- Deciduous vines shall have the required number of runners, each exceeding the minimum required length.
- Evergreens shall exceed the minimum size of the specified size range and all coniferous types shall have fully developed, mature needles, and average-sized buds on current season's growth.

(2) Remove and replace plants not conforming to the above requirements with satisfactory plants during the current fall planting season or, the engineer may allow them to remain in place. Use the same materials and method of replacement planting specified for the original planting.

(3) Replacing plant materials shall not extend the plant establishment period.

632.3.21 Contract Time

(1) The department will not charge contract time during the plant establishment period or when making replacements, unless other contract operations are in progress during the same period.

632.4 Measurement

(1) The department will measure the Trees, Shrubs, and Vines bid items by the number of plants of each species, variety, and size acceptably completed.

(2) The department will measure Landscape Planting Surveillance and Care Cycles as each individual care cycle acceptably completed.

632.5 Payment

632.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
632.0101	Trees (species, root, size)	EACH
632.0201	Shrubs (species, root, size)	EACH
632.0301	Vines (species, root, size)	EACH
632.9101	Landscape Planting Surveillance and Care Cycles	EACH

(2) Payment for the Trees, Shrubs, and Vines bid items is full compensation for providing, transporting, handling, storing, pruning, placing, and replacing plant materials; for excavating all plant holes, salvaging topsoil, mixing, and backfilling; for providing and applying all required fertilizer, weed barrier fabric, mulch, water, wrapping, guys and braces, rodent protection, herbicides and anti-desiccant spray; for removing guys and braces; and for disposing of all excess and waste materials. Payment for the Topsoil bid item used in planting will be as specified in 625. The department will pay for substituting larger plants, if allowed under 632.2.2.4, at the contract price for the specified size.

(3) Payment for Landscape Planting Surveillance and Care Cycles is full compensation for all the work required under this bid item. The department will assess damages under the Failing to Perform Landscape Surveillance administrative item for failing to perform the required surveillance and care as specified in 632.3.19.2.

632.5.2 Payment Schedule

(1) The department will pay the contract value of the work to the contractor according to the following schedule:

1. Each time an item or portion of an item is acceptably completed, except for care as specified in 632.3.19, the department will pay 65 percent of the contract value of the work for contracts containing a 2 growing season plant establishment period; and the department will pay for 80 percent of the contract value of the work for contracts containing a one growing season plant establishment period.
2. For contracts with a 2 growing season establishment period, each time an item or portion of an item acceptably completes one growing season, including care, and is satisfactory otherwise, the department will pay an additional 15 percent of the contract value of the work. If an item or portion of an item completes the second growing season, including care, and is satisfactory otherwise, the department will pay the final 20 percent of the contract value of this work.
3. For contracts with a one growing season establishment period, each time an item or portion of an item completes the growing season, including care, and is satisfactory otherwise, the department will pay the final 20 percent of the contract value of this work.

(2) The department will make final payments upon final acceptance and completion of all work required under the contract.

632.5.3 Reduced Payment

(1) The department will pay for plants that do not conform to 632.3.20 but that the engineer allows to remain in place, at 65 percent of the contract unit price for contracts containing a 2 growing season plant establishment period, and at 80 percent of the contract unit price for contracts containing a one growing season plant establishment period.

Section 633 Delineators and Markers

633.1 Description

(1) This section describes providing roadway delineators and markers including culvert makers and right-of-way markers.

633.2 Materials

633.2.1 Steel Posts

(1) Furnish a flanged channel section post weighing 1.12 pounds per linear foot or more before zinc coating, and made of steel with the following properties:

Minimum tensile strength	50 ksi
Minimum tensile yield strength	36 ksi
Minimum elongation	5.0 percent in 2 inches

(2) Furnish posts the length, and with mounting holes the size and spacing the plans show. Ensure the posts are symmetrical, well rolled, and free from defects that impair their strength or appearance.

(3) Hot-dip zinc coat the posts after completing forming, cutting, and punching or drilling. Perform zinc coating according to ASTM A123.

633.2.2 Flexible Delineators and Markers

(1) Furnish flexible delineators or markers from the department's APL for the application the bid item indicates. If the contract requires reflective sheeting, furnish posts with shop-applied reboundable type H reflective sheeting from the department's APL and of the size plan details show.

633.2.3 Hardware

(1) Furnish galvanized steel soil anchors, nuts, bolts, washers, and other metal parts unless the contract specifies otherwise.

633.2.4 Delineator Brackets

(1) Furnish aluminum for surface-mounted delineators conforming to ASTM B221, alloy 6061-T6 with type SH reflective sheeting from the department's APL. Furnish stainless steel stud bolts, self-locking nuts, and washers conforming to 513.2.1.

633.2.5 Delineator Reflectors

(1) Fabricate reflectors as the plans show using sheet aluminum conforming to 637.2.1.3 covered with type SH reflective sheeting from the department's APL.

633.2.6 Right-of-Way Marker Plaques

(1) Use department-furnished R/W marker plaques and survey marker informative plaques.

633.3 Construction

633.3.1 General

(1) Erect posts to a true vertical position and at the locations the plans show.

(2) Install flexible delineators and markers conforming to manufacturer's recommendations for the application the bid item indicates unless the plans show otherwise. Ensure that the curved side of single curvature posts has the required marking and faces traffic.

(3) Install steel posts by driving using equipment that does not damage the post. Replace posts bent or otherwise damaged by contractor operations.

633.3.2 Delineators

(1) Install steel delineator posts to support delineator reflectors. Use aluminum delineator brackets on concrete barriers or other structures. Set posts and brackets in the locations and at the offsets the plans show or the engineer directs.

(2) Attach each reflector securely to the supporting steel post.

633.3.3 Temporary Delineators

(1) Provide temporary delineators conforming to the requirements for permanent installations except, if the engineer approves, the contractor may furnish serviceable used posts. Maintain during construction by replacing damaged materials. Remove and dispose of temporary delineators when no longer needed.

(2) Upon contract completion, temporary delineator components become the contractor's property.

633.3.4 Right-of-Way Markers

(1) Provide right-of-way markers at the locations the plans show. Drive steel posts to the minimum depth the plans show, or to the depth required to provide adequate support, whichever is greater. If encountering rock above the minimum embedment depth, install as the plans show unless the engineer allows otherwise.

(2) The contractor may splice posts above grade. Provide the overlap the plans show or more.

(3) Attach R/W and survey marker informative plaques to the posts oriented as the plans show.

633.3.5 Culvert End Markers

(1) Provide flexible culvert end markers at the locations the plans show. Use white posts and apply black non-reflective sign tape to both sides of the top nine inches.

(2) Install posts in front of the object being marked as referenced from the direction of travel by the approaching highway traffic. Use only one marker where two or more apron endwalls are adjacent to each other.

633.3.6 Crossover Markers

(1) Install bases and flexible tubular marker posts to the pavement as the plans show. Use white posts with white reboundable sheeting. Attach posts to bases using a locking pin or other engineer-approved system.

Add 633.3.7 to specify construction requirements for median markers.

633.3.7 Median Markers

(1) Install bases and flexible tubular marker posts to the pavement as the plans show. Use white posts with yellow reboundable sheeting. Attach posts to bases using a locking pin or other engineer-approved system.

633.3.8 Salvaging Material

(1) Remove the delineator or marker the salvaged bid item indicates from the locations the contract designates. Take care to minimize damage to reusable materials. Restore the site, and dispose of unusable and surplus materials.

(2) Sort by delineator or marker type and load reusable materials onto separate pallets. The contractor may place hardware and smaller parts in clearly labeled crates or plastic buckets. Stockpile reusable components in engineer-approved locations on the project.

(3) The contractor may use salvaged materials for temporary installations under the contract.

633.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed except as follows:

- The department will measure the Salvaged bid items as each individual installation including the post and associated reflector, brackets, sheeting, marking, or plaque.
- The department will measure Markers Crossover as each installation including the post and base.

633.5 Payment

Revise 633.5 to add a new bid item for median markers.

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
633.0100	Delineator Posts Steel	EACH
633.0200	Delineators Flexible	EACH
633.0500	Delineator Reflectors	EACH
633.1000	Delineator Brackets	EACH
633.1100	Delineators Temporary	EACH
633.5100	Markers ROW	EACH
633.5200	Markers Culvert End	EACH
633.5300	Markers Crossover	EACH
633.5400	Markers Median	EACH
633.9000 - 9100	Salvaged (type)	EACH

(2) Payment for Delineator Posts Steel and Delineators Flexible is full compensation for providing and erecting the posts; and for removing and disposing of surplus materials, contractor-damaged posts,

and debris. Reflectors for use on steel delineator posts are paid for separately under the Delineator Reflectors bid item while reflective sheeting for flexible delineators is incidental to the Delineators Flexible bid item.

(3) Payment for Delineator Reflectors is full compensation for providing reflectors, including bolts, nuts, washers, screw-nails, or other connectors required for installation.

(4) Payment for Delineator Brackets is full compensation for providing surface-mounted delineators, including anchors, bolts, and gaskets.

(5) Payment for Delineators Temporary is full compensation for providing, maintaining, and removing delineators. The department will not pay for replacing temporary delineators damaged during construction.

(6) Payment for Markers ROW is full compensation for providing markers; for excavation including rock, grout, and backfill; and for splicing.

(7) Payment for Markers Culvert End is full compensation for providing the marker including non-reflective tape and soil anchor.

(8) Payment for the Markers Crossover and Markers Median bid items is full compensation for providing the marker pole and base.

(9) Payment for the salvaged bid items is full compensation for removing and stockpiling reusable delineators or markers; for restoring the site; and for disposing of damaged and surplus material.

Section 634 Wood and Tubular Steel Sign Posts

634.1 Description

(1) This section describes furnishing and erecting wood and tubular steel posts to support signs.

634.2 Materials

634.2.1 Wood

(1) Furnish posts conforming to 507.2.2 for lumber and timber, of the dimensions the plans show, and having 4 sides surfaced (S4S). Use either beam and stringer grade or structural joist and plank grade material with a minimum stress grade rating of 1200 fb at 19 percent maximum moisture.

(2) Select posts from one of the softwood species listed in 614.2.5 for wood posts and offset blocks.

(3) Pressure treat posts conforming to 507.2.2.6 using chromated copper arsenate solution.

634.2.2 (Vacant)

634.2.3 (Vacant)

634.2.4 (Vacant)

634.2.5 Tubular Steel

634.2.5.1 General

(1) Furnish tubular steel sign post assemblies consisting of 3 telescoping square steel tubes as follows:

1. Breakaway upper tube for mounting the sign.
2. Inside anchor tube.
3. Outside anchor tube.

(2) Fabricate the tubular components using structural quality 12-gauge strip steel conforming to ASTM A1011, grade 50 with an average minimum yield strength, after cold-forming, of 55,000 psi. Punch holes on all 4 sides for the full length as the plans show. Provide corner radii of approximately 5/32 inches and conform to other dimensions and tolerances as follows:

TABLE 634-1 TUBULAR POST DIMENSIONS AND TOLERANCES[1]

COMPONENT	OUTSIDE DIMENSIONS inches	OUTSIDE DIMENSION TOLERANCE inches	ALLOWABLE TWIST[2] inches/3 feet
UPPER TUBE	2.00 x 2.00	+/-0.008	+/-0.062
INSIDE ANCHOR TUBE	2.25 x 2.25	+/-0.010	+/-0.062
OUTSIDE ANCHOR TUBE	2.50 x 2.50	+/-0.010	+/-0.075

[1] Measure at least 2 inches from the ends of the tubes.

[2] Hold one side on a flat surface plate and measure the twist at the corner 3 feet away.

(3) Hot-dip galvanize each tube according to ASTM A653 grade 90. Treat corner welds and cut ends with cold-galvanized organic zinc paint as manufacturer recommends.

(4) The engineer will inspect sign post assemblies before installation. Ensure that the assemblies fit together without damaging the coatings. Replace scratched or otherwise damaged components at no expense to the department.

634.2.5.2 Upper Tube

(1) Furnish upper tubes fabricated to the lengths the plans show. If the plans show colored stock clean and phosphate before painting with an acrylic paint using an electrodeposition process followed by baking.

634.2.5.3 Anchor System

(1) Assemble the anchor system, consisting of the inner and outer anchor tubes, as the plans show with a 3-inch, grade 5 zinc plated bolt and nut. Ensure the holes of the 2 tubes match. For installations in poured concrete use an 18-inch inner tube and an 18-inch outer tube with no soil stabilization fins. For other installations use a 36-inch inner tube and an 18-inch outer tube with soil stabilization fins.

634.3 Construction

(1) Obtain the engineer's approval and locate underground facilities before installing sign posts. Do not install sign posts until the finished grade is established.

(2) Set and laterally position posts for supporting roadside signs as specified in 637.3.3.2. Erect posts in a true vertical position. Orient sign posts as the plan details show to ensure that posts will yield or break on impact as designed. For installations in concrete or asphalt, use box-outs as the plan details show.

(3) Excavate holes for wood posts to the depths and at the locations the plans show or the engineer directs. Backfill with excavated material placed and compacted in 6-inch layers. Do not paint wood posts.

(4) Cut upper tubes of steel posts to provide the sign height the plans show or the engineer directs. Treat cut steel post surfaces after installation with cold-galvanized organic zinc paint according to the paint manufacturer's instructions.

(5) Attach the required sign panels as the plans show or as the engineer directs.

(6) Remove and dispose of excess excavation, surplus material, and debris resulting from the installation.

634.4 Measurement

(1) The department will measure the Posts Wood bid items as each individual post acceptably completed.

(2) The department will measure the Posts Tubular Steel bid items as each individual post assembly, including each section and anchor, acceptably completed.

634.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
634.0400 - 0699	Posts Wood (size) (length)	EACH
634.0800 - 0899	Posts Tubular Steel (size) (length)	EACH

(2) Payment for the Posts Wood bid items is full compensation for providing, hauling, and placing the posts; for excavating and backfilling post holes; and for removing and disposing of surplus material.

(3) Payment for the Posts Tubular Steel bid items is full compensation for providing, hauling, and placing the posts; treating cut post ends; and providing hardware and anchors. The department will not pay for replacing damaged posts or upper tube cut-offs.

Section 635 Structural Steel Sign Supports

635.1 Description

(1) This section describes providing breakaway steel sign supports and replacing base connection bolts.

635.2 Materials

(1) Furnish ASTM A709, grade 50 for steel sign supports. Hot-dip zinc coat the sign support posts and stubs according to ASTM A123 after completing cutting, drilling, punching, and welding. Furnish mill inspection and testing certifications for posts and stubs conforming to 506.3.21.

(2) Furnish supplier-certified ASTM F3125 A325, type 1 steel bolts, ASTM A563 nuts, and ASTM F436 washers all hot-dip galvanized according to ASTM A153 supplemented by ASTM F2329.

635.3 Construction

635.3.1 Structural Steel Sign Supports

(1) Locate and erect the supports as specified for placement and orientation in 637.3.3.2. Construct concrete footings conforming to 636.

(2) Lubricate base connection bolts and nuts with a wax-based lubricant. Follow the tightening procedure the plan details specify. Use a calibrated torque wrench to establish the final required torque.

(3) Protect materials from damage to the zinc coating during transportation, storage, and erection. Paint cuts and other areas of damaged zinc coating with 2 coats of zinc dust/zinc oxide paint. Clean damaged and adjacent areas by sanding, scraping, chipping, or wire brushing before painting.

(4) Perform shop welding for structural steel sign supports as the plans show and conforming to AWS D 1.1, Structural Welding Code - Steel. Do not weld in the field without the engineer's written approval. The engineer will only allow field welding for repairs in noncritical locations and when a department-approved individual competent to perform inspections is present during the welding. Perform field welding using personnel qualified under AWS D 1.5, Bridge Welding Code.

635.3.2 Replacing Base Connection Bolts

(1) Install new bolts at locations the contract specifies conforming to torque requirements in the plan details. Repair or replace existing posts, base plates, and stiffener plates damaged during bolt replacement.

635.4 Measurement

(1) The department will measure Sign Supports Structural Steel HS by the pound acceptably completed, measured using the pay weights the plan details show.

(2) The department will measure Sign Supports Replacing Base Connection Bolts as each individual sign location acceptably completed.

635.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
635.0200	Sign Supports Structural Steel HS	LB
635.0300	Sign Supports Replacing Base Connection Bolts	EACH

(2) Payment for Sign Supports Structural Steel HS is full compensation for providing sign supports including base connection bolts, nuts, and washers. The department will pay separately for concrete footings under 636.5 and for signs under 637.5.

(3) Payment for Sign Supports Replacing Base Connection Bolts is full compensation for providing new bolts for each contract designated sign; and for repairing damage done during bolt replacement.

Section 636 Concrete Sign Supports

636.1 Description

(1) This section describes constructing drilled shaft concrete footings for structural steel sign supports constructed under 635 and for sign bridges and overhead sign supports constructed under 641.

636.2 Materials

(1) Use materials conforming to the following requirements:

Concrete 501

Steel reinforcement 505

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class II ancillary concrete as specified in 716.

636.3 Construction

636.3.1 General

(1) Construct drilled shaft footings and associated wings as specified for footings in 502.3. Cure exposed portions of concrete footings as specified in 502.3.8.1. Wait until the concrete has attained 3500 psi compressive strength or 7 equivalent days as specified in 502.3.10 before erecting any portion of the structure on the footing.

(2) The contractor shall locate the footing so that after properly erecting the sign support or sign bridge and after installing the sign or signs they are at the position, elevation, and orientation the plans, and specifications specify, or as the engineer directs.

(3) If the contract requires, install a 5/8-inch by 10-foot copper clad ground rod at the sign support. Install the rod next to the support or as the engineer directs.

636.3.2 Excavation

(1) Before beginning any excavation, locate existing underground cable, utility, or drainage structures in the vicinity and conduct operations to avoid damaging them.

(2) Excavate the footing to the required depth and diameter with minimal disturbance to adjacent soil.

636.3.3 Placing Concrete

(1) Place the concrete for the footing in the excavation, against the soil without forming, except as specified otherwise below.

(2) Place concrete to the initial height the plans show. Form the portion of the sign bridge footing that extends above the ground.

(3) If steel reinforcement is required, secure it in place before placing the concrete.

(4) Set and secure the anchor rod assemblies and post stubs at their proper location until the concrete hardens. Protect anchor rod threads above the top of the foundation level from concrete splash.

(5) Construct drilled shafts to extend above the finished ground elevation according to plan details. Do not place construction joints without the engineer's written approval. Line the upper 18 inches with a disposable casing to ensure a uniform diameter. Remove the disposable casing before backfilling. For the upper surface, provide a level plane finished true to grade.

(6) If the engineer determines the possibility of cave-ins, or soil displacement from the walls exists, or if necessary to shut off seepage water, then line the remaining depth of the footing shaft with a suitable casing. Ensure casings are of ample strength to withstand handling stresses, concrete pressure, and the pressure of surrounding soil materials. If removing the casings, withdraw them while placing the footing concrete or immediately following concrete operations. If removing the casing during the concrete operation, place at least 2 feet of concrete before starting to pull the casing, and maintain a head of concrete of from one to 2 feet during the pulling operation. Take care when pulling the casing to prevent moving the stub posts or anchor rod assembly, reinforcement steel, and upper casing, and to prevent any appreciable quantity of soil from mixing with the concrete.

(7) If required, cast the electrical conduit in the footing according to the plan details.

636.3.4 (Vacant)

636.3.5 Clean-Up

(1) After completing work and before acceptance, remove and dispose of excess excavation and surplus or discarded materials, and restore work or property damaged during operations.

636.4 Measurement

636.4.1 Concrete

(1) The department will measure Sign Supports Concrete Masonry by the cubic yard acceptably completed. The department will base measurement on the dimensions the plans show or that the engineer orders in writing. The department will not measure concrete placed outside the designated dimensions.

636.4.2 Steel Reinforcement

(1) The department will measure the Sign Supports Steel bid items by the pound acceptably completed. The department will compute the weight as specified for bar steel reinforcement under 505.4.

636.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
636.0100	Sign Supports Concrete Masonry	CY
636.0500	Sign Supports Steel Reinforcement	LB
636.1000	Sign Supports Steel Reinforcement HS	LB
636.1500	Sign Supports Steel Coated Reinforcement HS	LB

(2) Payment for Sign Supports Concrete Masonry is full compensation for providing concrete; for providing and removing casing; for providing required ground rods; for excavating and backfilling; for placing post stubs or anchor rods; for providing electrical conduit; for cleaning-up, repairing damage, and for disposing of excavation and surplus materials.

(3) Payment for the Sign Supports Steel bid items is full compensation for providing sign supports.

Section 637 Signing

637.1 Description

(1) This section describes providing signs, of the type or types specified, on supports in place or erected under the contract.

637.2 Materials

637.2.1 Sign Base Materials

637.2.1.1 Aluminum Extrusions

(1) Use the style of aluminum extrusions specified in the plans. The engineer will accept any shape reasonably close to the shape illustrated, with no interlocking arrangement, and conforming to the minimum weight requirements the plans specify. Use the same style and brand of extrusion required for all the work under the contract. Use aluminum extrusions conforming to ASTM B221, alloy 6061-T6, 6063-T5, or 6063-T6.

(2) Perform shearing, cutting, punching, drilling, or other fabrication procedures on extruded panels before preparing the aluminum to receive reflective material.

(3) The department will allow a maximum deviation from flat on the face of extrusions of 0.004 inches per one inch of extrusion width.

(4) The engineer will not require sign edge molding.

637.2.1.2 High-Density Overlaid Plywood

(1) Use base material conforming to the U.S. Product Standard PS 1 for construction and industrial plywood. Use 7-ply material manufactured from a group 1 wood and conforming to the requirements for B-B or better high-density overlay exterior plywood intended for use in highway signs, and suitable for applying reflective sheeting to without further surface preparation other than as specified below in 637.3.2.

(2) Make plywood sign panels from material not less than 5/8 inch thick, except that for signs with a face 2 feet by 2 feet or less with the horizontal dimension no greater than the vertical dimension, the contractor may use 1/2 inch thick material.

637.2.1.3 Sheet Aluminum

(1) For this base material, use aluminum alloy 5052-H38 complying with ASTM B209.

(2) Ensure sign blanks are free from laminations, blisters, slivers, open seams, pits from heavy rolled-in scale, ragged edges, holes, turned-down corners, or other defects that might affect their appearance or intended use. Use blanks conforming to the Aluminum Association, Inc., requirements for commercial flatness and uniformity of thickness. Perform shearing, cutting, and punching before coating and applying reflective or other surface material.

(3) Ensure that the sheared edges of sign blanks are straight and free from tears or raggedness. Round corners unless the plans show otherwise. Ensure punched or drilled holes are round; free from tears, raggedness, and distortion of the metal; and of the diameter and location the plans show.

(4) Degrease, etch, and coat the sign blank on both sides with a chromate treatment conforming to ASTM B921, class 2.

(5) For other than stop signs, furnish material that equals or exceeds the following nominal thickness for the indicated sign width:

WIDTH	NOMINAL THICKNESS
30 inches and under	0.080 inch
Greater than 30 through 36 inches	0.100 inch
Over 36 inches	0.125 inch

(6) For stop signs, furnish material that equals or exceeds the following nominal thickness for the indicated sign size:

SIZE	NOMINAL THICKNESS
24 inches x 24 inches	0.080 inch
30 inches x 30 inches	0.100 inch
36 inches x 36 inches and larger	0.125 inch

637.2.2 Sign Face Materials

637.2.2.1 General

(1) Sign sheeting material acceptance is subject to the performance criteria specified in 637.3.3.4.

637.2.2.2 Reflective Sheeting

(1) Furnish type H, SH and F reflective sheeting from the department's APL. If the manufacturer provides a warranty for the reflective sheeting, turn the warranty over to the department.

637.2.2.3 Nonreflective Sheeting

(1) Furnish nonreflective sheeting consisting of a flexible sign face material precoated with adhesive and with a protective liner. Ensure that sheeting thickness, without liner, is from 0.003 to 0.005 inches inclusive.

(2) Provide test data showing that the sheeting has no appreciable shrinkage, discoloration, cracking, crazing, chalking, blistering, delamination, or loss of adhesion.

637.2.3 Sign Message Material

637.2.3.1 (Vacant)

637.2.3.2 Stencil Paste

(1) Furnish stencil paste of a type the manufacturer of the underlying face material approves for that application.

637.2.3.3 Electronic Cuttable Overlay Film

637.2.3.3.1 General

(1) Furnish transparent colored electronic cuttable film for shop application over reflective sheeting. Use overlay film from the same manufacturer and with the same warranty as the underlying reflective sheeting.

637.2.3.3.2 Performance Requirements

(1) After overlaying, the composite shall conform to the same ASTM D4956 color specification limits and daytime luminance factors applicable to an equivalent background sheeting material of the same color with no overlay.

(2) Furnish film coated with a pressure-sensitive adhesive capable of adhering without using additional adhesive. Ensure that the protective lining for the adhesive is removable without soaking in water or other solvents.

(3) Furnish film with a coefficient of retroreflection that equals or exceeds 70 percent of that required by ASTM D4956 for similar colored retroreflective sheeting. For blue films, 55 percent or greater is acceptable.

637.2.3.4 Vandalism Sticker

(1) Affix a vandalism sticker to the face of type I and II signs. Obtain stickers from the department's sign shop located at:

3609 Pierstorff St.
Madison, WI 53704

(2) Position the stickers on the signs according to the following procedures:

1. Attach the sticker at the extreme lower left corner of square or rectangular signs, horizontally and typically outside the sign border, or just inside the sign border if the space between the edge of the sign and the border is not sufficient to accommodate the sticker.
2. On signs of other shapes, for example stop, yield, and no passing zone pennants, place the sticker at the lowest edge or corner of the sign, parallel with the border or edge of the sign, and at the left corner or left side of the sign.
3. On signs with a white border, place the sticker within the white border at the locations designated.

637.2.3.5 Sheeting Material Identification Code and Installation Date

(1) Affix identification code and installation date stickers on the back of signs as follows:

- On type I signs, in the lower right corner.
- On type II signs, in the upper right corner.

(2) Obtain stickers from the department's sign shop located at:

3609 Pierstorff St.
Madison, WI 53704

Add 637.2.3.6 to specify fabrication stickers for signs.

637.2.3.6 Fabrication Stickers

(1) Furnish 3-inch x 1 1/2-inch fabrication stickers consisting of a black message on white non-reflective sheeting. Include the sign fabrication company name and address in the message. Apply the message as specified in 637.3.2.4.1.

(2) Affix fabrication stickers on the back of signs as follows:

- Type I signs: in the lower right corner, below the date sticker.
- Type II signs: in the upper right corner, below the date sticker.

637.2.4 Sign Mounting Hardware

637.2.4.1 Type I Signs

(1) Connect individual aluminum extrusion panels together to form a completed sign assembly. For panel stitch hardware, use self-locking nuts, bolts, washers, and other hardware as follows:

1. Stainless steel conforming to 513.2.1.
2. Aluminum that the panel manufacturer either supplies or approves.

(2) Mount the sign assembly using aluminum post clips, stainless steel bolts with self-locking nuts, and a protective stainless steel flat washer against each post clip. Provide the following:

1. Stainless steel bolts and washers conforming to 513.2.1.
2. Stainless steel self-locking nuts conforming to ASME B18.16.6.
3. Aluminum post clips conforming to ASTM B221 alloy 6061-T6, ASTM B26 alloy 356.0-T6, or ASTM B108 alloy 356.0-T6.

637.2.4.2 Type II Signs

637.2.4.2.1 Ground-Mounted Signs

(1) Furnish components to attach signs to ground mounted wood or steel posts using hex head nuts and bolts, washers, and other steel hardware treated in one of the following ways:

1. Hot dipped coated according to ASTM A153.
2. Electrically zinc coated according to ASTM B633, type III, SC 3.

(2) Use only nuts and bolts manufactured with sufficient clearance to allow the nuts to run freely on the bolts after plating or coating.

637.2.4.2.2 Overhead-Mounted Signs

(1) Furnish a sign mounting system from the department's APL.

637.2.5 Color

(1) For sign face and sign message materials provide the color the plans show.

637.2.6 Permanent Barricades

(1) Furnish 8-foot barricades as well as red and white barricade sheeting from the department's APL. If the plans show installing on wood posts, fabricate conforming to the following:

Plywood 637.2.1.2
Wood posts 634.2.1
Mounting hardware 637.2.4.2.1

637.3 Construction

637.3.1 Definitions

(1) Type I signs consist of guide signs having extruded aluminum base material, reflective backgrounds, and non-removable messages. They are ground mounted on steel posts and are used in unlighted overhead locations.

(2) Type II signs consist of miscellaneous warning, regulatory, informational, and standard size guide signs, having sheet aluminum or plywood base material, and reflective or non-reflective backgrounds, and non-removable messages.

637.3.2 Manufacture and Assembly

637.3.2.1 General

(1) Manufacture signs to conform to the dimensions and details the plans show. Letter series refer to the standard series approved by the FHWA. Ensure that the corners of type I signs are square, but make the borders as the plans show.

(2) Where the department uses the term "message" in these specifications or on the plans, it includes letters, numerals, symbols, and borders.

637.3.2.2 Preparing Sign Panels for Reflectorization

637.3.2.2.1 Aluminum Panels

(1) If applying reflective sheeting to aluminum panels, prepare the panels as follows:

(2) Perform the preliminary cleaning of the sign blanks by completely submerging them in a 3 percent solution of inhibited alkaline cleanser at 160 to 180 F for 3 minutes, followed by a thorough rinse in clean running cold water. Instead of this method the contractor may use a grease solvent, such as naphtha, provided it applies the cleanser according to the manufacturer's directions.

(3) After this preliminary cleaning, immerse the panels for at least 3 minutes in a 6 percent to 8 percent solution of phosphoric acid at 100 F. Then rinse the panels in a spray of cold water, followed by immersing for one minute in circulating hot water at 180 F. Dry the panels with forced warm air.

(4) If using extrusions, and the panel length prohibits total immersion, then the contractor may apply 6 percent to 8 percent phosphoric acid at 100 F to the surface by swabbing, brushing, or spraying, and allowing it to remain for 5 minutes, then remove the acid using a cold water rinse and dry with forced warm air.

637.3.2.2.2 High-Density Overlaid Plywood Panels

(1) Ensure that the plywood blank surfaces are smooth, clean, and free from any oils, edge sealant, dust, or solvent. If the reflective sheeting manufacturer recommends, lightly sand the sign face surface then wipe with a solvent before applying the sheeting.

637.3.2.2.3 Handling Panels

(1) If reflectorizing the surface of aluminum or plywood sign blanks, handle the surface with devices or clean canvas gloves between cleaning and etching operations and when applying the reflective sheeting.

637.3.2.3 Applying Reflective Sheeting

(1) Prepare sign panels and blanks as specified above and according to the reflective material manufacturer's recommendations. Apply reflective sheeting according to the manufacturer's recommendations.

(2) After curing for 48 hours at 70 F, the bond between the reflective sheeting and the sign panel or blank must resist stripping from the panel with a stiff putty knife; and must withstand 8 hours of soaking in water at 75 F without appreciable loss of adhesion.

(3) Ensure that no line of separation exists between adjacent panels due to lack of reflective material. The contractor shall not extend the reflective sheeting from one panel to adjacent panels. Wrap the sheeting a minimum of 1/4 inch around the top and bottom edges of each panel.

637.3.2.4 Applying Messages on Type II Signs

637.3.2.4.1 Signs with Black or Dark Message on a White, Yellow, or Orange Background

(1) Apply messages using either of the following methods:

1. Use a silkscreen stencil process with a black or dark stencil paste of a type the manufacturer of the underlying reflective sheeting approves for that application.
2. Use an electronic cuttable overlay film shop-applied over underlying white reflective sheeting. Apply according to the manufacturer's recommended procedures. Ensure that the resultant composite produces the required background color.

637.3.2.4.2 Signs with White Message on a Red, Blue, Brown, or Green Background

(1) Apply messages using any of the following methods:

1. Individually cut the borders, letters, numerals, and symbols from white reflective sheeting and apply them to a background of colored reflective sheeting from the same manufacturer. Apply according to the manufacturer's recommended procedures.
2. Use the reverse screening process with a transparent stencil paste applied to white reflective sheeting. Ensure that the resultant background is uniform and has the required background color. Use the brand of transparent paste that the reflective sheeting manufacturer recommends.
3. Use an electronic cuttable overlay film shop applied over underlying white reflective sheeting. Apply according to the manufacturer's recommended procedures. Ensure that the resultant composite produces the required background color.

637.3.2.4.3 Signs with Yellow Message on a Brown Background

(1) Apply messages using either of the following methods:

1. Individually cut the borders, letters, numerals, and symbols from yellow reflective sheeting and apply them to a background of brown reflective sheeting from the same manufacturer. Apply according to the manufacturer's recommended procedures.
2. Use the reverse screening process with an opaque stencil paste applied to yellow reflective sheeting. Ensure that the resultant background is uniform and has the required background color. Use the brand of opaque paste that the reflective sheeting manufacturer recommends.

637.3.2.5 Applying Clear Finish

(1) If the reflecting material manufacturer recommends a clear finish, apply the finish to the face of the sign panel according to the manufacturer's instructions after applying the background and message for reflective type I and II signs and allowing them to dry completely.

637.3.2.6 Applying Messages on Type I Signs

(1) Completely assemble each sign in the shop before applying the sign message. Cut the applied message between each aluminum extrusion.

(2) For signs with a black or dark message on a white, yellow, or orange background, conform to item 2 of 637.3.2.4.1(1).

(3) For signs with a white message on a red, blue, brown, green, or black background, conform to item 1 of 637.3.2.4.2(1). Use type SH sheeting for the message.

(4) For route markers, use type SH sheeting in the shape the plans show. Apply letters and numbers as specified in 637.3.2.4.

637.3.2.7 Assembling Type I Signs

(1) For type I signs use aluminum extrusion sign base material.

(2) Assemble individual aluminum extrusions into signs the size the plans show, according to the extrusion fabricator's recommendations and in a manner the engineer approves.

(3) Make each extension the full width of the sign without joint or splice.

637.3.2.8 Assembling Type II Signs

637.3.2.8.1 General

(1) Provide type II signs of the size and shape the plans show. Unless the plans show otherwise, use sheet aluminum for permanent type II signs.

(2) Do not use horizontal joints on a type II sign with a vertical dimension of 48 inches or less.

(3) Do not use vertical joints on a type II sign with a horizontal dimension of 144 inches or less. Do not use more than one vertical joint on wider type II signs.

(4) Mount permanent flags to type II signs if the plans show.

637.3.2.8.2 Battens Over Joints

(1) If using 2 or more sheets of sign base material other than sheet aluminum to make a single type II sign, attach a 6-inch batten of the same material as the sign base by screws or rivets to the back of the sign and covering the joint.

(2) Use screws to attach battens to plywood signs. Drive the screws into the sign from the back and do not cut the face of the sign. For battens on plywood signs, the contractor may use one inch by 6-inch lumber pressure treated conforming to 507.2.2.6 using one of the waterborne preservatives specified in 507.2.3. Use battens that extend the full length of the joint, except stop horizontal battens within 10 inches of each sign post to allow mounting of the sign base material directly on the post, and stop vertical battens within 10 inches of horizontal stiffeners or stringers to allow mounting the sign base material directly on them. Additionally, the contractor shall not use horizontal battens if locating a horizontal stiffener or stringer as specified below properly battens the joint.

637.3.2.8.3 Horizontal Stiffeners

(1) For plywood signs, provide stiffeners made of 2 x 6 lumber pressure treated as specified for wood sign posts in 634.2.1(3). Screw 2 horizontal stiffeners to the back of each type II sign with one or more of the following:

1. Vertical joints between adjacent panels of sign base material.
2. Plywood base material and a horizontal dimension exceeding 80 inches and a vertical dimension less than 36 inches.
3. Aluminum base material and a horizontal dimension exceeding 80 inches regardless of vertical dimension.

Horizontal stiffeners are not required for the following:

1. Signs mounted on bridges with either continuous bearing on the bridge or mounted on spacer blocks at both the top and the bottom of the sign.

2. Signs mounted on horizontal stringers.

(2) On plywood signs, drive the screws from the back of the sign and do not cut the face of the sign. Position the center of the stiffeners 9 inches above the bottom of the sign and 9 inches below the top of the sign, respectively. Except on signs having a vertical dimension of 27 inches or less, then center only one stiffener on the back of the sign. Ensure that stiffeners extend the full length of the sign.

637.3.2.8.4 Horizontal Stringers

(1) Provide horizontal stringers made of flanged channel section posts conforming to 633.2.1. Bolt 2 stringers to the back of each sheet aluminum sign panel with a horizontal dimension greater than 77 inches. If mounted on one or more posts; fasten the sign, each stringer, and each post at their points of intersection with a bolt or lag screw passing through or into all 3 parts of the assembly.

637.3.3 Installing Signs

637.3.3.1 General

(1) If erecting signs before their message becomes applicable, cover the sign faces conforming to 643.3.4.3 to make their messages unreadable during both daytime and nighttime. Maintain the covering in good condition until the message becomes applicable and the engineer orders the covering removed or until the contract expires.

(2) The contractor shall not install stop signs and yield signs before the time that they are applicable.

637.3.3.2 Placing and Orienting

(1) Establish and stake, or mark on the pavement, the longitudinal location of each sign, including signs on the main line roadways, frontage roads, ramps, and intersecting roads as the plans show or as the engineer directs.

(2) Laterally position the sign from the shoulder edge or curb as the plans show or as the engineer directs.

(3) The proper elevation, offset, level, and orientation of signs erected are the contractor's responsibility. Exercise care to preserve stakes. Reset stakes lost, damaged, displaced, or removed.

(4) Generally, erect signs so the edge and face of the sign are truly vertical and the face is normal to the centerline of the roadway that the sign serves, and so the sign faces slightly away from the motorists line of sight in order to avoid specular reflection and glare.

637.3.3.3 Fastening Signs to Supports

(1) If the plans require the contractor to mount signs on utility poles or highway lighting poles installed by others, then follow the method of mounting the plans show.

(2) Fasten type II signs to wood sign posts with bolts or lag screws. For signs with type H, type SH, or type F Reflective Sheeting, place a fiber, nylon, or clear plastic washer between the head of the bolt or screw and the face of the sign. For signs, place a metal washer on the bolt beneath the nut.

(3) Fasten overhead-mounted type II signs using a mounting system from the department's APL. Conform to torque limitations and other installation instructions provided by the sign mounting system manufacturer. Provide a copy of those instructions to the engineer.

(4) Fasten signs to flanged beam sign supports and sign bridges according to the plans and the sign manufacturer's recommendations.

637.3.3.4 Performance

(1) Under 105.11.2.3 the department may revoke acceptance and direct the contractor to repair or replace previously accepted sign installations if the department subsequently discovers evidence of defective materials or improper installation. Deficiencies that warrant department action include but are not limited to the following:

- Sign posts more than five degrees out of plumb.
- Signs twisted by more than 5 degrees from plan orientation.
- Signs with delaminated or warped plywood.
- Signs with bubbling, fading, delaminating, or buckling sheeting.

637.3.4 Permanent Barricades

(1) Provide permanent barricades in the locations the plans show. Fasten barricades to pavement using an engineer-approved method. If fabricating barricades as allowed under 637.2.6, conform to:

Install wood posts 634.3

Attach barricade boards to the posts 637.3.3.3

637.4 Measurement

(1) The department will measure the Sign Flags Permanent bid items as each individual flag acceptably completed.

(2) The department will measure the Signs bid items by the square foot acceptably completed, measured as the area of sign face for individually mounted signs and the area of the entire base panel for multiple signs mounted as an assembly.

(3) The department will measure the Barricades Permanent bid items as each individual barricade acceptably completed.

637.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
637.0600-0699	Sign Flags Permanent (type)	EACH
637.1000 - 1999	Signs Type I (reflectivity)	SF
637.2000 - 2999	Signs Type II (reflectivity) (folding)	SF
637.5450 - 5455	Barricades Permanent (type)	EACH

(2) Payment for the Sign Flags Permanent bid items is full compensation for providing permanent flags.

(3) Payment for the Signs bid items is full compensation for providing signs including mounting hardware and temporary flags; and for preserving and resetting sign location stakes.

(4) Payment for the Barricades Permanent bid items is full compensation for providing barricades. The department will pay separately for associated signs.

(5) The department will pay separately for required sign supports, sign bridges, and electrical cable.

Section 638 State Owned Signs and Supports

638.1 Description

(1) This section describes moving, removing, revising, or erecting state owned signs and supports.

638.2 Materials

(1) Furnish signing materials conforming to 637. Use aluminum base material at least 0.040 inch thick.

(2) Fabricate demountable route markers, overlay plaques, letters, numbers, symbols, and borders as the plans show. Unless the contract specifies otherwise, use the same sheeting type as the existing sign being revised.

638.3 Construction

638.3.1 General

(1) A sign is an installation at a single location that consists of several components or parts that together form one complete sign.

(2) Do not display a sign before its message becomes applicable. If necessary cover the sign conforming to 643.3.4.3.

(3) Erect signs and supports at the new location as specified in 634 if using wood posts and as specified in 635, 636, and 637 if using steel supports.

638.3.2 Moving Signs

(1) Under the Moving Signs bid items, remove existing signs, and transport and erect the signs at new locations. This work does not include moving structural steel supports, or moving or removing the footings.

(2) Remove the signs without damaging them, and re-erect at the new location.

(3) If moving any sign on wood posts, tubular steel posts, or flanged, steel channel supports, then also move the posts or supports, unless provided otherwise.

(4) Remove signs 25 square feet and larger from their supports before transporting. The contractor may transport smaller size signs attached to their supports, provided it uses methods that do not damage the sign.

638.3.3 Moving Sign Supports

(1) Under the Moving Small Sign Supports bid item, remove existing wood supports; flanged, steel channel or other supports and transport to and erect these supports at new locations, and remove any resulting unused concrete footings.

(2) Under the Moving Structural Steel Sign Supports bid item, remove existing structural steel supports and transport to, and erect the supports at new locations, and remove any resulting unused concrete footings.

(3) Inspect the supports before moving and notify the engineer of any damage or deficiencies.

638.3.4 Removing Signs

(1) Under the Removing Signs bid items, remove existing signs from their supports.

(2) Aluminum type II signs and steel stringers are the department's property. Return signs and stringers palletized for handling with a forklift. Contact the region signing coordinator at least 3 business days in advance to coordinate the shipment and drop-off location.

(3) Plywood type II and all type I signs are the contractor’s property, unless the contract specifies otherwise. Dispose of these signs off the right-of-way.

638.3.5 Removing Sign Supports

(1) Remove wood, flanged and channel steel, structural steel, overhead, or other sign supports. Supports become the contractor’s property, unless the contract specifies otherwise. Satisfactorily dispose of supports off the right-of-way. Remove unused concrete footings as specified in 638.3.8.

638.3.6 Revising Signs

(1) Revise the existing sign message as the contract specifies or the engineer directs. Schedule operations so a sign is out of service for the least time practicable and, if possible, revise the message without removing the sign from its support.

(2) Under demountable bid items, revise the message by removing, replacing, or adding demountable copy. Unless the contract specifies otherwise, use new message units similar to existing message units already on the sign revised. Fasten demountable copy to type I sign panels with aluminum rivets or aluminum self-tapping screws. Place aluminum rivets or aluminum self-tapping screws at the ends

and at 90 degree corners of demountable copy letters, numbers, symbols, border, and route markers. Space rivets or self-tapping screws at a maximum of 6 inches on center. Do not install rivets or self-tapping screws within 1 inch of extruded aluminum panel joints

(3) Under non-removable bid items, revise the message by covering with a demountable overlay plaque.

638.3.7 Erecting State Owned Signs

(1) Under the Erecting State-Owned Signs bid items, load state-furnished signs at a specified source, and transport and erect the signs at required locations.

(2) Advise the engineer at least 10 business days before proposing to load and haul the signs so the engineer has sufficient time to make them available.

(3) Erect state-furnished signs as specified for erecting signs in 634 through 637.

638.3.8 Restoring the Site

(1) Restore the site of any sign moved, removed, or erected, repair any damage to work caused by the contractor's operations, and dispose of any surplus excavation or materials. Remove unused concrete footings resulting from the moving or removing of signs as specified for their removal in 204.3 and fill the resulting holes with earth or other suitable material as required, and restore the area to a condition similar to the adjacent area.

638.4 Measurement

(1) The department will measure the bid items under this section as each individual sign location or sign support location acceptably completed, except under the Small Sign Supports bid items, the department will measure each individual post of the associated sign support system.

638.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
638.2100 - 2199	Moving Signs (type)	EACH
638.2600 - 2699	Removing Signs (type)	EACH
638.3000	Removing Small Sign Supports	EACH
638.3100	Removing Structural Steel Sign Supports	EACH
638.3150 - 3199	Removing Overhead Sign Supports (type) (structure)	EACH
638.3200 - 3299	Revising Signs (type) (message)	EACH
638.3600 - 3699	Erecting State-Owned Signs (type)	EACH
638.4000	Moving Small Sign Supports	EACH
638.4100	Moving Structural Steel Sign Supports	EACH

(2) Payment for the bid items under this section is full compensation for the work required under the particular bid item; for providing message units as required; and for restoring the site. Payment does not include compensation for furnishing new wood posts, steel sign supports, and concrete footings, if required, the department will pay for these under the pertinent contract bid item, or as extra work if no bid item exists.

Section 639 Drilling Wells

639.1 Description

(1) This section describes drilling vertical holes of specified sizes in earth formation or rock formation, or both to the required depth; inserting casing pipe; placing liner pipe, if required; sealing casing with grout; placing pump, screen, and well platform; constructing well shelter; and test pumping.

639.2 Materials

639.2.1 General

(1) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

(2) For grout use fine aggregate conforming to 501.2.5.3 and type I, IL, IS, IP, or IT cement.

(3) Furnish lumber and timber conforming to 507.2.2.

639.2.2 Well Casing Pipe

639.2.2.1 Upper Drillhole

(1) If using 8, 10, or 12-inch pipe temporarily in constructing the upper drillhole, use pipe of sufficient strength and weight to withstand driving operations. Use welded or threaded coupling joints with this pipe.

639.2.2.2 Lower Drillhole

(1) For casing the lower drillhole, use new steel casing pipe. Use pipe conforming to NR 812.17.

639.2.3 Liner Pipe

(1) For liner pipe use new steel pipe of sufficient strength and weight to structurally withstand driving operations. On this pipe, use welded joints and fit with standard type driving shoes. Use the length and diameter of liner pipe the engineer directs.

639.2.4 Pump

(1) Use a hand-operated metal drinking fountain type pump with a mounting base that accepts the casing pipe specified and conforms to the plan details. For the drop pipe use new zinc coated standard steel with a 1 1/4 inch inside diameter, unless the plans specify otherwise. Use a 7/16-inch diameter steel pump rod having 14 standard threads per one inch. For depths to the static water surface of 150 feet or less, use a cylinder with a 2-inch inside diameter, and for depths exceeding 150 feet, use a cylinder with an inside diameter of 1 11/16 inches.

(2) Provide cast iron floor drains conforming to the size and details the plans show.

639.2.5 Well Screen

(1) Provide a stainless steel screen of the specified diameter and conforming to NR 812.13 requirements.

639.3 Construction

639.3.1 Code, Permit, and Registration Requirements

(1) Perform work connected with drilling, driving, and outfitting a well according to NR 812, well construction and pump Installation, Wisconsin administrative code of the WDNR, division of environmental analysis and review.

(2) The contractor shall obtain permits, licenses, or other requirements needed to prosecute the work at its own cost and expense. Provide notices, pay fees, and comply with laws, ordinances, codes, and regulations bearing on the conduct of the work.

(3) Employ an engineer-approved well driller registered with the WDNR division of environmental analysis and review before starting drilling operations. The well driller shall produce satisfactory evidence of experience, capability, and equipment before performing any work.

(4) Use a pump installer registered with the WDNR division of environmental analysis and review to install the pump.

639.3.2 Geologic Formation

(1) The contractor shall save and deliver a sample of material taken from each 5 feet of drilling and at every change in formation, to the Wisconsin geological and natural history survey. The contractor shall also keep an accurate record of the top and bottom of each layer of formations penetrated.

(2) Provide daily written reports to the engineer beginning when the drilling equipment is erected and ending when the drilling equipment is removed. Include the following:

1. The nature of the materials encountered during drilling.
2. The work done during each day, including depth drilled, casing set, and water tests.

3. The depth-to-water level in the well at the beginning and end of each shift.
4. Other data the engineer may request for the record.

(3) Immediately advise the engineer of any circumstances that might alter well construction, or have any effect in determining if the drilling operations should change. If the contractor fails to keep the engineer informed, this may result in non-payment for items of work performed.

(4) Take the above-specified material samples every 5 feet and at each change in formation according to Wisconsin geological and natural history survey instructions.

(5) After completing a job sample, pack it in a box or bag, and mail or ship it express collect to the following address:

Wisconsin Geological and Natural History Survey
3817 Mineral Point Road
Madison, WI 53705-5100

(6) The contractor may obtain sample bags and tags at no cost by writing to the same address. Send the driller's log of the well at the same time. The driller's log shall include, in addition to a record of material encountered:

1. Data on size or sizes of hole.
2. Length and size of casing, including liner and screen.
3. Water level.
4. Results of pumping tests.

639.3.3 Water Sampling and Testing

(1) Immediately after completing the well, collect water samples in conformance with the procedure stated in NR 812.22 and submit the samples in bottles furnished by the laboratory for bacteriological and nitrate analysis, and for iron and manganese, turbidity and hardness determination to:

State Laboratory of Hygiene
465 Henry Mall
Madison, WI 53706

(2) The contractor shall indicate in the remarks section of the data sheet accompanying the sample bottles that a copy of the report be forwarded to the engineer on the project and sent to the:

State Department of Natural Resources
Environmental Analysis and Review
101 South Webster Street
PO Box 7921
Madison, WI 53703

639.3.4 Precautions to Take

(1) Take precautions to prevent contaminated or polluted water, or other pollutants such as gasoline from entering the drill hole during construction of the well and following completion.

(2) If the well becomes contaminated or polluted during construction or upon completion due to contractor neglect, at no cost to the department, perform work or supply casings, seals, sterilizing agents or other materials necessary to eliminate the contamination or pollution.

(3) Exercise extreme care in performing the work to prevent caving in or breaking down the strata overlying the one that is producing the water. Obtain the engineer's approval of the contractor's method of developing, pumping, or bailing the well, until producing water substantially free of silt or sand, and until the turbidity is less than 5 on the silica scale described in Standard Methods of Water Analysis. Upon completing the well, provide and secure a screwed, flanged, or welded cap to the top of the well casing.

(4) Between placing the protective well casing and grouting the well, seal the annular space between the inner casing and the larger outer casing with a temporary plug to prevent the entry of foreign material.

(5) If the contractor fails to construct the well to the depth specified, or the depth the engineer orders, or if the well is abandoned because of loss of tools or from any other cause, for example, poor well alignment, construct another well at an adjacent engineer-approved location. Fill the abandoned hole with concrete as specified for abandoning pipes and structures in 204.3.3.

(6) Take the necessary precautions to protect trees and structures at the site from damage by and during the operations.

639.3.5 Drilling Well Holes

(1) Ensure that holes drilled through earth formations are the required size, and extend from the ground surface to underlying rock formation, or to the depth the engineer directs. Drill each hole with a fully dressed bit the proper size to accommodate driving the corresponding well casing pipe concurrently with drilling operations. If drilling holes through rock formation use a fully dressed bit, the proper size to produce the required drilled hole size.

(2) If the driller considers it necessary to blast in the drill hole, if drilling through formations containing boulders, discuss the problem with the engineer before any shooting or blasting. Perform blasting work using a licensed blaster.

(3) Furnish potable water for drilling operations.

639.3.6 Alignment

(1) Align the well so that the pump proper and its accessories function and operate free of any trouble that might occur from a misaligned well casing. Drill the well so that the centerline does not deviate from a straight line more than the following distance per 100 feet of pump setting depth, plus 25 percent: for a 4-inch well, 4 inches; for a 6-inch or larger well, 6 inches.

(2) If the engineer judges the well alignment unsatisfactory at any time, because of a condition in excess of that above, then correct the condition before proceeding with the drilling. If the hole is misaligned and correction is not possible or practicable, drill a new hole.

(3) During well construction, furnish the labor, tools, and equipment required for making alignment tests, and make these tests when the engineer directs.

639.3.7 Well Casing

(1) Ensure that the well casing when in place is watertight from top to bottom. If driving into unconsolidated material or through it to a seat in rock, as opposed to setting in place in a larger drilled hole, fit the casing with an engineer-approved standard driving shoe. During grouting operations, remove the outer temporary casing used to construct the upper drill hole unless the engineer allows otherwise.

639.3.8 Well Screen

(1) Fit the lower end of the well casing pipe, if specified, with the required well screen. Install the well screen in a way that allows removing the screen later.

(2) Submit a selected sample of the water bearing formation to be developed, to the screen manufacturer for mechanical analysis and its recommendation of a size of screen slot openings and length of screen necessary to allow the well to produce the required yield capacity. The contractor shall not use a screen less than 3 feet long, unless the engineer approves. Furnish a copy of the manufacturer's report or recommendation to the engineer.

639.3.9 Liner Pipe

(1) If a caving formation occurs in drilling in rock, seal it by driving a liner pipe fitted with a driving shoe into the rock to at least 10 feet above the caving zone. Then extend a drill hole, the same diameter as the liner pipe, below the liner pipe to the depth necessary to produce the required quantity of water.

639.3.10 Grouting

(1) Mix a neat cement grout by methods, and to a consistency, the engineer approves, using not more than 5 1/2 gallons of clean water per sack of cement. The contractor shall not use admixtures in the cement grout.

(2) Place this grout in the annular space between the inner well casing and the outer casing, or the casing and the hole where the casing does not extend the entire depth of the hole. If using a liner pipe, then fill the annular space between the liner and the casing to the top of the liner pipe.

(3) Place the grout by using a pressure method the engineer approves, with a pump designed for the purpose, forcing the grout from the bottom upward toward the surface. Continuously place this grout until the annular spaces are filled.

(4) Provide standby grout placing equipment in case the original equipment fails. Use standby equipment that provides gravity placement of grout with a pipe or tremie in the annular space between the casings.

(5) With the engineer’s approval, and if applying through a conductor pipe that extends to the placement point, the contractor may use concrete grout, consisting of cement, sand, and water in a proportion of one sack cement, to an equal volume of dry sand, and 5 1/2 gallons of water, instead of neat cement.

639.3.11 Test Pumping

(1) Upon reaching a water bearing formation that appears capable of producing the desired yield, the engineer may direct conducting pumping tests to determine if the water supply is satisfactory, and to establish the well depth.

(2) Provide a pump capable of pumping the specified gallons per minute to the discharge point against a free discharge and capable of continuous operation for the specified test period. Make provisions for throttling the pumping rate in order to determine water level data at various pumping rates.

(3) Furnish suitable and adequate equipment for making volumetric measurements of water pumping rates. Furnish electric probes or other engineer-approved means to measure static and dynamic water levels to the nearest 1/10 of a foot.

(4) Before conducting a pumping test, clear the well of cuttings and determine the well depth and static water level.

(5) Begin test pumping at a low rate and gradually increase it in a way that allows measuring the dynamic water level at various discharge increments. Take measurements of the dynamic water level at discharge increments the engineer specifies. At each increment, hold the pumping rate constant during measurement of the water level and rate of discharge.

(6) Maintain the specified pumping rate for the specified test period to determine if the well conforms to contract provisions.

(7) If the engineer deems the well adequate, make measurements of the dynamic water level at higher discharge rates as the engineer designates.

(8) If at any point during the test pumping the engineer determines the water supply is inadequate, discontinue test pumping, and the engineer will deem a unit of test pumping complete. The engineer will direct any further drilling and subsequent test pumping.

(9) Transport water pumped from a well during a test period or at any time during the contractor's operations to a place where it causes no damage.

639.3.12 Pump and Well Platform

(1) Construct the concrete platform at the prepared well site as the plans show. Mount the pump on the well casing according to plan details.

639.3.13 Wayside Well Shelter

(1) Construct the wayside well shelter with the materials and as the plans show.

639.3.14 Cleaning Up Operations

(1) Upon completing well drilling operations and placing materials for the well, pump, and related facilities; clean the well by bailing to remove cuttings from the drill hole; clear the site of debris, excess materials and equipment; and perform any necessary ground leveling work required to restore the site.

(2) Disinfect the well as required by the Wisconsin well construction and pump installation code NR 812.41.

639.3.15 Welding

(1) Perform welding conforming to AWS D 1.1, Structural Welding Code - Steel.

639.4 Measurement

639.4.1 Drilled Holes

(1) The department will measure the Drill Hole in Earth and Drill Hole in Rock bid items by the linear foot of vertical depth of hole acceptably completed.

639.4.2 Well Casing Pipe

(1) The department will measure the Well Casing Pipe bid items by the linear foot acceptably completed. The department will measure the casing pipe for the lower drill hole from the upper cutoff point to the bottom of the driving shoe. The department will not measure the outer temporary casing used to construct the upper drill hole for payment.

639.4.3 Well Screen

(1) The department will measure Well Screen by the linear foot acceptably completed, from the bottom of the driving shoe to the lower end of the screen.

639.4.4 Grout for Sealing Well Casing

(1) The department will measure Grout for Sealing Well Casing by the cubic foot acceptably completed.

639.4.5 Pump and Well Platform

(1) The department will measure Pump and Well Platform as each individual unit acceptably completed.

639.4.6 Wayside Well Shelter

(1) The department will measure Wayside Well Shelter as each individual shelter acceptably completed.

639.4.7 Test Pumping

(1) The department will measure Test Pumping, performed at the engineer's direction, as each individual unit acceptably completed. The depth of the well, as the engineer determines, whether shallower or deeper, will not constitute basis for the contractor to claim additional compensation.

639.5 Payment

639.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
639.0100 - 0199	Drill Hole in Earth (inch)	LF
639.0500 - 0599	Drill Hole in Rock (inch)	LF
639.1000 - 1099	Well Casing Pipe (inch)	LF
639.1700	Well Screen	LF
639.2100	Grout for Sealing Well Casing	CF
639.2500	Pump and Well Platform	EACH
639.3000	Wayside Well Shelter	EACH
639.4000	Test Pumping	EACH

639.5.2 Drilled Holes

(1) Payment for the Drill Hole in Earth and Drill Hole in Rock bid items is full compensation for providing materials required for drilling, including temporary casing pipe for upper drill hole; for providing water necessary for drilling holes; for drilling, blasting, alignment, and making alignment tests; for removing temporary casing; for procuring licenses and permits; for collecting and delivering samples of drilling to the Wisconsin geological and natural history society; for collecting and delivering water samples to the state laboratory of hygiene; for disposing of excavated material; and for record keeping and reporting.

(2) If the contractor fails to construct the well to the depth specified, or the depth the engineer orders, or if the well is abandoned because of loss of tools, or from any other cause such as poor well alignment, and the engineer directs the contractor to drill in another location the department will not make further payment until the new well progresses to the point in construction beyond that which the previous well was abandoned, only then will the department pay as provided here. The department will not make additional compensation for filling the abandoned hole with concrete, according to the requirements for abandoning wells and structures specified in 204.3.3. The department will include costs of materials, labor, and equipment involved in blasting or shooting operations in the price bid for other items, and will not pay for work done and materials used in the abandoned hole.

639.5.3 Well Casing Pipe

(1) Payment for the Well Casing Pipe bid items is full compensation for providing materials, including pipe and driving shoes; for handling, hauling, welding, driving, placing, and cutting off casing; for disinfecting the well; and for disposing of surplus materials, including pumped water.

(2) The department will pay for providing the liner pipe as extra work.

639.5.4 Well Screen

(1) Payment for Well Screen is full compensation for providing materials; and for handling, hauling, and installing screen.

639.5.5 Grout for Sealing Well Casing

(1) Payment for Grout for Sealing Well Casing is full compensation for providing materials; and for mixing and placing grout.

639.5.6 Pump and Well Platform

(1) Payment for Pump and Well Platform is full compensation for providing materials; for providing material for and grading mound at well site; for placing and finishing concrete; for installing pump, fittings, and fixtures; and for cleaning up the well site and disposing of debris and surplus materials.

639.5.7 Wayside Well Shelter

(1) Payment for Wayside Well Shelter is full compensation for providing and erecting materials; for excavating and backfilling; and for cleaning up the site and removing debris and surplus material.

639.5.8 Test Pumping

(1) Payment for Test Pumping is full compensation for performing the required testing.

(2) The department will include costs of obtaining, preserving, and transmitting geologic, water samples, and records including materials, labor, equipment, transportation, and incidentals in the unit prices for bid items.

(3) The cost of clean-up operations, including site restoration, is included in the unit prices for bid items.

(4) The department will not pay for contract time while awaiting test results on required water samples unless other contract operations are in progress in the same time.

Section 641 Sign Bridges and Overhead Sign Supports

641.1 Description

(1) This section describes providing zinc coated steel sign bridges and overhead sign supports.

641.2 Materials

641.2.1 General

(1) , Furnish zinc coated steel sign structures.

641.2.2 Steel Bolts

641.2.2.1 High-Strength Bolts

(1) Furnish zinc-coated type 1 bolt/nut/washer assemblies for field tensioning conforming to 506.2.5 and as follows:

- Use the size, number, type, and configuration of hardened flat washers the DTI manufacturer recommends for bolt diameters greater than 1 1/8 inches.
- Ensure that the supplier pre-assembles each bolt/nut/washer assembly before shipping.
- Ensure that bolt/nut/washer assemblies are accompanied by a certified report of test or analysis giving the results of the supplier's rotational-capacity testing. No field rotational-capacity testing is required.
- Ensure that bolt/nut/washer assemblies are shipped in sealed and labeled containers.
- Furnish 3 or more additional bolt/nut/washer assemblies of each rotational-capacity lot for pre-installation testing.
- Submit 2 or more additional bolts and 3 or more additional nuts and washers from each lot and heat for department mechanical testing. The contractor need not submit components from a lot and heat the department previously approved.

641.2.2.2 Direct Tension Indicating Washers

(1) Furnish zinc-coated direct tension indicating (DTI) washers conforming to ASTM F959 type 325. Ensure that DTIs have identifying marks applied by the manufacturer. Provide the engineer with 2 copies of the DTI manufacturer's instructions showing acceptable installation configurations. Provide 3 or more additional DTIs as required for pre-installation testing. Also provide the engineer with at least two 0.005-inch metal feeler gauges.

641.2.2.3 Anchor Rods

(1) Furnish anchor rods conforming to ASTM F1554, grade 55 and Supplementary Specification S4, ASTM A563 heavy hex nuts, and ASTM F436 washers all hot-dip galvanized according to ASTM A153, class C, supplemented by ASTM F2329. Over-tap galvanized nuts according to ASTM F2329.

(2) Use only nuts and anchor rods manufactured with sufficient clearance to allow the nuts to run freely on the rods after coating the threads and nuts with a wax-based lubricant.

641.2.3 Grating

(1) Provide walkway grating conforming to the plans.

641.2.4 Pipe

(1) Provide pipe for handrail conforming to ASTM B241 alloy 6063-T6.

641.2.5 Steel Chain

(1) Provide zinc coated carbon steel chain of the size, type, and length the plans show and include accessories the plans show.

641.2.6 Certification

(1) Submit a certified report of test or analysis to the engineer for the castings, columns, truss members, pipes, anchor rods, high-strength bolts, nuts, and washers, and structural sections. The engineer must approve the material before the contractor may install in the work.

(2) The engineer may retest materials delivered to the job site; furnish the specimens for this testing at no expense to the department.

641.2.7 Aluminum Components

(1) Furnish extruded aluminum for handrails conforming to ASTM B221, alloy 6061-T6. Furnish aluminum structural shapes for catwalk supports conforming to ASTM B308, alloy 6061-T6. Furnish plate and sheet aluminum conforming to ASTM B209, alloy 6061-T6. Ensure material is free from discoloration, nicks, and blemishes.

(2) Furnish stainless steel U bolts, bolts, nuts, and washers for connections to aluminum components conforming to 513.2.1.

641.2.8 Steel Sign Bridges

(1) Furnish materials conforming to the following:

Structural Steel and Miscellaneous Metals 506.2

(2) Furnish sign bridge trusses, columns, and steel accessories zinc coated according to ASTM A123, the zinc coating must withstand 8 one-minute dips in the Preece test solution, ASTM A239.

Revise 641.2.8 to clarify submittal requirements and require steel sign bridges from a fabricator on the APL.

(3) Ensure that steel sign bridges are fabricated by an approved fabricator selected from the department's APL. Also ensure that the fabricator submits a fabrication progress report on department form DT2334 electronically to the department's fabrication library. Update this form weekly for each sign bridge in fabrication.

(4) Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting department form DT2326 with each set of shop drawings.

641.2.9 Overhead Sign Supports

(1) Provide commercially fabricated overhead sign supports conforming to the edition of AASHTO design specifications and fatigue category the plans show in the overhead sign support layout details.

Revise 641.2.9(2) to allow non-tapered poles and arms unless the plans show otherwise. This change was implemented in ASP 6 effective with the December 2017 letting.

(2) Provide steel pole shafts, mast arms or trusses, and luminaire arms zinc coated according to ASTM A123. The contractor may provide either straight or tapered pole and arm shafts unless the plans specify otherwise. Provide bolts and other hardware conforming to 641.2.2.

Revise 641.2.9 to clarify submittal requirements & require overhead sign supports from a fabricator on the APL.

(3) Ensure that overhead sign supports are fabricated by an approved fabricator selected from the department's APL. Also ensure that the fabricator submits a fabrication progress report on department form DT2334 electronically to the department's fabrication library. Update this form weekly for each overhead sign support in fabrication.

(4) Submit shop drawings identified by structure number, design computations, and material specifications to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting department form DT2326 with each set of shop drawings. Provide tightening procedures for mast arm or luminaire arm to pole shaft connections on the shop drawings. Have a professional engineer registered in the state of Wisconsin sign, seal, and date the shop drawings and certify that the design conforms to AASHTO standards and the contract.

641.3 Construction

641.3.1 General

641.3.1.1 Methods

(1) Construct and fabricate components conforming to 506.3. Conform to 506.3.22 for shop inspection and to 506.3.25 for field inspection. Provide mill inspection and test reports conforming to 506.3.21.

(2) Construct concrete footings conforming to 636. Cure exposed portions of concrete footings as specified in 502.3.8.1. Wait until the concrete has attained 3500 psi compressive strength or 7 equivalent days as specified in 502.3.10 before erecting any portion of the structure on the footing.

641.3.1.2 High-Strength Bolts

641.3.1.2.1 Handling and Storage

(1) Store bolts/nut/washer assemblies and DTIs in closed containers in a protected shelter to protect them from dirt and moisture until used. Maintain fastener system components as nearly as possible in the as-manufactured condition until installed. Remove from storage only as needed and promptly return unused components to storage.

641.3.1.2.2 Pre-installation Testing

(1) Notify the engineer before performing the required field pre-installation testing.

(2) Lubricate high-strength bolt threads with a wax-based lubricant before testing. Test bolt/nut/washer assemblies with DTIs in all the configurations used for installation.

(3) Perform pre-installation testing in the field conforming to the procedures enumerated in department form DT2322 for bolt/nut/washer assemblies of each rotational-capacity lot with DTIs in each

installation configuration. Provide the engineer with the test results by submitting 2 copies of department form DT2322.

641.3.1.2.3 Bolt Installation

(1) Do not begin bolt installation without the engineer's approval.

(2) Lubricate high-strength bolt threads with a wax-based lubricant before installation.

(3) Tension high-strength bolts using DTIs. Install the DTI on the bolt with the protrusions facing away from the connected materials. Install bolt/nut/washer assemblies with DTI washers in the same configuration used for pre-installation testing.

(4) Tighten conforming to department form DT2322 to provide the correct installation tension. During the operation, ensure no rotation of the part not turned by the wrench. Snug systematically from the most rigid part of the connection to the free edges. Repeat until the full connection is in a snug condition and the faying surfaces are in firm contact. Systematically tighten the connection required number of refusals is achieved. If the gaps on the DTI are completely closed, discontinue tightening.

(5) Perform QC testing as specified in 506.3.12.3.3.3 for tensioning with DTIs. After observing at the initial QC testing frequency, the engineer may decide to observe QC testing at a reduced frequency. The engineer may verify bolt installation by periodically testing with a feeler gauge.

641.3.1.3 Anchor Assembly

(1) Install structures on anchor rods conforming to the procedures enumerated in department form DT2321. Complete department form DT2321 for each structure. Indicate the parties responsible for the installation and submit the form to the engineer for inclusion in the permanent project record.

641.3.1.4 Sign Installation

(1) Install permanent signs as soon as support structures are erected. If permanent signing is not available, install sign blanks to control vibration. Fasten to the supporting structure conforming to 637.3.3.3.

(2) For overhead sign supports, ensure that sign blanks are the same sizes and at the same locations as the permanent signs.

(3) For sign bridges, attach sign blanks to a minimum of 1/4 the truss length near its center. Use sign blanks that are at a minimum 24 inches larger than the truss depth and project an equal distance beyond the top and bottom chord members.

(4) Install structure identification plaques on overhead sign supports and sign bridges in the locations the plan details show.

641.3.2 Steel Sign Bridges

641.3.2.1 General

(1) Under the Sign Bridge Single Pole Sign Support One Sign bid items, furnish and erect single pole sign supports with attachments for signs facing in one direction.

(2) Under the Sign Bridge Single Pole Sign Support Two Signs bid items, furnish and erect single pole sign supports with attachments for signs facing in opposite directions.

(3) Under the Sign Bridge Cantilevered bid items, furnish and erect cantilevered sign bridges with a single supporting structure.

(4) Under the Sign Bridge Structure Mounted bid items, furnish and erect sign bridges mounted on overhead roadway bridges.

(5) Under the Sign Bridge bid items, furnish and erect sign bridges with multiple supporting structures.

641.3.2.2 Welding

(1) Perform shop welding for steel sign bridges and supports as the plans show and conforming to AWS D 1.1, Structural Welding Code - Steel.

(2) Do not weld in the field without the engineer's written approval. The engineer will only allow field welding for repairs in noncritical locations and when a department-approved individual competent to perform inspections is present during the welding. Perform field welding using personnel qualified under AWS D 1.5, Bridge Welding Code.

(3) Inspect welds visually, additionally, if the engineer determines, test butt welds in main, stress-carrying members subject to tension or stress reversal by radiographic or ultrasonic methods over the entire length of the weld. Test other butt welds in these members by the same methods, except the engineer will determine the length of weld to test. Use either the dye penetrant method, or the magnetic particle method to test the fillet welds connecting columns to bases and main chord members, including the associated flanges, gussets, or main load carrying brackets or members, and on fillet welds

connecting flanges to the main truss chord members. Perform the dye penetrant test according to ASTM E165 and perform the magnetic particle method according to ASTM E709.

(4) Shop weld aluminum catwalk supports and handrails conforming to AWS D 1.2, Structural Welding Code - Aluminum. Do not weld aluminum in the field.

641.3.2.3 Fabrication

(1) Blast clean and then zinc coat the fabricated sign bridge trusses, columns, and their steel accessories after completing cutting, punching, drilling, and welding.

(2) After zinc coating, assemble the individual members making up the truss sections, unless fabricated and zinc coated in one piece in the shop, adjust to the proper shape and alignment, and tighten the high-strength bolts to the required tension. Provide a certificate of compliance certifying that high-strength bolts within truss sections are tensioned conforming to 506.3.12. Then, assemble the truss sections that make up any one sign bridge in the shop, and adjust to proper alignment and camber as the plans show. Matchmark all truss sections and shims before disassembling for shipment.

641.3.2.4 Handling and Field Assembly

(1) Protect zinc coated members from damage to the zinc coating during transportation, storage, and erection. Paint areas of damaged zinc coating with 2 coats of zinc dust/zinc oxide paint. Clean damaged and adjacent areas by sanding, scraping, chipping, or wire brushing. Apply a profile to the bare metal surface using a needle gun before painting. For areas of damage larger than 10 square inches metalize according to AASHTO M36 or, for field repairs, using an engineer-approved high-temperature application of zinc powder and flux in paste or stick form.

(2) Assemble the sections making up the truss, together as a single unit, before attaching to the columns.

641.3.3 Overhead Sign Supports

(1) Under the Overhead Sign Support bid item, furnish and erect commercially designed sign supports fabricated from steel. Construct according to the shop drawings.

641.4 Measurement

(1) The department will measure the Sign Bridge bid items as a single lump sum unit for each sign bridge acceptably completed.

(2) The department will measure the Overhead Sign Support bid items as a single lump sum unit for each overhead sign support acceptably completed.

641.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
641.0100	Sign Bridge Single Pole Sign Support One Sign (structure)	LS
641.0600	Sign Bridge Single Pole Sign Support Two Signs (structure)	LS
641.1200	Sign Bridge Cantilevered (structure)	LS
641.5100	Sign Bridge Structure Mounted (structure)	LS
641.6600	Sign Bridge (structure)	LS
641.8100	Overhead Sign Support (structure)	LS

(2) Payment for the Sign Bridge bid items is full compensation for providing sign bridges; for anchor assemblies and templates; for high-strength bolt/nut/washer assemblies and DTIs including those required for testing; and for sign blanks. Concrete footings are paid for separately under 636.5.

(3) Payment for the Overhead Sign Support bid items is full compensation for designing the sign support structure; for providing the sign support; for excavating and backfilling; for providing concrete footings including reinforcing steel; for providing anchor assemblies and templates; for high-strength bolt/nut/washer assemblies and DTIs including those required for testing; and for sign blanks.

(4) The department will pay separately for signs and the sign mounting system under 637.5 and for luminaires under 659.5.

Section 642 Field Facilities

642.1 Description

(1) This section describes furnishing, placing or erecting, equipping, and maintaining field offices and field laboratories as required in the contract at engineer-approved locations.

642.2 Materials

642.2.1 General

(1) Provide field offices and field laboratories that are mobile, house-type trailers, or houses, or other engineer-approved types that are floored, roofed, and weatherproofed, and have a minimum ceiling height of 6 feet-9 inches.

(2) Equip these facilities with suitable artificial lighting and adequate heating equipment along with the necessary fuel to maintain a minimum temperature of 68 F during the hours occupied.

(3) Provide and maintain an adequate supply of bottled drinking water.

(4) Provide and maintain suitable interior or exterior sanitary facilities conforming to State and local health requirements, in clean and good working condition, and stock with sanitary supplies for the duration of the contract.

(5) Supply a first aid kit in each field office and field laboratory provided under the contract. Ensure the kits are readily accessible to project personnel. Check the contents of each kit at least once each week and replenish expended items. Ensure each kit contains, at a minimum, a supply of latex or nitrile gloves, CPR masks, adhesive tape, pressure and cling bandages, antiseptic wipes, bite/sting swabs, cold packs, and safety goggles.

(6) For situations that may expose the eyes or body of a worker to corrosive or potentially harmful materials, provide emergency use facilities capable of flushing the eyes, or drenching the body of an exposed worker with water for 15 minutes.

(7) Provide at least 4 windows, positioned for cross ventilation, and equipped with required locks and screens. Securely fasten heavy screening over all windows. Use screening made of No. 2 mesh, 14-gauge or heavier, steel wire cloth, zinc coated after weaving.

(8) Equip with a 6-pound or larger fire extinguisher conforming to class A, B, and C of the NFPA Code.

(9) Equip the exterior doors with heavy-duty clasps bolted through the door and jamb with heavy-duty padlocks.

642.2.2 Field Office

642.2.2.1 General

Revise 642.2.2.1 to require additional technology to support increased remote access & printing needs in the field. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Provide each field office with two rooms, separated by an interior door with a padlock. Ensure that each room has a separate exterior door and its own air conditioner. Locate the office where a quality internet connection can be achieved.

(2) Provide local and long distance telephone service for exclusive department use that has the following:

- Two programmable touch-tone phones, one of which is cordless. Ensure that phone operations will not interfere with other telecommunications equipment.
- Voice mail service or an answering machine.

(3) Provide unlimited high-speed internet service for exclusive department use via cable or DSL connection with a modem/router and capable of supporting cloud enabled file sharing, voice over internet protocol (VoIP), video conferencing, and web based applications. Ensure that system meets the following:

- Includes a wireless network for the field office.
- Can accommodate IPSec based VPN products.
- Has a bandwidth range as follows:

Field office with 1-5 staff:	A minimum connection speed of 5 Mbps download and 1 Mbps upload. If a cable or DSL option is not available the contractor may provide a personal hotspot using cell phone tethering or other device able to achieve the specified minimum speeds inside the field office.
Field office with 6 or more staff:	A minimum connection speed of 10 Mbps + 1/2 Mbps per user download and 5 Mbps upload.

Projects over 50 million dollars: A minimum connection speed of 20 Mbps + 1/2 Mbps per user download and 10 Mbps upload. Coordinate network setup at the leased office with the WisDOT network team.

(4) Provide and maintain a Windows 7 and Windows 10 compliant multi-function device with copy, print, and scan capabilities that can accommodate both 8 1/2" x 11" and 11" x 17" paper. Replenish paper, toner cartridges, and other supplies before fully expended. Ensure that department staff can connect to the device either directly or through the field office wireless network.

(5) Equip with a drafting table with a drafter's stool. Except as specified in 642.2.2.4, provide 2 ergonomically correct office chairs in working condition with, at a minimum, the following:

1. Five-legged base with casters.
2. Seat adjustable from 15 to 22 inches from the floor with a seamless waterfall, rounded, front edge.
3. High backrest with no arms or adjustable arms.

642.2.2.2 Type B

(1) Under bid item Field Office Type B, furnish a facility with minimum exterior dimensions of 8 feet wide and 20 feet long, excluding hitch; and equipped as specified in 642.2.2.1

642.2.2.3 Type C

(1) Under bid item Field Office Type C, furnish a facility with minimum exterior dimensions of 10 feet wide and 30 feet long or 8 feet wide and 40 feet long, excluding hitch; equipped as specified in 642.2.2.1; and with the following:

1. Two suitable office desks with drawers and locks.
2. Three folding chairs.

642.2.2.4 Type D

(1) Under bid item Field Office Type D, furnish a facility with minimum exterior dimensions of 10 feet wide and 30 feet long, excluding hitch; and equipped as specified in 642.2.2.1; and with the following:

1. Three suitable office desks with drawers and locks.
2. One additional office chair for a total of 3.
3. Two folding tables.
4. Nine folding chairs.

642.2.3 Field Laboratory

(1) Under the Field Laboratory bid item, furnish a facility of minimum exterior dimensions of 8 feet wide and 16 feet long, excluding hitch; and equipped as specified in 642.2.2.1 except as follows:

1. Provide a suitable workbench.
2. Provide at least 15 linear feet of shelving, approximately 14 inch wide.
3. Provide an adequate water supply for testing purposes.
4. Only one air conditioner is required.
5. No office chairs are required.

(2) If using the laboratory for HMA pavement work, equip it with a suitable fan with a minimum capacity of 1000 cubic feet per minute, in good working condition. Install the fan in an outside wall above the work bench used for asphalt extraction testing. Enclose the fan inlet and work bench top in a suitable hood or enclosure that allows effective removal of the fumes from the extraction testing.

642.3 Construction

(1) Locate field offices and field laboratories at engineer-approved locations. Do not combine field offices and field laboratories, or combine them with, or attached them to, any buildings used by the contractor, unless the engineer allows in writing.

(2) Anchor or secure the field offices and field laboratories to prevent them from overturning by high velocity winds. Locate the field office in a dust-reduced and vibration-free environment.

(3) Do not begin construction operations requiring the use of the field office and laboratory by the department, until the required field office and laboratory are furnished, leveled, secured, fully equipped, and made ready for use.

(4) The field office and laboratory shall remain available for department use until the engineer approves their closure or removal.

(5) These field facilities are for the sole use of the department and upon contract completion remain the contractor's property.

(6) The contractor may furnish, if the contract allows, the field office and field laboratory facilities jointly in cooperation with other contractors on designated projects.

642.4 Measurement

(1) The department will measure the Field Office and Field Laboratory bid items as each field office or laboratory acceptably completed.

642.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
642.5000 - 5999	Field Office (type) (project)	EACH
642.6000	Field Laboratory (project)	EACH

(2) Payment for the Field Office and Field Laboratory bid items is full compensation for providing, equipping, securing, and maintaining the facility; for telecommunications equipment, installation, and service fees; and for providing bottled water, utilities, fuel, ventilation, and toilet facilities as required, either independently or jointly, for the time specified in 642.3.

Revise 642.5(3) to restrict department payment of usage fees to long distance phone calls.

(3) The department will pay for long distance telephone usage fees incurred by department staff.

Section 643 Traffic Control

643.1 Description

(1) This section describes providing, maintaining, repositioning, and removing temporary traffic control devices as follows:

Drums	Warning lights	42-inch cones
Barricades	Arrow boards	Portable changeable message signs
Flexible tubular markers	Signs	

643.2 Materials

643.2.1 General

(1) Furnish materials and devices conforming to the WMUTCD that are acceptable according to the ATSSA publication Quality Guidelines for Temporary Traffic Control Devices and Features.

(2) Place the name and telephone number of the agency, contractor, supplier, or person responsible for 24-hour emergency service on each drum, a rail of each barricade, arrow board, the back of each sign, Portable Changeable Message Sign, and cone. Use non-reflective letters at least 3/4 inch but no more than 2 inches high.

(3) Traffic control devices remain the contractor's property upon completion of the work unless the contract specifies otherwise.

643.2.2 Department's Approved Products List (APL)

(1) Furnish materials from the department's APL as follows:

- Drums
- Barricades
- Flexible tubular marker posts including bases
- Warning lights and attachment hardware
- Arrow boards
- Sign sheeting
- 42-inch cone assemblies
- Portable changeable message signs

643.2.3 Signs

643.2.3.1 General

(1) Layout signs according to the plans. If the plans do not show the layout, conform to the department's Sign Plate Book. If neither the plans nor the Sign Plate Book shows the layout, conform to the FHWA Manual of Standard Highway Signs.

(2) If the contract does not specify the size, provide signs as large or larger than the size the WMUTCD specifies for higher-speed locations. The engineer may allow smaller signs if space is limited and the WMUTCD allows.

(3) Use the materials and methods specified in 637, for type II signs, to manufacture and assemble signs. In addition, the contractor may use the following:

1. For all signs, one or more of the following:
   - 1.1. An exterior grade B-B or better overlay plywood sign base 1/2-inch or thicker.
   - 1.2. For signs 24 inches or less wide, corrugated polypropylene or polyethylene plastic sign base.
     - 1.2.1. Provide a 0.4-inch thick base with a 0.035-inch wall thickness and 0.4-inch cell size.
   - 1.3. An aluminum/plastic laminate sign base.
     - 1.3.1. Provide an aluminum faced composite base 0.080 - 0.100 inches thick, with aluminum outer layers 0.010 - 0.020 inches thick surrounding a polyethylene or other thermoplastic core.
2. For signs mounted on portable sign supports or barricades, in addition to the materials and methods specified above, the contractor may also use one or more of the following:
   - For signs wider than 24 inches, corrugated polypropylene or polyethylene plastic sign base.
   - A retroreflective roll-up sign.
   - A sheet aluminum sign base 0.080 inches or thicker.

(4) Prepare the sign base as the sheeting manufacturer recommends.

(5) If using plywood sign bases with prismatic sheeting, use new plywood. For other sign base types, the contractor may use a reconditioned base if previous sheeting materials are removed before applying new prismatic sheeting. Do not remove messages and reapply new messages to existing signs with prismatic sheeting, except as specified for overlays in 643.2.3.2.

(6) Provide a sign support system as follows:

1. For signs mounted on posts, use posts from the FHWA list of accepted breakaway sign supports.

2. For signs mounted on portable sign supports or barricades, use signs and supports from the departments approved products list.

643.2.3.2 Sign Message Overlays

643.2.3.2.1 General

(1) The contractor may alter the message on standard construction signs by applying demountable plaque overlays or direct-applied pressure-sensitive sheeting overlays. Do not apply more than one overlay per sign. Do not encompass more than one line of the sign message with the overlay. On W20-5 or W20-58 series signs, the contractor may use 2 overlays to independently alter the right/left lane message and the ahead/distance message.

(2) Match the specified letter height, letter series, and letter stroke width of the message on the sign on which mounting plaques or overlays.

(3) Ensure that the reflectivity and the color of the sheeting on plaques or sheeting overlays and base signs are similar enough that the composite sign exhibits the visual impact of one integral sign during both daytime and nighttime.

(4) Match the sign face material for overlays to the base sign reflective sheeting material.

(5) Do not use sign overlays for symbol messages, except for the lane reduction transition sign, WO4-2.

643.2.3.2.2 Demountable Plaque Overlays

(1) For the base material, furnish sheet aluminum conforming to 637.2.1.3. Furnish reflective sheeting for sign face material conforming to 643.2.3.1. Apply the sign message using stencil paste conforming to 637.2.3.2 and clear finish conforming to 637.3.2.5.

643.2.3.3 Sign Covering Material

(1) Furnish sheet aluminum, plywood, or corrugated plastic sign covers conforming to the requirements for sign base materials specified in 643.2.3.1, except the minimum thickness for aluminum covers is 0.040 inches. With the engineer's approval, the contractor may use systems specifically manufactured to cover highway signs or other weather resistant materials that will not damage the sign's reflective face. Do not use tape or other adhesives to fabricate or attach covers.

(2) Ensure that covers are blank, opaque, and match the sign face color or are flat black. Use only one color per sign.

(3) Furnish spacers, 0.08-inch nylon washers that will not damage the sign's reflective face.

643.2.4 Cellular Communication for Portable Changeable Message Signs (PCMS)

(1) Furnish a cellular modem registered to a cellular carrier with a 12 volt DC power supply, a built-in security, port forwarding, and IP pass-through capabilities. Ensure that the modem can handle -30 C to +75 C temperatures.

(2) Provide the department with an IP address, serial port settings, and passwords.

643.3 Construction

643.3.1 General

Revise 643.3.1(1) to require removing devices from the project or storing devices away from traffic when not in use. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Provide and maintain traffic control devices located where the plans show or engineer directs to maintain a safe work zone throughout the contract duration. Relocate as required to accommodate changing work operations. When not in use, place devices away from traffic outside of paved and gravel shoulder surfaces. Where there is barrier on the shoulder, the contractor may place devices not in use on the shoulder as close as possible to the barrier and delineated with drums. Lay signs and supports flat on the grade with uprights oriented parallel to and downstream from traffic. Do not stack devices or equipment. Promptly remove temporary devices from within the project limits as follows:

- That will not be used within 14 consecutive calendar days.
- Within 5 business days of substantial completion unless the engineer allows otherwise.

(2) Attach warning lights to traffic control devices with vandal resistant hardware.

(3) Do not power PCMS and arrow boards with a generator.

(4) Perform traffic control work according to part VI of the WMUTCD for temporary traffic control unless the contract specifies or engineer directs otherwise. Ensure the proper placement and operation of signs and traffic control devices before beginning associated work. Relocate signs and traffic control devices concurrently with moving work operations.

(5) Review signs and traffic control devices for location, position, visibility, and appropriateness for job conditions immediately after each setup. Do additional reviews as necessary to provide a safe work

zone and ensure signs and traffic control devices conform to the contract. Perform work zone reviews from the direction of approaching traffic. Include temporary pavement marking placed under 649.

(6) Replace devices the ATSSA guide defines as unacceptable. Maintain traffic control devices on the project at or above the quality the ATSSA guide defines as marginal by doing the following:

1. Keep sheeting on drums, barricades, and other devices clean.
2. Promptly repair sheeting scratches, rips, and tears.
3. Repair or replace devices that have large areas of abrasion or missing sheeting.
4. Replace devices that have excessive color fading.
5. Do not use devices fractured, punctured, dented, or deformed severely enough to affect the overall dimensions, stability, visibility, or reflectivity.
6. Maintain the retro-reflectance of signs, drums, posts, and barricades at a level not less than 50 percent of the minimum value specified for type III reflective sheeting in ASTM D4956.

(7) Promptly restore traffic control devices damaged or disturbed within 2 hours of becoming aware of a deficiency.

(8) If, in the engineer's judgment, the contractor fails to provide the traffic control required to maintain a safe work zone under the contract, the engineer may restrict construction operations.

643.3.2 Flexible Tubular Markers

(1) Attach bases to the pavement as the plan details show.

(2) Attach the posts to the base using a locking pin or other engineer-approved system. Use new marker posts with reflective sheeting for installation in new locations. The contractor may furnish used posts, in like-new condition with new reflective marking, as replacement posts.

(3) Remove bases in a way that minimizes damage to the pavement. If bolted, remove the bolts below the pavement surface. Repair damage done during removal as the engineer directs.

643.3.3 Arrow Boards

(1) The contractor may use solar arrow boards only in stationary setups.

(2) Operate arrow boards during the hours of darkness at an illumination level of not more than 50 percent of the daytime level. Ensure the following:

- The arrow board is continuously visible and identifiable for a distance of one mile in advance of the beginning of the lane closure taper.
- The lamps are visible at a minimum 18 degrees horizontal angle and 8 degrees vertical angle, measured from a perpendicular to the arrow board plane.
- The minimum lamp "on" time is 50 percent and no lamps remain illuminated during "off" time.

(3) Do not display arrows or chevrons by lighting in sequence from left to right, or right to left.

643.3.4 Signs

643.3.4.1 General

(1) Install post mounted signs as the plans show. Trim posts neatly with top of sign, so that no portion of the post protrudes above the sign. Do not install signs on existing posts unless the plans show or the engineer or post owner allows. Do not install signs or sign posts on guardrail posts.

(2) Use spacers when fastening a sign or sign cover on existing signs and attach at a minimum of four points per panel as follows:

- For aluminum signs: use 3/16 inch diameter aluminum rivets or aluminum self-tapping screws.
- For plywood signs: use 3/16 inch diameter wood screws.
- Space screws or rivets at least 12 inches apart and at least 1/4 inch from the edge of the cover.

(3) Repair or replace damaged permanent signs resulting from covering as the engineer directs. Remove covers when no longer necessary.

643.3.4.2 Sign Message Overlays

(1) Fasten plaque overlays to base signs with 4 bolts or screws, one in each corner of the plaque. Apply sheeting overlays so that no curling or lifting of the overlay occurs during use. Promptly replace the sign if any part of the overlay curls or lifts.

(2) Position plaques or sheeting overlays on base signs so that they appear to be an integral part of the message. Ensure that plaques or sheeting overlays completely cover the underlying sign message that is no longer applicable. Do not overlay any other part of base sign messages, or let the overlay extend beyond the base sign border.

643.3.4.3 Covering Signs

(1) If a sign message is no longer relevant, promptly remove the sign or cover all or, if the engineer allows, part of the sign with materials conforming to 643.2.3.3.

- Make Type I sign covers square or rectangular and sized in increments of 12 inches.
- Cover Type II signs completely.

643.3.4.4 Fixed Message Signs

(1) Custom signs, or standard signs with a dimension greater than 60 inches are fixed message signs. If fastening a fixed message sign to an existing sign, completely cover the underlying sign message that is not applicable.

643.3.5 Portable Changeable Message Signs

643.3.5.1 General

(1) Ensure that the PCMS is level and operating satisfactorily before activating. Maintain the PCMS in good working condition. Repair damaged or malfunctioning PCMS units within 2 hours after discovering a problem.

(2) Place the sign so that in the operating mode the bottom of the message panel is 7 feet or higher above the top of curb or near edge of pavement. In rural areas with no view obstructions, the contractor may reduce the minimum mounting height to 5 feet. Orient the message panel so the message is legible from 850 feet under both day and night conditions.

(3) Store predetermined messages in the controller memory for recall on demand. In addition, store other messages as the engineer directs. Display messages using all upper case alphanumeric characters 18 inch high by 11 inch wide.

(4) Provide password protection to the PCMS control unit unique to the project.

643.3.5.2 Cellular Communication

(1) Install the cellular modem in a lockable, weatherproof compartment in the PCMS trailer. Mount the antenna at the highest practical location on the PCMS.

(2) A minimum of 14 days before deployment, demonstrate to the department that the cellular modem is capable of communications with the Traffic Management Center. If remote communications are interrupted or temporarily unavailable, the department will notify the contractor to change messages manually. Update messages within 2 hours of receiving notification.

643.3.6 Traffic Control

(1) Under the Traffic Control bid item, install and reposition traffic control devices as required to restrict access to a portion or all of the roadway to public traffic. This work includes initial set up, stage changes, and removal after the work is completed.

643.4 Measurement

643.4.1 Items Measured by the Day

(1) The department will measure the number of calendar days acceptably completed that each sign or each device under a bid item is in use. The department will not measure a sign or a device on days it is not required. The department will deduct one day for each calendar day a sign or a device is required but out of service for more than 2 hours.

(2) The department will only measure the Traffic Control PCMS bid items on days the PCMS is available for exclusive use under the contract.

643.4.2 Flexible Tubular Markers

(1) The department will measure the Traffic Control Flexible Tubular Marker bid items as each individual installation and removal acceptably completed. The department will measure replacement posts and bases damaged by public traffic.

643.4.3 Fixed Message Signs

(1) The department will measure Traffic Control Signs Fixed Message by the square foot acceptably completed, measured as the area of the sign face.

643.4.4 Covering Signs

(1) The department will measure the Traffic Control Covering Signs bid items as each individual cover/uncover cycle acceptably completed per location, measured as the number of cover/uncover cycles for existing signs. The department will not measure additional cover/uncover cycles as might be required to accommodate the contractor's operations.

643.4.5 Traffic Control

(1) The department will measure Traffic Control once for the contract acceptably completed and will not include any work performed under other specific traffic control contract bid items.

643.5 Payment

643.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
643.0300	Traffic Control Drums	DAY
643.0400 - 0449	Traffic Control Barricades (type)	DAY
643.0500	Traffic Control Flexible Tubular Marker Posts	EACH
643.0600	Traffic Control Flexible Tubular Marker Bases	EACH
643.0700 - 0799	Traffic Control Warning Lights (type)	DAY
643.0800	Traffic Control Arrow Boards	DAY
643.0900	Traffic Control Signs	DAY
643.0910	Traffic Control Covering Signs Type I	EACH
643.0920	Traffic Control Covering Signs Type II	EACH
643.1000	Traffic Control Signs Fixed Message	SF
643.1050	Traffic Control PCMS	DAY
643.1051	Traffic Control PCMS with Cellular Communications	DAY
643.1070 - 1079	Traffic Control Cones (height)	DAY
643.5000	Traffic Control	EACH

643.5.2 Signs and Devices

(1) Payment for the signs and devices bid items is full compensation for furnishing and maintaining those signs and devices. Payment also includes the following:

- Repairing pavement damaged by removing bases under Traffic Control Flexible Tubular Marker Bases.
- Posts or other sign supports as well as partially or fully covering or uncovering signs under Traffic Control Signs and Traffic Control Signs Fixed Message.

643.5.3 Covering Signs

(1) Payment for the Traffic Control Covering Signs bid items is full compensation for providing full or partial sign covers, for removing covers, and for repairing or replacing damaged signs.

643.5.4 Traffic Control

(1) Payment for Traffic Control is full compensation for costs associated with traffic control required under 643 but not included in other 643 contract bid items.

Section 645 Geosynthetics

645.1 Description

(1) This section describes providing geotextiles for subgrade separation and stabilization, drainage filtration, subgrade reinforcement, and under culverts and riprap.

(2) This section also describes providing geogrid for subgrade, marsh, and slope stability reinforcement.

645.2 Materials

645.2.1 General

(1) Furnish material that is insect, rodent, mildew, and rot resistant in a wrapping that protects the it from ultraviolet radiation and from abrasion due to shipping and hauling. Keep material dry until installed. Clearly mark rolls to show the material type.

(2) The engineer may obtain material samples for testing from the job site as specified here in 645.2 for individual materials, or as the engineer directs.

(3) If no minimum values are specified here in 645.2, use those specified in the special provisions.

645.2.2 Geotextile

645.2.2.1 General

(1) Furnish geotextiles of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Fabric shall have the minimum strength values in the weakest primary direction. The contractor may use nonwoven fabric that is one or a combination of the following: needle punched, heat bonded, or resin bonded.

(2) If using sewn seams, furnish a field sewn seam sample produced from the geotextile and thread and with the equipment proposing to use on the project, before incorporating into the work.

645.2.2.2 Geotextile, Type SAS (Subgrade Aggregate Separation)

Replace 645.2.2.2(1), 645.2.2.4(1), 645.2.2.6(1), 645.2.2.7(1), and 645.2.2.8(1) to switch from ASTM D4833 to ASTM D6241 for puncture testing. This change was implemented in ASP 6 effective with the December 2017 letting

(1) Furnish fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	170 lb
Minimum puncture strength	ASTM D6241	350 lb
Maximum apparent opening size	ASTM D4751	No. 70
Minimum permittivity	ASTM D4491	0.35 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) For quantities over 20,000 square yards, furnish to the engineer, at least 10 days before use in the work, a manufacturer's certified report of test or analysis that shows the geotextile delivered conforms to the above requirements. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of fabric for testing from the job site for each 20,000 square yards or lesser portion used in the work.

645.2.2.3 Geotextile, Type MS (Marsh Stabilization)

(1) Furnish fabric conforming to the physical properties the special provisions specify.

(2) Deliver to the engineer a sample of the geotextile material at least 15 days before incorporating into the work. At the same time, furnish a sewn seam sample using the same geotextile, thread, seam spacing, and number, and overlap distance as are intended or required for use.

(3) Furnish to the engineer, at least 15 days before use in the work, a manufacturer's certified report of test or analysis that shows that the geotextile delivered conforms to the above requirements. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of fabric for testing from the job site for each 10,000 square yards or lesser portion used on the contract.

645.2.2.4 Geotextile, Type DF (Drainage Filtration)

(1) Furnish fabric conforming with the physical requirements of either schedule A, schedule B, or schedule C as the contract specifies.

SCHEDULE A TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	110 lb
Minimum puncture strength	ASTM D6241	200 lb
Minimum apparent breaking elongation	ASTM D4632	30%

Maximum apparent opening size	ASTM D4751	300 µm
Minimum permittivity	ASTM D4491	0.70 s^{-1}

SCHEDULE B TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	180 lb
Minimum puncture strength	ASTM D6241	350 lb
Minimum apparent breaking elongation	ASTM D4632	30%
Maximum apparent opening size	ASTM D4751	300 µm
Minimum permittivity	ASTM D4491	1.35 s^{-1}

SCHEDULE C TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	180 lb
Minimum puncture strength	ASTM D6241	350 lb
Minimum apparent breaking elongation	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	600 µm
Minimum permittivity	ASTM D4491	1.00 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

(2) Do not use slit film woven fabric for this work.

(3) For quantities over 2000 square yards, furnish to the engineer, at least 10 days before use in the work, a manufacturer's certified report of test or analysis that shows the geotextile delivered conforms to the above requirements. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of fabric for testing from the job site for each 2000 square yards or lesser portion used in the work.

645.2.2.5 Geotextile, Type SR (Subgrade Reinforcement)

(1) Furnish fabric conforming to the physical properties the special provisions specify.

(2) For quantities over 10,000 square yards, furnish to the engineer, at least 10 days before use in the work, a manufacturer's certified report of test or analysis that shows the geotextile delivered conforms to the above requirements. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of fabric for testing from the job site for each 10,000 square yards or lesser portion thereof used on this contract.

645.2.2.6 Geotextile, Type R (Riprap)

(1) Use fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength	ASTM D4632	205 lb
Minimum puncture strength	ASTM D6241	400 lb
Minimum apparent breaking elongation	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	No. 30
Minimum permittivity	ASTM D4491	0.12 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

645.2.2.7 Geotextile, Type HR (Heavy Riprap)

(1) Use fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]
Minimum grab tensile strength, lb	ASTM D4632	305 lb
Minimum puncture strength, lb	ASTM D6241	500 lb
Minimum apparent breaking elongation, %	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	No. 30
Minimum permittivity	ASTM D4491	0.40, s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

645.2.2.8 Geotextile, Type C (Modified SAS)

(1) Use fabric conforming to the following physical properties:

TEST	METHOD	VALUE[1]

Grab tensile strength, lb	ASTM D4632	205 lb
Puncture strength, lb	ASTM D6241	350 lb
Maximum apparent opening size	ASTM D4751	No. 50
Minimum permittivity	ASTM D4491	0.12 s^{-1}

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

645.2.2.9 Geotextile, Type ES (Embankment Stabilization)

(1) Furnish fabric conforming to the physical properties the special provisions specify.

(2) Deliver to the engineer a sample of the geotextile material at least 15 days before incorporating it into the work. At the same time, furnish a sewn seam sample using the same geotextile, thread, seam spacing and number, and overlap distance as are intended or required for use in the work.

(3) Furnish to the engineer, at least 15 days before use in the work, a manufacturer's certified report of test or analysis that shows that the geotextile delivered conforms to the above requirements. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of fabric for testing from the job site for each 10,000 square yard or lesser portion used on the contract.

645.2.3 Geogrid

645.2.3.1 General

(1) Furnish geogrid that consists of either single or joined multiple layers of a uniform square or rectangular grid of bonded, formed, or fused polymer tensile strands. Furnish polyester, polypropylene, polyamide, or polyethylene material that maintains dimensional stability during handling, placing, and installation. Use geogrid that is at least 6.0 feet wide.

(2) Deliver a sample of the geogrid material to the engineer at least 10 business days before incorporating into the work. Submit a manufacturer's Certified Report of Test or Analysis that verifies that the geogrid delivered meets the requirements of this specification. The engineer will obtain samples of geogrid for testing from the job site for each 10,000 square yards, or portion thereof, incorporated into the work.

645.2.3.2 Geogrid, Type SR (Subgrade Reinforcement)

(1) Provide geogrid for subgrade reinforcement that complies with the following physical properties:

TEST	METHOD	VALUE[1]
Tensile Strength at 5% Strain (both principal directions in lb/ft)	ASTM D4595[2]	450 min
Flexural Rigidity (both principal directions in mg/cm)	ASTM D1388[3]	150,000 min.
Aperture Area (in^2)	Inside Measurement[4]	5.0 max
Aperture Dimension (in)	Inside Measurement[4]	0.5 min

[1] All numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

[2] The tensile strength (T) of a joined multi-layered geogrid shall be computed using the following equation:

$$T = n \times t \times f$$

Where:

n = the number of individual layers in the joined multi-layered geogrid

t = the tensile strength of a single layer of geogrid as determined using testing method ASTM D4595

f = reduction factor based on the number of layers comprising the multi-layered system and determined by the equation f = 1.00 - [0.04(n - 1)]

[3 Values determined by option "A" cantilever test of testing method ASTM D1388 using test specimens that are 36 inches ±0.04 inch long. Test specimen widths for differing geogrids are variable and equal to one element plus 1/2 the aperture width on both sides of that element. An element is defined as the minimum number of parallel strands that form a distinguishable repeating pattern.

[4] Aperture area and aperture dimension for joined multi-layer geogrids are determined based on measurement of a single layer of the geogrid.

645.2.3.3 Geogrid, Type MR (Marsh Reinforcement)

(1) Provide geogrid for marsh reinforcement that complies with the physical properties specified in the contract special provisions.

645.2.3.4 Geogrid, Type SSR (Slope Stability Reinforcement)

(1) Provide geogrid for slope stability reinforcement that complies with the physical properties specified in the contract special provisions.

645.3 Construction

645.3.1 Geotextiles

645.3.1.1 General

(1) For geotextiles that require sewing, sew factory and field seams with a thread having the same or greater durability as the fabric material. Use a 401 stitch conforming to Federal Standard No. 751a for seams. Ensure that seams develop a tensile strength equal to or greater than 60 percent of the specified grab tensile strength of the fabric, unless specified otherwise.

645.3.1.2 Geotextile, Type SAS

(1) Before placing the geotextile, smooth, shape, and compact the subgrade to the required grade, section, and density. After placing the fabric on the subgrade area, the engineer will not allow traffic or construction equipment to travel directly on the fabric.

(2) Roll the fabric out on the roadway and pull taut manually to remove wrinkles. Join separate pieces of fabric by overlapping or sewing. Place the fabric in the overlapped joints so it overlaps at least 18 inches.

(3) The engineer may require the use of weights or pins to prevent the wind from lifting the fabric.

(4) After placing, do not expose the fabric longer than 48 hours before covering.

(5) Place the base material over the fabric by back dumping with trucks and leveling with a crawler dozer. The contractor shall not use construction equipment that causes ruts deeper than 3 inches. Fill ruts with additional material. The engineer will not allow the contractor to smooth ruts without adding additional material. Cover damaged areas with a patch of fabric using a 3-foot overlap in all directions.

645.3.1.3 Geotextile, Type MS

(1) Complete clearing operations before placing the fabric. Within the area being covered by fabric, cut stumps and sharp objects level with the ground surface. Do not remove sod, grass, and roots that extend beneath the ground surface. Carefully place the geotextile on the ground using hand methods to avoid disturbing the existing root mat and vegetation. Roll the fabric out as smoothly as possible and pull taut manually to remove wrinkles. The engineer may require the use of weights or pins to prevent the wind from lifting the fabric. After placement, do not expose the fabric longer than 48 hours before covering. If visible defects exist, replace the defective section of fabric with a new defect-free section of fabric.

(2) Place the geotextile with the machine direction perpendicular to the roadway alignment. Sew seams with 2 parallel stitch lines according to plan details. Space the parallel stitching no more than one inch apart. Place seams perpendicular to the roadway alignment and facing upward. Ensure that seams develop at least 80 percent of the specified cross direction tensile strength of the fabric, as determined by the same testing methods. Do not make butt splices between individual roll ends. One stitch line may not cross another stitch line. Repair breaks or faults in any seam as the engineer directs.

(3) Place the initial fill layer over the fabric to a depth not less than one-foot but not more than 2 feet by carefully end dumping and pushing on to the fabric. The contractor shall not use construction equipment that causes ruts deeper than 3 inches and does not excessively deform the marsh surface. The contractor shall not drive vehicles on the fabric. Complete the initial lift and install instrumentation before placing any additional material. After placing the initial lift, place subsequent lifts no deeper than one foot. Do not begin any lift until completing the preceding lift and obtaining the engineer's approval. Conduct spreading operations so that no damage occurs to the fabric. Unless the engineer directs otherwise, place and spread lifts by expanding outward from the centerline of the fill. If fill placement damages the fabric, remove the fill material around the damaged area and the engineer will examine the damaged area to determine if the material requires replacement.

645.3.1.4 Geotextile, Type DF

(1) Before placing the geotextile in trench drains, construct the trench to the grades and dimensions the plans show or as the engineer directs. Remove protruding stones and other matter that might damage the geotextile from the trench walls and base before placing the fabric. Place the geotextile in the trench so it conforms to the trench walls and remains in proper position during drain construction and backfilling. The contractor may join separate pieces of fabric by overlapping or sewing. If overlapping, place the fabric in overlap joints of at least 18 inches in the direction of drain flow. Correct misaligned

fabric as the engineer directs. The engineer will direct treatment of damaged fabric areas by one of the following methods:

1. Place an additional section of fabric extending at least 24 inches beyond any point of the damaged area and position between the trench walls and the damaged fabric.
2. Remove the section of fabric containing the damaged area and replace it with a new section of fabric.

(2) After placing, do not expose the fabric longer than 48 hours before covering.

(3) For applications other than trench drains, construct the surface on which placing the fabric to the grades and dimensions the plans show. Prepare the surface by removing or covering objects that might damage the fabric. Carefully place the fabric to prevent damage and secure in position. Conduct backfilling or covering operations so that no damage or misalignment occurs to the fabric. Treat fabric damage or misalignment as specified in the previous paragraph. After placement, do not expose the fabric longer than 48 hours before covering or backfilling.

645.3.1.5 Geotextile, Type SR

(1) Before placing the fabric, smooth and shape the roadway to the required grade and section, and if the engineer requires, compact to the specified density. After placing the fabric on the earth grade, the contractor shall not allow traffic or construction equipment to travel on the fabric.

(2) Roll out the fabric on the roadway and pull taut manually to remove wrinkles. Join parallel strips of fabric by overlapping or sewing. Sew seams as specified in 645.3.1.1, except ensure a tensile strength equal to or greater than 60 percent of the specified directional tensile strength of the fabric develops. Overlap the fabric in joints at least 24 inches. Overlap butt splices between fabric rolls at least 36 inches. The engineer may require the use of weights or pins to prevent the wind from lifting the fabric.

(3) Cover tears, holes, or rips in the fabric with a patch of fabric overlapping the defect 36 inches in directions.

(4) Cover fabric within 72 hours of placement.

(5) Place the backfill material in an initial lift of 12 inches. Do not place subsequent lifts, in layers exceeding 12 inches thick. Spread each lift with a crawler type tractor and compact with suitable compaction equipment. The contractor shall not use construction equipment that causes ruts deeper than 4 inches. The engineer will not allow turning movements for any hauling or spreading equipment on the fabric until at least 2 lifts of backfill, at least 18 inches deep, are placed and compacted. Do not begin subsequent lifts until spreading and compacting a distance of at least 1000 feet of the previous lift. Maintain a 1000-foot interval between subsequent lifts until completing each lift. If ruts greater than 4 inches develop during construction operations, the engineer may require the contractor to use lighter equipment, equipment with lower contact pressure, or smaller loads on existing equipment.

(6) Fill ruts in the surface of each lift of backfill with additional material. Do not smooth ruts without adding additional backfill.

645.3.1.6 Geotextile, Type R

(1) Before placing the fabric, grade the area smooth and remove stones, roots, sticks, or other matter that might prevent the fabric from completely contacting the soil.

(2) Place the fabric loosely and lay it parallel to the direction of water movement. The engineer may require pinning or stapling to hold the geotextile in place. Join separate pieces of fabric by overlapping or sewing. Overlap the fabric in the joints at least 24 inches in the direction of flow. After placing, do not expose the fabric longer than 48 hours before covering.

(3) Cover damaged areas with a patch of fabric that overlaps 3 feet in all directions.

(4) Place riprap from the base of the slope upward. The engineer will determine the freefall height of riprap, but in no case should this height exceed one foot.

645.3.1.7 Geotextile, Type HR

(1) Place as specified in 645.3.1.6, except that the freefall height of riprap must not exceed 6 inches.

645.3.1.8 Geotextile, Type C

(1) Before placing geotextile, construct and shape the grade to the required grade and section. After placing the fabric, the engineer will not allow traffic or construction equipment to travel on the fabric.

(2) Roll out the fabric on the excavation and pull taut manually to remove wrinkles. Join separate pieces of fabric by overlapping or sewing. Overlap the fabric in joints at least 18 inches. The engineer may require the use of weights or pins to prevent the wind lifting the fabric.

(3) After placing, do not expose the fabric longer than 48 hours before covering.

(4) Then place the specified backfill material over the fabric. The contractor shall not use construction equipment that causes ruts over 3 inches deep. Fill ruts with additional material and level to required grade. Do not smooth ruts without adding additional material.

645.3.1.9 Geotextile, Type ES

(1) Before placing the geotextile, construct the embankment to the required elevation and make the surface smooth and level. Place the fabric on the prepared surface to the limits the plans show with the machine direction of the fabric oriented in the direction the plans show. Roll out the fabric as smoothly as possible and pull taut manually to remove wrinkles. The engineer may require the use of weights or pins to prevent the wind lifting the fabric. After placing, do not expose the fabric longer than 48 hours before covering. If visible defects or damage to the fabric exists, remove the section containing the defect or damage and replace with a new section of defect-free fabric.

(2) Sew seams between fabric strips with 2 parallel stitch lines spaced no more than one inch apart according to the details the plans show. Orient seams parallel to the roadway alignment and face upward. Sew seams with a thread having the same or greater durability as the fabric material. Use a 401 stitch conforming to Federal Standard No. 751a for all seams. Ensure that all seams develop a tensile strength equal to or greater than 50 percent of the specified cross direction tensile strength of the fabric. Repair sewing defects in any seam as the engineer directs. Do not use butt splices between individual roll ends.

(3) Place the initial fill layer over any fabric layer to a depth not less than 8 inches or more than one foot. Carefully end dump and push this lift on to the fabric. Perform spreading operations and use equipment in a way that does not displace or damage the fabric. Do not make sharp turning movements while placing the initial lift over any individual fabric layer. The contractor shall not drive vehicles on the fabric. Complete the preceding lift before beginning the next lift. Place and compact additional lifts as specified in 207.

(4) Unless specified otherwise, use the granular fill material, specified in the plans and special provisions, from at least 8 inches below to at least 8 inches above any single or multiple layer geotextile installation.

645.3.2 Geogrid

645.3.2.1 General

(1) Place geogrid as the plans show or engineer directs. Pull flat and secure using pins, staples, or other devices to prevent movement or displacement. Lap butt joints between roll ends at least 12 inches unless the plans or special provisions specify otherwise. Secure lapped sections together using engineer-approved ties, straps, clips, or other devices. Do not operate vehicles or construction equipment directly on geogrid.

(2) Cover small rips, tears, or defects in the geogrid with an additional section of geogrid secured in place overlapping the damaged area by at least 3 feet in all directions. Remove and replace geogrid sections with large rips, tears, defects, or other damage as the engineer directs before backfilling.

(3) After placement, backfill the geogrid to the depth and with the type of material the plans or special provisions specify. Place, spread, and compact backfill conforming to the standard spec or special provision requirements for that backfill material, except ensure that the initial lift over the geogrid is at least 4 inches deep.

(4) Do not displace or damage the geogrid during backfill operations. The engineer may direct the contractor to repair or replace damaged, displaced, or otherwise defective geogrid and may require equipment and operations changes to prevent further damage or displacement.

645.3.2.2 Geogrid, Type SR

(1) Before placing geogrid, establish the placement surface to the required lines, grades, and dimensions the plans show or as the engineer directs. Smooth and shape the surface to eliminate rocks, clods, roots, or other debris that may damage the geogrid during placement or backfilling.

(2) Overlap parallel strips at least 6 inches.

645.3.2.3 Geogrid, Type MR

645.3.2.3.1 General

(1) Complete clearing operations before placing geogrid. Cut stumps and sharp objects level with the ground surface where placing geogrid. Do not remove sod, grass, or roots that extend beneath the ground surface unless the engineer directs. Avoid disturbing the existing root mat and vegetation during geogrid placement. Unroll the geogrid and pull tight manually to remove wrinkles. If the geogrid

has different strengths in the machine and cross directions, orientate as the plans or special provisions specify.

(2) Overlap parallel strips at least 12 inches unless the plans or special provisions specify otherwise.

645.3.2.4 Geogrid, Type SSR

645.3.2.4.1 General

(1) Before placing the geogrid, smooth and shape the roadway to the required lines, grades and dimensions the plans show or as the engineer directs. Smooth and shape the surface to eliminate rocks, clods, roots, or other debris that may damage the geogrid during placement or backfilling.

(2) Overlap parallel strips at least 12 inches unless the plans or special provisions specify otherwise.

645.4 Measurement

(1) The department will measure the Geotextile and Geogrid bid items by the square yard acceptably completed.

645.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
645.0100 - 0199	Geotextile (type)	SY
645.0200 - 0299	Geogrid (type)	SY

(2) Payment for the Geotextile bid items is full compensation for providing geotextile. Payment for the Geotextile Type MS, Type ES, Type R, Type HR, and Type C bid items also includes preparing the marsh area or foundation before installation.

(3) Payment for the Geogrid bid items is full compensation for providing geogrid. Payment for Geogrid Type MR also includes preparing the marsh area before installation.

Section 646 Pavement Marking

646.1 Description

(1) This section describes providing and removing pavement marking.

646.2 Materials

646.2.1 General

(1) Furnish pavement marking products from the department's APL. Submit certificates of compliance certifying that the products supplied under the contract conform to these specifications.

646.2.2 Glass Beads

(1) Furnish dual coated glass beads treated for both moisture resistance and adherence conforming to AASHTO M247, Type I, except with a minimum of 80 percent true spheres. For each batch of beads actually furnished for the work, submit a certificate of compliance certifying that beads supplied under the contract conform to these specifications.

(2) Furnish beads in containers or bags labeled with the bead type, net weight, lot or batch number, blend date, and manufacturer's name and address.

646.3 Construction

646.3.1 General

646.3.1.1 General Marking

Revise 646.3.1.1(1) to reinstate language that prohibited removing polymer overlay material to receive pavement marking. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Prepare the surface and apply marking as the manufacturer specifies. Provide manufacturer specifications as the engineer requests. Do not mark over a marking product with less adherence or over chipped or peeled marking. Do not remove polymer overlay materials in areas receiving pavement marking. Use only epoxy pavement marking where the contract requires marking placed on polymer overlays.

(2) For moving marking operations conform to the marking plan details.

(3) On highways open to 2-way traffic, in addition to the marking vehicle, provide a leading vehicle and at least one trailing vehicle. Do not use flashing arrow panels to direct traffic to pass. Equip each leading and trailing vehicle with the following:

1. A slow-moving vehicle emblem.
2. One or more flashing or revolving yellow lights showing to the front and rear.
3. Signs to advise traffic of the wet line and number of vehicles in the marking train.

(4) On one-way roadways, operate marking train vehicles in the direction of traffic. Provide the same marking train as specified for 2-way traffic in 646.3.1.1(3) except as follows:

- A leading vehicle is not required, but use 2 trailing vehicles.
- The contractor may use flashing arrow panels to direct traffic to pass.

Revise 646.3.1.1(5) to require masking over pavement marking when resealing bridge decks. This change was implemented in ASP 6 effective with the December 2017 letting.

(5) After the marking can sustain exposure to traffic, re-apply clear protective surface treatment conforming to 502.2.11 where removed from structures during marking surface preparation. Seal exposed concrete including grooves for tape. Cover marking during resealing with a system that will not degrade the marking's retroreflectivity when removed. Uncover marking before opening to traffic.

646.3.1.2 Liquid Marking

(1) Apply marking to the width and color the bid item indicates. Provide a sharp cutoff for both sides and ends of the marking with a uniform cross-section. Do not damage existing marking that will remain in place.

(2) If the engineer requests, provide calculations demonstrating that the application rate is consistent with the specified dimensions and that the bead application rate is consistent with the specified rate. If on any 0.5-mile section or individual special marking have a calculated application rate less than 90 percent of that specified, remove and remark this section or special marking.

(3) If the roadway is open to traffic use temporary raised pavement markers or apply temporary same day marking. Apply permanent marking within 7 days of completing mainline paving. If the roadway is closed during construction, apply permanent marking before opening to traffic.

(4) Protect freshly applied marking until the line is dry or cured enough to prevent pickup under traffic. Place traffic cones on wet lines immediately behind the marking train or use a convoy of moving vehicles to keep traffic from crossing the wet line. Remove cones promptly after the line dries or cures.

(5) Apply liquid marking and glass beads across the line at or exceeding the following:

LIQUID MARKING	PAVEMENT TYPE	THICKNESS (mils)	BEAD APPLICATION (pounds per gallon)
Paint	all	16	8-10
Epoxy	SMA, seal coats, and polymer overlays	25	25
Epoxy	all other	20	22.5

646.3.1.3 Cold Weather Marking

Revise 646.3.1.3 to include tape; epoxy width, thickness, and bead rate; and proving period for cold weather marking.

(1) Do not place permanent paint or permanent tape marking if the ambient or pavement temperature is below 50 F. Choose an epoxy marking compatible with field conditions when placed. Do not place permanent epoxy marking if the ambient or pavement temperature is below 35 F unless the engineer allows in writing.

(2) If the engineer allows or requires marking below the specified minimum temperatures, apply epoxy from the department's APL in the exact location and width where permanent marking would be installed. Place epoxy at the mil thickness and the glass bead application rate specified for permanent epoxy. Maintain until weather permits permanent placement.

(3) Using the failure criteria specified in 646.3.1.5, perform corrective maintenance whenever the failure rate exceeds 25 percent of any section of marking. Completely remove and replace cold weather marking with permanent marking when weather permits. The proving period for the final marking begins after replacement.

646.3.1.4 Removing Marking

(1) Completely remove marking from locations the plan show or as the engineer directs. Unless the bid item designates water blasting, the contractor may use one or a combination of air blasting, water blasting, and grinding. Provide a dust control system and remove accumulated sand or other materials. Collect, haul, and dispose of dust or residue from removals.

(2) Perform air blasting conforming to the following:

- If air blasting within 10 feet of a lane open to traffic, remove all dust and other residue continuously while blast cleaning.
- If removing existing marking before applying new marking, expose at least 90 percent of the marking surface.
- If removing yellow centerline for no passing zone changes, ensure that the cycling mechanism on line removal equipment produces a uniform cycle or alternatively remove by hand.

(3) Perform water blasting only if the ambient temperature is at least 36F and rising. Use a truck mounted ultra-high pressure pump and water tank capable of delivering a minimum of 30,000 psi and up to 40,000 psi to water jet nozzles. Provide a vacuum recovery system that contains waste water and debris to provide a clean, damp-dry surface, without a secondary cleanup operation.

(4) Grind using a truck-mounted or hand system capable of complete removal of the marking. Provide a vacuum system to completely collect dust and debris.

646.3.1.5 Proving Period

(1) The department will accept the work based on an inspection conducted when the contractor completes the work. The engineer will, however, conduct post acceptance inspections periodically during a proving period to evaluate the performance of the marking. The proving period begins on the last day of the month, for all marking placed within each calendar month. For paint, the proving period is 180 days. For other marking, the proving period extends through April 15 of the next calendar year or 180 days, whichever is longer. If weather or road surface conditions prevent the engineer from fully evaluating the marking at the end of the proving period, the engineer may extend the proving period.

(2) The engineer will determine the percent failing during the proving period. The engineer will exclude failures due to abrasion loss at private entrances and within intersections, except for roundabouts. The department defines failure as discoloration, chipping, substrate exposure, or inadequate reflectivity. Color readings need to meet ASTM D6628. The department measures reflectivity in the direction of travel. Failing reflectivity, in millicandelas/lux/m^2, is defined as:

MATERIAL	COLOR	180 DAY DRY RETROREFLECTIVITY
Paint	White	< 235
	Yellow	< 140
Epoxy	White	< 250
	Yellow	< 160
Permanent Tape	White	< 525
	Yellow	< 380

(3) The engineer will conduct an initial inspection of each marking section defined as follows:

1. Each edge line, lane line, or centerline, measured through any 0.5 mile section.
2. Gore marking or turning lane marking at a single interchange or intersection.
3. Each roundabout.

(4) Replace all marking in sections with more than 10 percent failing and repair or replace marking that the engineer deems improperly constructed. If post-acceptance inspections uncover evidence of defective material or improper construction, the department may revoke acceptance under 105.11.2.3.

646.3.2 Long Line Marking

646.3.2.1 General

(1) Long lines are centerlines, lane lines, edge lines, channelizing lines, and dotted extension lines.

(2) On contracts without the Locating No-Passing Zones bid item where pavement resurfacing covers the marking, mark the beginning and end of all existing centerlines. After completing the resurfacing, accurately re-mark the centerlines.

646.3.2.2 Liquid Marking Equipment

(1) Use equipment that can spray both yellow and white material to produce uniform lines of the specified dimension. Ensure the equipment can do the following:

- Applies lines both on the left and right sides, not necessarily simultaneously.
- Applies 2 lines simultaneously, with either line in a solid or intermittent pattern, in yellow or white.
- Reports a daily-accumulated installed length for each gun.
- Reports a volume of paint used each day.

(2) Use automatic, mechanical devices to apply glass beads and report the volume used.

646.3.2.3 Grooving

646.3.2.3.1 General

(1) Provide a groove depth as follows:

PRODUCT	GROOVED DEPTH
Grooved Wet Reflective Epoxy	80 +/- 10 mils
Grooved Tape	120 +/- 10 mils

(2) Groove a maximum of 4 inches from both ends and 1 inch wider than the width of the marking segment. Achieve straight alignment with the grooving equipment, not to exceed a 3/8 inch variation in any 40-foot section of travelled way. Use a high-pressure air blower to clean the groove.

(3) For grooving concrete, if water is used in the grooving process, allow the groove to dry a minimum of 24 hours before cleaning. Before applying the marking, ensure that the groove surface is clean and dry.

(4) For grooving asphalt, wait 5 or more days after paving. Notify the engineer immediately if the structural integrity of the asphalt pavement is inadequate to support grooving operations.

646.3.2.3.2 Wet Reflective Epoxy

(1) Apply wet reflective epoxy in a grooved slot with an epoxy binder that is 20 mils thick. Provide a double drop system of 5.3 pounds per gallon of wet reflective elements with 18-22 pounds per gallon of the following gradation:

US MESH	PERCENT PASSING
18	65 - 80
30	30 - 50
50	0 - 5

646.3.2.4 Contrast Marking

Revise 646.3.2.4(1) to no longer require the application of black aggregate on black epoxy.

(1) Apply 1 1/2 inches of black epoxy with a matte finish on either side of the white marking; black marking is not required on the ends. Apply epoxy at a wet mil thickness of 20. Do not apply glass beads to black epoxy.

646.3.2.5 Permanent Same Day Marking

(1) Under the Marking Same Day bid item, apply centerlines and no-passing barrier lines on the same day the final surface is placed or on the same day existing marking is removed. If weather or pavement conditions prohibit same-day applications, delineate the travel lanes and provide no-passing signing as the engineer directs. Apply centerlines as soon as conditions allow. The engineer may restrict operations until this marking is completed.

(2) As an option, the contractor may use temporary marking to conform to these same-day requirements. Remove temporary marking before placing same day permanent marking.

646.3.3 Special Marking

(1) Under the Marking Railroad Crossings bid items, apply the RXR symbol and 3 transverse lines as the plans show. Also apply edge lines, lane lines, and centerlines adjacent to the railroad crossing.

(2) Under the Marking Curb bid items, mark the vertical face and the top of the curb.

(3) Under the Marking Aerial Enforcement Bars bid items, the department will locate the marking. Notify the engineer at least one week before marking so the State Patrol can provide exact locations.

646.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed and as follows:

- The department will measure the Marking Yield Line bid items as each individual triangle in the yield line.

(2) The department will measure the LF bid items under this section by the linear foot of line acceptably completed.

(3) The department will measure the Marking Corrugated Median bid items by the square foot acceptably completed.

(4) The department will measure the Marking Removal bid items under this section as follows:

- Marking Removal Lines bid items by the linear foot of line acceptably completed.
- Marking Removal Special Marking bid items as each individual arrow, symbol, or word acceptably removed. The department will count removing an RXR symbol as 3 individual symbol removals.

Revise 646.4(5) specify measurement of the cold weather bid items previously in STSP 646-010.

(5) The department will measure the Cold Weather Marking Epoxy bid items by the LF of initial marking acceptably placed, maintained, and removed. The department will not measure work under these bid items as follows:

- If the contractor fails to maintain and remove the initial marking as required in 646.3.1.3(2).
- If initial marking is placed on days when the department is assessing liquidated damages.

646.5 Payment

Revise 646.5 to add payment for Cold Weather Marking Epoxy 4-Inch and 8-Inch bid items previously in STSP 646-01.

646.5.1 General

(1) The department will pay for measured quantities at the contract unit price under the following bid items.

ITEM NUMBER	DESCRIPTION	UNIT
646.1000 - 1020	Marking Line (material) 4-Inch	LF
646.1021 - 1999	Marking Line Grooved (material/type) 4-Inch	LF
646.3000 - 3020	Marking Line (material) 8-Inch	LF
646.3021 - 3999	Marking Line Grooved (material/type) 8-Inch	LF
646.4500 - 4699	Marking Line Same Day (material) (width)	LF
646.5000 - 5099	Marking Arrow (material)	EACH
646.5100 - 5199	Marking Word (material)	EACH
646.5200 - 5299	Marking Symbol (material)	EACH
646.5300 - 5399	Marking Railroad Crossing (material)	EACH
646.5400 - 5499	Marking Aerial Enforcement Bar (material)	EACH

646.5500 - 5599	Marking Outfall (material)	EACH
646.6000 - 6199	Marking Stop Line (material) (width)	LF
646.6200 - 6299	Marking Yield Line (material) 18-Inch	EACH
646.6300 - 6399	Marking Dotted Extension (material) 18-inch	LF
646.6400 - 6499	Cold Weather Marking Epoxy (width)	LF
646.7000 - 7199	Marking Diagonal (material) (width)	LF
646.7200 - 7399	Marking Chevron (material) 24-inch	LF
646.7400 - 7599	Marking Crosswalk (material/type) (width)	LF
646.8000 - 8099	Marking Corrugated Median (material)	SF
646.8100 - 8199	Marking Curb (material)	LF
646.8200 - 8299	Marking Island Nose (material)	EACH
646.8300 - 8399	Marking Parking Stall (material)	LF
646.9000 - 9299	Marking Removal Line (method) (width)	LF
646.9300 - 9399	Marking Removal Special Marking (method)	EACH
646.9400 - 9499	Marking Removal Plowable Raised Pavement Marker	EACH

(2) Payment for the Marking bid items under this section is full compensation for providing the marking; and for resealing areas of clear protective surface treatments on structures.

(3) Payment for liquid markings includes remarking as required under 646.3.1.2(2).

(4) Payment for the Marking bid items under this section also includes installing and removing all temporary marking installed under the contractor option of same-day marking.

(5) Payment for the Marking Removal bid items is full compensation for removing the marking and for resealing areas of clear protective surface treatments on structures.

646.5.2 Cold Weather Marking

(1) Payment for the Cold Weather Marking Epoxy bid items is full compensation for providing the initial marking including maintenance and removal. If the associated Cold Weather Marking bid item is not in the contract, the department will pay for the initial marking, maintenance, and removal as extra work.

(2) The department will pay separately for the final marking under the associated Marking bid items.

Section 648 Locating No-passing Zones

648.1 Description

(1) This section describes locating and marking both ends of no-passing zones on the pavement surface independently from existing no-passing zones.

648.2 Materials

(1) Furnish paint that will be readily visible until no-passing barrier lines are placed. Use white on asphalt and black on concrete.

648.3 Construction

648.3.1 Equipment

(1) Furnish two vehicles equipped with two-way communications equipment, full-width flashing yellow light bars with 360 degree visibility, and distance measuring instruments (DMI). Ensure that DMI have an accuracy of at least 10 foot per mile and decrease the measured distance when the vehicle backs up.

(2) Provide a target on the lead vehicle 42 inches above the roadway offering a sharp cutoff when it appears and disappears. Ensure that the observer's eye in the trailing vehicle is 42 inches above the roadway.

648.3.2 Locating No-Passing Zones

(1) Establish no-passing zones where there is inadequate sight distance conforming to the methods described in 3-2-2 of the department's traffic guidelines manual. Do not allow the line-of-sight to extend outside the shoulder and ensure that there are no blind spots within the required sight distance.

(2) Establish both ends of no-passing zones to an accuracy of 50 feet. If the no-passing zone is less than 500 feet long, extend the zone to 500 feet by lengthening at its beginning in each traffic direction. Conform to the no-passing zone sight distance requirements as follows:

POSTED SPEED LIMIT	NO-PASSING ZONE SIGHT DISTANCE	MINIMUM DISTANCE[1] BETWEEN ZONES
25 - 30 mph	0.10 miles/528 feet	0.10 miles/528 feet
35 - 40 mph	0.13 miles/686 feet	0.10 miles/528 feet
45 - 50 mph	0.16 miles/845 feet	0.13 miles/686 feet
55 mph	see[2]	0.15 miles/792 feet

[1] If the distance between 2 successive no-passing zones is less than the minimum distance between zones, connect the 2 zones.

[2] The no-passing zone sight distance is specified in the special provisions.

(3) Establish no-passing barrier lines as the plan details show for features including but not limited to the following:

1. Major intersections with full right turn lane or bypass lanes.
2. Two-lane to four-lane divided highway transitions.
3. Median islands.
4. Two-lane bridges less than 24 feet wide.
5. Railroad - highway grade crossings.
6. Climbing lanes and passing lanes.

(4) If the contract specifies, also establish no-passing zones on detour routes. Unless the engineer directs otherwise, use state trunk highway criteria to locate no-passing zones on county trunk highways and local roads on the detour route. Base the locations on posted detour speed limits.

(5) Establish no-passing zones at other locations the contract specifies and at engineer-directed special locations. Check with the engineer before beginning work to determine if there are special no-passing zones to mark under the contract.

(6) Check the correctness of no-passing zones leading into and out of the project limits. Ensure that the minimum distance between zones and sight distance are correct.

648.3.3 No-Passing Zone Marks

(1) Spray paint T's and dots on the roadway to mark the beginning and end of all no-passing zones. Make T's one foot by one foot with at least a 2-inch wide line with a 3 to 4 inch diameter dot on the centerline adjacent to the T stem.

648.3.4 No-Passing Zone Log

(1) Upon completing the work, furnish the engineer 4 copies of department form DT2124. Locate features to the 1/100 of a mile. For east-west roads, log entries from west to east. For north-south roads, log entries from south to north. Log the following:

- Date of survey.
- Cardinal direction of travel.
- Beginning and ending of each no-passing barrier line in both directions.
- Sight distance and speed criteria for each zone.
- Location of features requiring no-passing barrier lines specified in 648.3.2.
- Useful geographical references including but not limited to county and regional boundary lines, county trunk highways, and starts and ends of all bridges.

648.4 Measurement

(1) The department will measure Locating No-Passing Zones by the mile acceptably completed, measured as the actual centerline length of road surveyed and reported to the nearest 1/100 of a mile.

648.5 Payment

(1) The department will pay for the measured quantity at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
648.0100	Locating No-Passing Zones	MI

(2) Payment is full compensation for all the work required under this section.

Section 649 Temporary Pavement Marking

649.1 Description

(1) This section describes providing and removing temporary pavement marking.

649.2 Materials

(1) Furnish pavement marking materials conforming to 646.2.

649.3 Construction

(1) Construct conforming to the following:

General marking 646.3.1.1
Long line 646.3.1.2
Removing marking 646.3.1.4

(2) Do not groove in temporary marking.

(3) Apply liquid marking and glass beads across the line at or exceeding the following:

LIQUID MARKING	THICKNESS (mils)	BEAD APPLICATION (pounds per gallon)
Paint	12	4 - 5
Epoxy	16	12 - 15

(4) If installing raised pavement markers at a new location, use new markers. If installing replacement markers, the contractor may install used markers in like-new condition.

(5) For pavements open to all traffic, apply centerline and no-passing barrier line markings as follows:

- On intermediate layers, including milled surfaces, on the same day the pavement is placed or milled.
- On the upper layer, on the same day the pavement is placed unless the contractor applies permanent marking on the same day the pavement is placed.
- If weather conditions preclude same-day application, delineate the travel lanes and provide no-passing signing as the engineer directs. Apply centerlines and no-passing barrier lines as soon as conditions allow. The engineer may restrict operations until these markings are completed.

(6) If required to apply no passing zone temporary pavement marking, reference the beginning and end of existing no-passing barrier lines. Apply temporary no-passing barrier lines at those existing locations. If the contract contains the Locating No-Passing Zones bid item, relocate permanent no-passing zones as specified in 648.

(7) Protect freshly applied paint marking until dry enough to prevent pickup under traffic. Replace temporary marking, including raised markers, that deteriorates or fails to adhere to the extent that the roadway is not adequately delineated.

(8) Inspect and maintain temporary marking, including raised markers, as specified in 643.3.1(5).

649.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed and the LF bid items under this section by the linear foot of line acceptably completed.

649.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
649.0100 - 0299	Temporary Marking Line (material/type) (width)	LF
649.0500 - 0599	Temporary Marking Arrow (material)	EACH
649.0600 - 0699	Temporary Marking Word (material)	EACH
649.0700 - 0799	Temporary Marking Raised Pavement Marker (type)	EACH
649.0800 - 0899	Temporary Marking Stop Line (material) 18-Inch	LF
649.0900 - 0959	Temporary Marking Diagonal (material) 12-Inch	LF
649.0960 - 0970	Temporary Marking Removable Mask Out Tape (width)	LF

Revise 649.5(2) to restore language making temporary marking placed under the contractor's same day option incidental.

(2) Payment for the Temporary Marking bid items is full compensation for providing the marking or marker; for maintaining, and for removing the marking or marker. Placing and removing temporary markings applied under the 646 contractor option for same-day marking are incidental to the associated permanent pavement marking bid item.

Section 650 Construction Staking

650.1 Description

(1) This section describes the contractor-performed construction staking required under individual contract bid items to establish the horizontal and vertical position for the following:

Storm sewer	Subgrade	Base
Curb, gutter, and curb & gutter	Pipe culverts	Structure layout
Concrete pavement	Concrete barrier	Resurfacing reference
Electrical installations	Supplemental Control	Slope Stakes
Curb Ramps		

650.2 (Vacant)

650.3 Construction

650.3.1 General

(1) Department and contractor responsibilities for construction staking are specified in 105.6. Conform to 105.6 and the additional requirements specified here in 650.3 for the individual contractor-staking bid items the contract includes.

(2) Protect and preserve known property and survey marks and land monuments as specified in 107.11.3. The contract may require related work under the 621 bid items.

(3) Obtain or calculate benchmark data, grades, and alignment from plan information. The engineer will furnish data for the horizontal and vertical control points, control point ties, horizontal alignments, profiles, and elevations. Reestablish, set additional, and maintain the horizontal and vertical control points and control point ties, as needed for bid items. Furnish, set, reference, and maintain stakes and markings necessary to establish the alignment, location, benchmarks, elevations, and continuous profile-grades for road and structure work as needed for bid items. Supervise and coordinate construction staking.

(4) Check horizontal and vertical information including but not limited to alignments, locations, elevations, and dimensions, that either the plans show or the engineer provides, for compatibility with existing field conditions. Conduct similar compatibility checks and accuracy checks of horizontal and vertical positions either the department or the contractor establishes in the field.

(5) Perform survey work using conventional methods, or where the contract allows, GPS machine guidance. The contractor may employ global positioning technology, robotic total station systems, laser systems, conventional methods, or other engineer-approved methods the engineer deems capable of achieving the specified horizontal and vertical tolerances for the work in question. Establish additional benchmarks and control points as necessary to support the method of operation.

(6) Maintain neat, orderly, and complete survey notes, drawings, and computations used in establishing the lines and grades. Make the survey notes and computations available to the engineer within 24 hours, upon request, as the work progresses.

(7) Furnish surveying equipment, stakes, flags, pins, lath, whiskers, and other materials necessary to perform this work, subject to the engineer's approval.

650.3.2 Storm Sewer

(1) Set and maintain construction stakes or marks as necessary to achieve the required accuracy and to support the method of operations. Locate pipe, inlet, catch basin, manhole, and endwall construction stakes to within 0.02 feet horizontally and establish the elevations to within 0.01 feet vertically. Determine that the final elevations of storm sewer pipe outfalls and inlets match the existing field elevations, and provide this information to the engineer at a mutually agreed upon date or least 14 calendar days before ordering inlets, catch basins, manholes, endwalls, and storm sewer pipe.

650.3.3 Subgrade

650.3.3.1 General

(1) Under the Construction Staking Subgrade bid item the contractor may substitute global positioning system (GPS) machine guidance for conventional subgrade staking on all or part of the work. The engineer may require the contractor to revert to conventional subgrade staking methods for all or part of the work at any point during construction if, in the engineer's opinion, the GPS machine guidance is producing unacceptable results.

650.3.3.2 Subgrade Staking

(1) Set construction stakes or marks at intervals of 100 feet, or more frequently, for rural sections and at intervals of 50 feet, or more frequently, for urban sections. Include additional stakes at each cross-

section as necessary to match the plan cross-section, achieve the required accuracy, and to support construction operations. Also set and maintain stakes as necessary to establish the horizontal and vertical positions of intersecting road radii, auxiliary lanes, horizontal and vertical curves, and curve transitions. Locate stakes to within 0.25 feet horizontally and establish the grade elevation to within 0.03 feet vertically.

650.3.3.3 GPS Machine Guidance

650.3.3.3.1 General

(1) No subgrade stakes are required for work completed using GPS machine guidance.

(2) Coordinate with the engineer throughout the course of construction to ensure that work performed using GPS machine guidance conforms to the contract tolerances and that the methods employed conform to the contractor's GPS work plan and accepted industry standards. Address GPS machine guidance issues at weekly progress meetings.

650.3.3.3.2 GPS Work Plan

(1) Submit a comprehensive written GPS work plan for department review at least 5 business days before the preconstruction conference. The engineer will review the plan to determine if it conforms to the contract.

(2) Construct the subgrade as the contractor's GPS work plan provides. Update the plan as necessary during construction of the subgrade.

(3) The GPS work plan should discuss how GPS machine guidance technology will be integrated into other technologies employed on the project. Include, but do not limit the contents to, the following:

1. Designate which portions of the contract will be done using GPS machine guidance and which portions will be done using conventional subgrade staking.
2. Describe the manufacturer, model, and software version of the GPS equipment.
3. Provide information on the qualifications of contractor staff. Include formal training and field experience. Designate a single staff person as the primary contact for GPS technology issues.
4. Describe how project control is to be established. Include a list and map showing control points enveloping the site.
5. Describe site calibration procedures. Include a map of the control points used for site calibration and control points used to check the site calibration. Describe the site calibration and checking frequency as well as how the site calibration and checking information will be documented.
6. Describe the contractor's quality control procedures. Describe procedures for checking, mechanical calibration, and maintenance of equipment. Include the frequency and type of checks performed to ensure that the constructed subgrade conforms to the contract plans.

650.3.3.3.3 Equipment

(1) Use GPS machine guidance equipment to meet the requirements of the contract.

(2) Perform periodic sensor calibrations, checks for blade wear, and other routine adjustments as required to ensure that the final subgrade conforms to the contract plans.

650.3.3.3.4 Geometric and Surface Information

650.3.3.3.4.1 Department Responsibilities

(1) At any time after the contract is awarded the contractor may request the contractor data packet. The department will provide the packet within 5 business days of receiving the contractor's request.

650.3.3.3.4.2 Contractor Responsibilities

(1) Develop and maintain the initial design surface DTM for areas of the project employing GPS machine guidance. Confirm that the design surface DTM agrees with the contract plans.

(2) Provide design surface DTM information to the department in LandXML or other engineer-approved format.

650.3.3.3.4.3 Managing and Updating Information

(1) Notify the department of any errors or discrepancies in department-provided information. The department will determine what revisions may be required. The department will revise the contract plans, if necessary, to address errors or discrepancies that the contractor identifies. The department will provide the best available information related to those contract plan revisions.

(2) Revise the design surface DTM as required to support construction operations and to reflect any contract plan revisions the department makes. Perform checks to confirm that the revised design surface DTM agrees with the contract plan revisions. Provide a copy of the resultant revised design

surface DTM to the engineer in LandXML or other engineer-approved format. The department will pay for costs incurred to incorporate contract plan revisions as extra work.

650.3.3.3.5 Site Calibration

(1) Designate a set of control points, including a total of at least 6 horizontal and vertical points or 2 per mile, whichever is greater, for site calibration for the portion of the project employing GPS machine guidance. Incorporate the department-provided control framework used for the original survey and design.

(2) Calibrate the site by determining the parameters governing the transformation of GPS information into the project coordinate system. Use the full set of control points designated under 650.3.3.3.5 (1) for the initial site calibration. Provide the resulting site calibration file to the engineer before beginning subgrade construction operations.

650.3.3.3.6 Construction Checks

650.3.3.3.6.1 Daily Calibration Checks

(1) In addition to the site calibration, perform site calibration checks. Perform these checks at individual control points not used in the initial site calibration. At a minimum, check the calibration at the start of each day as described in the contractor's GPS work plan. Report out-of-tolerance checks to the engineer. The measured position must match the established position at each individual control point within the following tolerances:

- Horizontally to 0.10 feet or less.
- Vertically to 0.05 feet or less.

(2) Discuss the previous week's daily calibration check results at the weekly progress meeting for monitoring the GPS work.

650.3.3.3.6.2 Final Subgrade Elevation Checks

(1) Check the subgrade against the plan elevation at randomly selected points on cross-sections located at stations evenly divisible by 100. Conduct at least 20 random checks per stage, per project, or per mainline roadway mile whichever results in the most tests. Also check the subgrade at additional points as the engineer directs. Notify the engineer at least 2 business days before making subgrade checks so the engineer can observe the process.

(2) Ensure that at least 4 of any 5 consecutively tested random subgrade points are within 0.10 foot vertically of the plan elevation. Notify the engineer if more than one of any five consecutively tested random subgrade points differs by more than 0.10 feet from the plan elevation.

(3) The department may conduct periodic independent subgrade checks. The department will notify the contractor if any individual check differs by more than 0.10 feet from the design.

650.3.4 Base

(1) Set construction stakes or marks at 100-foot intervals for rural sections and 50-foot intervals for urban sections. Set and maintain sufficient stakes at each cross-section to match plan cross-section, achieve the required accuracy, and to support the method of operations. Set and maintain stakes as necessary to establish horizontal and vertical position along intersecting road radii, auxiliary lanes, vertical and horizontal curves, and curve transitions. Locate stakes within 0.25 feet horizontally and establish the grade elevation to within 0.03 feet vertically.

650.3.5 Curb, Gutter, and Curb & Gutter

(1) Set construction stakes or marks at 50-foot intervals, maximum. Set and maintain stakes as necessary to achieve the required accuracy and to support the method of operations. Set additional construction stakes as necessary to establish location and grade of curb, gutter, and curb & gutter, including points where the alignment or grade changes, along intersecting radii, and at the radius points of intersecting road radii. Locate stakes to within 0.02 feet horizontally and establish elevations to within 0.01 feet vertically.

650.3.6 Pipe Culverts

(1) Set and maintain construction stakes or marks as necessary to achieve the required accuracy and to support the method of operations. Locate stakes for pipe culverts and appurtenant inlets and catch basins to within 0.25 feet horizontally and establish the grade elevation to within 0.03 feet vertically. If installing pipe culverts at existing drainage ditches, verify the existing ditch location, elevations, and skew for a minimum of 150 feet from pipe ends, and provide this information to the engineer at a mutually agreed upon date or 14 calendar days before ordering pipe culverts.

650.3.7 Structure Layout

(1) Set construction stakes or marks on a line offset from the structure centerline or on a reference line, whichever is appropriate, for both roadway and substructure units. Establish the plan horizontal and vertical positions to the required accuracy. Also, set and maintain stakes and marks as necessary to support the method of operations. Locate stakes and marks to within 0.02 feet of the true horizontal position, and establish the grade elevation to within 0.01 feet of true vertical position. The department, unless the contract specifies otherwise, will compute deck grades with contractor-supplied girder elevation data.

650.3.8 Concrete Pavement

(1) Set construction stakes or marks at 25-foot intervals. Set and maintain additional stakes as necessary to establish location and grade along intersecting road radii; and for auxiliary lanes, vertical curves, horizontal curves, and curve transitions according to the plans. Locate stakes to within 0.02 feet horizontally and establish elevations to within 0.01 feet vertically. Set and maintain sufficient additional stakes at each cross-section to achieve the required accuracy and to support the method of operations.

650.3.9 Concrete Barrier

(1) Set construction stakes or marks at 50-foot intervals, maximum. Set and maintain additional stakes as necessary to establish location and grade of concrete barrier including points where the grade changes, along intersecting radii, and at the radius point of intersecting radii to achieve the required accuracy and to support the method of operations. Locate stakes to within 0.02 feet horizontally and establish the grade elevation to within 0.01 feet vertically.

650.3.10 Resurfacing Reference

(1) Set construction stakes for pulverized and re-laid pavement before beginning milling operations. Place construction stakes or pins for offsetting the roadway reference line at 100-foot intervals, minimum, or as the engineer directs.

(2) Place construction stakes or marks for other types of resurfacing work at 300-foot intervals, minimum, or as the engineer directs.

(3) Set and maintain additional stakes as necessary to establish location and grade along intersecting road radii, auxiliary lanes, and curve transitions according to the plans.

650.3.11 Electrical Installations

(1) Set and maintain construction stakes or marks as necessary to achieve the required accuracy and to support the method of operations. Locate stakes to within 0.02 feet horizontally and to establish the grade elevation to within 0.01 feet vertically.

650.3.12 Supplemental Control

(1) Set and maintain construction marks as required to support the method of operations consistent with third-order, class I horizontal and third-order vertical accuracy. Check the department-provided horizontal and vertical control information and notify the engineer of any discrepancies. Provide marks to establish and maintain intermediate vertical and horizontal control for reference line alignment, side road alignments, radius points, bench level circuits, and offsetting the horizontal roadway alignment. These marks constitute the field control used to govern and prosecute the work.

(2) Document and provide to the engineer complete descriptions and reference ties of the control points, alignment points, and benchmarks to allow for quick reestablishment of the plan data at any time during construction and upon project completion. Document additional control on department forms DT1291 and DT2262 as described in CMM 7-10.

650.3.13 Slope Stakes

(1) Verify the existing ground elevations as shown for roadways on cross-section sheets for accuracy. Take and document a minimum of 7 shots per roadway section, one at the centerline or at an engineer-approved offset from the centerline and 3 on each side of the roadway. For the shots on the roadway sides, take one shot at the subgrade shoulder point, one shot at the slope stake, and one shot at the slope intercept. If the elevation at the slope intercept is off by more than 0.4 foot, notify the engineer.

(2) Set and maintain slope stakes on each side of the road at each cross-section location the plans show. Locate stakes to within 0.25 feet horizontally and establish elevations to within 0.1 feet vertically. Stake additional clearing & grubbing and marsh excavation limits.

650.3.14 Curb Ramps

(1) Set and maintain construction stakes as necessary to establish the location and grade of curb ramps and the adjacent sidewalk. Locate stakes to within 0.02 feet horizontally and establish the grade elevation to within 0.01 feet vertically. Adjust elevations as required to conform to the plans.

650.4 Measurement

(1) The department will measure the Construction Staking bid items for subgrade, base, concrete pavement, resurfacing reference, and slope stakes by the linear foot acceptably completed, measured along each roadway centerline. The department will not measure staking for base underlying concrete pavement.

(2) The department will measure Construction Staking Curb Gutter and Curb & Gutter by the linear foot acceptably completed, measured along the base of the curb face. The department will measure Construction Staking Concrete Barrier by the linear foot acceptably completed, measured along the base of the barrier. The department will not measure these bid items if abutting concrete pavement.

Revise 650.4(3) to measure curb ramp staking only when the plan details contain location-specific layout information.

(3) The department will measure the EACH bid items under this section as each individual unit acceptably completed as follows:

- Construction Staking Storm Sewer: as each individual inlet, catch basin, manhole, and endwall.
- Construction Staking Pipe Culverts: as each individual pipe culvert.
- Construction Staking Curb Ramps: as each individual curb ramp opening with location-specific layout information that includes elevations in the plan details.

(4) The department will measure the Construction Staking Structure Layout bid items as a single lump sum unit for each structure acceptably completed. The department will measure Construction Staking Electrical Installations as a single lump sum unit for all electrical installations on each project acceptably completed. The department will measure Construction Staking Supplemental Control as a single lump sum unit for all control marks on each project acceptably completed.

650.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
650.4000	Construction Staking Storm Sewer	EACH
650.4500	Construction Staking Subgrade	LF
650.5000	Construction Staking Base	LF
650.5500	Construction Staking Curb Gutter and Curb & Gutter	LF
650.6000	Construction Staking Pipe Culverts	EACH
650.6500	Construction Staking Structure Layout (structure)	LS
650.7000	Construction Staking Concrete Pavement	LF
650.7500	Construction Staking Concrete Barrier	LF
650.8000	Construction Staking Resurfacing Reference	LF
650.8500	Construction Staking Electrical Installations (project)	LS
650.9000	Construction Staking Curb Ramps	EACH
650.9910	Construction Staking Supplemental Control (project)	LS
650.9920	Construction Staking Slope Stakes	LF

(2) The department will not make final payment for any staking item until the contractor submits survey notes and computations used to establish the required lines and grades to the engineer within 21 days of completing this work. The department will deduct from payments due the contractor for the additional costs specified in 105.6.

(3) Payment for the Construction Staking bid items is full compensation for locating and setting construction stakes; for adjusting stakes to ensure compatibility with existing field conditions; and for relocating and resetting damaged or missing construction stakes.

(4) Payment for Construction Staking Supplemental Control also includes resetting damaged or missing preliminary construction stakes, and protecting and reestablishing the alignment of roadways.

(5) Payment for Construction Staking Storm Sewer also includes setting construction stakes as necessary for storm sewer pipe associated with each inlet, catch basin, manhole, or endwall staked.

(6) Payment for Construction Staking Pipe Culverts also includes setting construction stakes for appurtenant inlets and catch basins as necessary associated with each pipe culvert staked.

Section 651 General Requirements for Electrical Work

651.1 Description

(1) This section describes general personnel qualifications, materials, construction methods, and testing requirements used to perform electrical work required in the contract under 652 through 678.

651.2 Materials

(1) Furnish materials conforming to the WSEC. The department is not a municipal electric department under the provisions of the SPS 316 component of the WSEC.

(2) The department specifies selected materials and manufactured products for electrical work on the department's QPL.

(3) Within 10 business days after notice of award of the contract, furnish a materials list and shop drawings to the engineer. Include bid items, names and addresses of manufacturers, catalog cut sheets with catalog numbers, and manufacturer's specifications in the materials list. Do not deliver materials or begin the work without the engineer's written approval. The engineer may reject all or part of the materials list. Resubmit alternatives for rejected materials within 15 business days of receipt of the engineer's written rejection. Do not substitute or change materials without the engineer’s written approval.

(4) Provide UL or NRTL listed electrical materials or obtain the engineer's approval for materials that do not have a UL or NRTL standard.

(5) Furnish samples of materials proposing to use for testing at the engineer's request. The department will compensate the contractor if material is destroyed.

(6) Return materials loaned from the region electrical units stock to that region electrical unit under the following terms:

- Ensure that return materials are new and in original packaging.
- Return materials to the electrical unit within 6 months of the date that they were picked up.
- Region electrical personnel will not release loaned materials for contractor pick up until the region traffic engineer has a copy of the contractor's order forms for exact replacement materials.
- Ensure that contractor-ordered replacement materials conform to the latest specifications and drawings used for new state replacement orders.
- The department will not accept monetary reimbursement.

651.3 Construction

651.3.1 General

(1) Perform electrical work according to WSEC and the WMUTCD.

(2) Excavate as required to perform the work. If the contractor encounters rock, stones, boulders, debris, or other material during excavation, remove and dispose of that material. Place trench backfill in 12-inch or shallower thoroughly-compact layers. Dispose of excess material as specified for disposing of surplus unsuitable material in 205.3.12. Restore areas damaged or disturbed by the contractor's operations.

(3) Before assembly, apply anti-seize compound to the threads and mating surfaces of threaded connections exposed to the weather. Do not use spray-on products. Do not apply anti-seize compound to the following:

- Electrical Connections.
- Anchor rods and anchor assemblies associated with type 9, 10, 12, & 13 poles under 657, high mast light poles under 660, and camera poles under 677.
- Friction connections using ASTM F3125 high-strength A325 steel bolts.

(4) Unless the contract specifies or engineer directs otherwise, touch up damage to painted equipment with 2 coats of synthetic resin enamel or with 2 coats of engineer-approved zinc-rich paint. Repair damage to galvanized coatings with 2 coats of zinc dust/zinc oxide paint conforming to 614.2. These requirements apply to both contractor-furnished and state-furnished equipment.

(5) Exothermically weld electrical connections between grounding electrode conductors and grounding electrodes.

(6) Each day before electrical crews leave a signalized intersection open to public traffic do the following:

- Remove unused signal heads or cover them from traffic's view.
- Energize and turn on available intersection lighting if signalization is not operational unless the engineer approves otherwise.

(7) Provide as-built drawings detailing the final placement of conduit, cabling, equipment, and geometric modifications under the contract. Provide a PDF copy conforming to CMM 1-65.14. The engineer will reject as-builts with incomplete or incorrect content or not conforming to CMM standards.

651.3.2 Personnel Qualifications

(1) Perform electrical work using a journey worker electrician or an electrical apprentice under the onsite supervision of a journey worker electrician. Before performing electrical work, provide the documentation specified in 651.3.2(3) to the engineer proving that the electricians performing the work have attained status as journey worker and apprentice electricians.

(2) The department defines electrical work as electrical and related construction required under the contract, performed as specified in the standard specifications, contract special provisions, standard detail drawings, and plan details applicable to electrical construction.

(3) Provide a completion certificate from a state apprenticeship program or a card issued by the Wisconsin department of safety and professional services to prove electricians are qualified.

651.3.3 Testing

(1) After installation and before final hookup, disconnect loads whether buried or not, and test grounded conductors, equipment grounding conductors, ungrounded conductors, and shielding contained in the cable with a megger. Submit the megger test results to the engineer. Ensure that the megger reads greater than 500 mega ohms during each of the following tests:

- To ground.
- Between each conductor.
- Between each shield.

(2) Furnish equipment necessary to test the completed electrical installation. Test and demonstrate to the engineer's satisfaction that the following conditions exist:

1. The circuits are properly connected, continuous, and free from short circuits and unspecified grounds.
2. The connection conforms to the specified wiring layout, or the manufacturer's wiring layout or both.
3. Each circuit operates as designed.

(3) Notify the engineer and request a signal inspection at least 5 business days before the date of the requested inspection. In the event of deficiencies, request a reinspection when the work is corrected. The engineer will not authorize turn-on until the contractor corrects deficiencies.

(4) Operate the completed traffic signal installation for 72 hours consecutively, using the specified signal sequence and all special functions, such as preemption, as the plans show, or as the engineer approves.

(5) The traffic signal installation is not complete until the electrical work is complete and electrical systems work properly.

(6) Operate the completed lighting installation for 20 consecutive nights without failure. Each component that fails shall be repaired or replaced and that component shall again be subject to the twenty-night proper working order test.

(7) The lighting system is not complete until electrical work is complete and inspected by the engineer, and electrical systems work properly.

651.4 (Vacant)

651.5 Payment

(1) The department will pay for the work specified in 651 separately under the various traffic signal, lighting, and ITS contract bid items.

Section 652 Electrical Conduit

652.1 Description

(1) This section describes providing rigid metallic or rigid nonmetallic conduit for traffic signals, lighting, and other electrical work, and rigid nonmetallic conduit for traffic signal detectors.

652.2 Materials

652.2.1 General

(1) Furnish electrical conduit and fittings with a UL or NRTL label on each piece installed.

652.2.2 Rigid Metallic Conduit

(1) Furnish conduit and fittings conforming to ANSI C 80.1 for rigid metallic conduit.

652.2.3 Rigid Nonmetallic Conduit

(1) Furnish PVC electrical conduit conforming to UL 651. Use schedule 40 heavy wall type for enclosed locations. Use schedule 80 extra-heavy wall type for locations exposed to the elements.

652.2.4 Reinforced Thermosetting Resin Conduit

(1) Furnish reinforced thermosetting resin conduit (RTRC) electrical conduit marked type AG conforming to UL 2515. Ensure that wall thickness, coupling type or method, fittings, and hanger system conform to manufacturer recommendations for installation on the outside of structures.

652.2.5 Loop Detector Conduit

(1) Furnish one-inch schedule 40 PVC electrical conduit conforming to 652.2.3. Use PVC fittings and attachments designed specifically for the conduit furnished to join and terminate PVC conduit. Use engineer-approved PVC terminal adaptor fittings to connect cast iron T-condulets to PVC conduit.

(2) Furnish cast iron T-condulets made by a department-approved manufacturer. Use steel, domed-type, wedge-nut style covers with neoprene gaskets on cast iron condulets.

652.3 Construction

652.3.1 Installation of Conduit

652.3.1.1 General

(1) Under the Conduit Special bid item, the contractor may use either rigid metallic or rigid nonmetallic conduit.

(2) Use conduit of the nominal inside diameter the plans show. Make each run of conduit the distance the plans show or as the engineer directs. Install each run of conduit between adjacent access points using one size for its entire length. A run is the conduit from pull box to pull box, junction box to junction box, or pull box to junction box. If the engineer approves, the contractor may substitute a larger size of conduit than the contract shows for that run.

Delete 652.3.1.1(3), the department no longer allows drilled and open drain hole conduit installations.

(3) Install tracer wire in each conduit run that will receive future conductors as the conduit is laid. Unless the contract specifies wire or cable, install a 12 AWG. XLP insulated, stranded, copper, 600-volt AC, wire. Provide wire 4 feet longer than the conduit run and double it back at least 2 feet at each raceway access point. Anchor the tracer wire at each access point.

(4) Ream and thread the ends of rigid metallic conduit and use WSEC-approved bushings. If not installing wire or cable, install engineer-approved threaded caps with anti-seize compound applied to the threads.

(5) Cap or plug rigid nonmetallic conduit immediately after installation, unless the conduit terminates in a pull box, and keep capped or plugged until installing the wire or cable. Install end bells on rigid nonmetallic conduit raceway access points before installing wire or cable. Ream non-metallic conduits to eliminate internal sharp edges before installing end bells. Use only UL or NRTL listed adapter fittings to connect rigid nonmetallic conduit to rigid metallic conduit.

652.3.1.2 Installing Underground

(1) Unless the plans specify otherwise, install conduit in trenches excavated with vertical sides and of a depth and width sufficient to accommodate the outside diameter of the conduit couplings. Lay the conduit at the depth below grade the plans show. Backfill the trench with select material passing a one-inch sieve.

(2) Excavate trenches true to line and grade to provide the conduit uniform bearing throughout its length. Do not backfill the trench before inspecting the conduit. Carefully tamp the backfill in place as specified for placing backfill in layers in 651.3. Place at least 0.7 cubic feet of size No. 2 coarse aggregate, as specified in 501.2.5.4.5, directly under each drainage hole.

(3) If cinders are present when laying rigid conduit, encase the conduit in at least 2 inches of concrete, or remove for at least 12 inches below the conduit and backfill the excavation with suitable material.

(4) Apply an engineer-approved zinc-rich paint to field-cut threads not covered by fittings and to other areas with damaged or missing zinc coating. Clean application and adjacent areas before painting.

652.3.1.3 Installing Conduit Special Underground

(1) Under the Conduit Special bid items, conform to 652.3.1.2 except install by jacking, boring, auguring, or other engineer-approved methods that do not disturb the existing overlying pavement, curb and gutter, or sidewalk. Use conduit suitable for the installation method used. Repair pavement, curb and gutter, or sidewalk that the engineer determines damaged by the installation.

652.3.1.4 Installing on Structures

(1) Install conduit on structures as the plans show either by embedding in concrete or mounting on the outside of the structure. Unless specifically provided otherwise, do not leave openings in the structure for subsequent conduit placement. Install engineer-approved expansion fittings where the conduit crosses an expansion joint in a structure. Install additional expansion fittings conforming to the WSEC and adjust for the ambient temperature at the time of concrete pour.

(2) If embedding conduit in concrete, hold it rigidly in place while pouring the concrete. Provide drainage for embedded raceways.

(3) If mounting on the outside of the structure, use reinforced thermosetting resin conduit (RTRC) and hardware conforming to manufacturer recommendations. Use only manufactured bends and sweeps. Do not make field bends. Ensure that the installer is certified by the manufacturer of the conduit and conforms to manufacturer recommendations for installation on the outside of structures. Provide evidence of installer certification to the engineer before installation.

652.3.1.5 Constructing Loop Detector Slots

(1) Under the Loop Detector Slots bid item, construct slots in existing asphalt or concrete pavement for loop detector conduit, as the plans show or the engineer directs.

(2) Construct by sawing the full width and depth of the slot, or by sawing both edges of the slot full depth and removing the remainder by chipping, or other engineer-approved methods. Clean the slots with jets of water and compressed air; remove dirt, dust, and debris; and thoroughly dry before installing the detector loop conduit. Remove and dispose of surplus material.

652.3.1.6 Installing Loop Detector Conduit

(1) Under the Conduit Loop Detector bid item, provide loop detector conduit and related fittings as the plans show.

(2) After installation, protect the loop detector conduit from any damage that could occur. Repair or replace damaged loop detector conduit at no expense to the department. The engineer will approve the replacement or repair method, and the resulting finished work.

652.3.2 Marking and Inspecting

(1) Mark the location of each conduit as the plans show.

(2) After the conduit installation is complete, inspect each installed conduit before any wire is pulled. During this inspection, ensure that the conduit raceway is fully open for its entire length. Replace any conduit that the engineer determines is crushed, damaged, or unsatisfactory.

(3) If the engineer directs, expose the conduit at a randomly selected conduit arrow mark. If the distance from that conduit's centerline to a plumb line projected down from the tip of the arrow mark is more than six inches, expose all arrow marked conduits. Destroy arrow marks not meeting the six-inch limit and remark the conduit.

652.4 Measurement

(1) The department will measure the Conduit Rigid Metallic, Conduit Rigid Nonmetallic, and Conduit Reinforced Thermosetting Resin bid items by the linear foot acceptably completed, measured along the conduit centerline from the centerline of fittings or, where there are no fittings, from the free ends of the conduit. The department will measure engineer-specified drain duct from a pull box to a ditch or sewer.

(2) The department will measure the Conduit Special bid items by the linear foot acceptably completed, measured from pull box to pull box.

(3) The department will measure Conduit Loop Detector by the linear foot acceptably completed, measured around the loop and from the loop to the nearest pull box.

(4) The department will measure Loop Detector Slots by the linear foot acceptably completed.

652.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
652.0100 -0199	Conduit Rigid Metallic (size)	LF
652.0200 - 0399	Conduit Rigid Nonmetallic (schedule) (size)	LF
652.0400 - 0599	Conduit Reinforced Thermosetting Resin (size)	LF
652.0600 - 0699	Conduit Special (size)	LF
652.0800	Conduit Loop Detector	LF
652.0900	Loop Detector Slots	LF

(2) Payment for the Conduit Rigid Metallic, Conduit Rigid Nonmetallic, Conduit Reinforced Thermosetting Resin, and Conduit Special bid items is full compensation for providing the conduit, conduit bodies, and fittings; for providing conduit hangers, clips, attachments, and fittings used to support conduit on structures; for pull wires or ropes; for expansion fittings and caps; for excavating, bedding, and backfilling, including any sand, concrete, or other required materials; for disposing of surplus materials; and for making inspections.

(3) Payment for the Conduit Special bid items also includes repairing overlying pavement, curb and gutter, or sidewalk the contractor disturbs or damages.

(4) Payment for the Conduit Rigid Nonmetallic bid items also includes pull box drain duct the engineer directs under the 653 Pull Box bid items.

(5) Payment for Conduit Loop Detector is full compensation for providing materials, including conduit, compacted backfill, surface sealer, pull wire, condulets, and conduit fittings.

(6) Payment for Loop Detector Slots is full compensation for sawing; for chipping; for removing and disposing of surplus material; and for cleaning the slot.

(7) The department will not pay extra for conduit the contractor substitutes under 652.3.1.1. The department will pay separately for tracer wires under the appropriate Electrical Wire bid items specified in 655.5.

Section 653 Pull Boxes and Junction Boxes

653.1 Description

(1) This section describes providing, adjusting, and removing pull boxes and providing junction boxes.

653.2 Materials

(1) Furnish steel pull boxes made of corrugated steel pipe conforming to the material requirements of 521.2 with annular corrugations.

(2) Furnish non-conductive pull boxes and junction boxes from department approved product list. The contractor may field trim to customize pull box lengths.

(3) Furnish manhole frames and solid lids conforming to 611.2. Use locking covers in pavement roadway locations and on 12-inch pull boxes.

(4) Furnish grounding lugs and copper or stainless steel mechanical connectors. Use stainless steel for mechanical connections to pull boxes and junction boxes.

653.3 Construction

(1) Provide pull boxes with manhole frames and solid lids. The contractor may extend pull boxes as the plans show using the same material as the pull box. Saw extensions parallel to the annular ring and clamp to the pull box using a band manufactured for this purpose. Excavate, place coarse aggregate drain material, and backfill as the plans show. Dispose of surplus or unsuitable material as specified under 205.3.12. Use covers stamped "WISDOT ITS" for communications pull boxes or "ELECTRIC" for other pull boxes.

(2) Under the Junction Boxes bid items, provide junction boxes mounted and connected as the plans show. Grounding lugs are not required in junction boxes with less than 50 volt AC.

(3) Under the Adjusting Pull Boxes bid item, move existing pull boxes to grade level. Excavate, adjust subsurface components as required, and backfill as the plan details show. Dispose of surplus or unsuitable material as specified under 205.3.12.

(4) Under the Removing Pull Boxes bid item, excavate and remove existing pull boxes. Backfill with material similar to the surrounding material. Dispose of surplus or unsuitable material as specified under 205.3.12.

653.4 Measurement

(1) The department will measure the bid items under this section as each individual box acceptably completed.

653.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
653.0100 - 0149	Pull Boxes Steel (size)	EACH
653.0150 - 0179	Pull Boxes Nonconductive (size)	EACH
653.0180	Pull Boxes Steel Communications (inch)	EACH
653.0200 - 0299	Junction Boxes (size)	EACH
653.0900	Adjusting Pull Boxes	EACH
653.0905	Removing Pull Boxes	EACH

(2) Payment for the Pull Boxes bid items is full compensation for providing pull boxes; for materials including grounding lugs; for aggregate, manhole frames and covers; for required pull box extensions; conduit extensions less than 10 feet long including fittings; and for excavating, backfilling, and disposing of surplus material. The department will pay separately for engineer-directed pull box drain duct under the Conduit Rigid Nonmetallic bid items as specified in 652.5.

(3) Payment for the Junction Boxes bid items is full compensation for providing materials including grounding lugs and stainless steel mounting hardware, wiring, supports, grout, and temporary asphalt; for any pavement cutting and grouting; and for disposing of surplus material.

(4) Payment for Adjusting Pull Boxes is full compensation resetting the box elevation; for required materials; and for excavating, backfilling, and disposing of surplus material.

(5) Payment for Removing Pull Boxes is full compensation for removal, and for excavating, backfilling, and disposing of surplus material.

Section 654 Bases

654.1 Description

(1) This section describes constructing concrete bases for traffic signals, street lights, and control cabinets.

654.2 Materials

(1) Furnish bar steel reinforcement conforming to 505.2.4.

(2) Furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class III ancillary concrete as specified in 716.

(3) Furnish anchor rods conforming to ASTM F1554 grade 105 and Supplementary Specification S4, ASTM A563 nuts, and ASTM F436 washers for type 1 and 2 traffic signal bases; for type 5, 6, 7, and 8 street light bases; for type 10 control cabinet bases; and for type 11 walkway lighting unit bases. Hot-dip zinc coat according to ASTM A153, class C, supplemented by ASTM F2329.

Revise 654.2(4) to include top and bottom templates for anchor rod assemblies used with type 10 and 13 bases.

(4) For type 10 and 13 concrete monotube pole bases, furnish anchor rod assemblies with top and bottom templates. Include rods, nuts, and washers conforming to 641.2.2.3.

(5) For control cabinet bases furnish either mechanical or adhesive stainless steel masonry anchors and stainless steel bolts or studs, nuts, and washers.

(6) Use schedule 40 PVC electrical conduit conforming to 652.

654.3 Construction

(1) Construct drilled shaft concrete bases conforming to 636.3. Cure exposed portions of concrete footings as specified in 502.3.8.1. Wait until the concrete has attained 3500 psi compressive strength or 7 equivalent days as specified in 502.3.10 before erecting any portion of the structure on the footing.

(2) Construct rectangular concrete bases for control cabinets as specified for footings in 502.3 except cure exposed portions of concrete bases as specified in 502.3.8.1. Wait until the concrete has attained the anchor manufacturer recommended compressive strength or 7 calendar days before installing masonry anchors.

654.4 Measurement

(1) The department will measure the Bases bid items as each individual base acceptably completed.

654.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
654.0100 - 0199	Concrete Bases (type)	EACH
654.0200 - 0299	Concrete Control Cabinet Bases (type)	EACH

(2) Payment for the Bases bid items is full compensation for providing concrete bases; for embedded conduit and electrical components; for anchor templates, rods, nuts, and washers; for bar steel reinforcement; and for excavating, backfilling, and disposing of surplus materials.

Section 655 Electrical Wiring

655.1 Description

(1) This section describes providing electrical wire and cable for traffic signal, highway/roadway lighting, and other underground installations.

655.2 Materials

655.2.1 Cable In Duct

(1) Furnish conductors conforming to electrical wire, lighting specified in 655.2.6.

(2) Furnish conductors enclosed in a red, or black with a red stripe, coilable polyethylene duct, suitable for direct earth burial, and manufactured from high density polyethylene conforming to the applicable requirements of ASTM D3350.

(3) Use UL or NRTL listed Cable in Duct (CID) conforming to the WSEC specifications for nonmetallic underground conduit with conductors, type NUCC.

655.2.2 Traffic Signal Cable

(1) Furnish solid copper conductor traffic signal cables conforming to IMSA Specification Number 20-1. Provide wire size and number of conductors as the plans show.

(2) For wiring that extends from the terminal strip in each signal head to the mounting base, use an IMSA, 20-1 cable, 14 AWG 4, 5, or 7 conductor as required.

655.2.3 Type UF Cable

(1) Furnish type UF cable with ground including the number and size of conductors as the plans show. Use cable conforming to ANSI/UL 493.

655.2.4 Communication Cable

(1) Furnish communication cable conforming to IMSA Specification 20-6. Use 6 pairs of 18 AWG in each cable. Twist conductors 12 turns per foot by the individual pair.

655.2.5 Grounded Conductor and Equipment Grounding Conductor for Traffic Signals

(1) Use green insulation or green insulation with a yellow tracer applied by thermoset method.

(2) Furnish 10 AWG or 8 AWG, or both, XLP, USE rated, 600 volt AC, single conductor, stranded copper for conductors.

655.2.6 Electrical Wire for Lighting

(1) For underground networks, unless the contract specifies a multi-conductor cable, furnish single conductor, stranded copper, XLP insulated, USE rated wire sized as the plans show.

(2) For underground network to luminaire connections, furnish single conductor, stranded copper, XLP insulated, USE rated wire. Use 12 AWG unless plans show otherwise.

(3) Identify insulated conductors by covering the insulation surface with a tough, strongly adhered color coating conforming to Method I, or by surface printing conforming to Method III of IPCEA (Insulated Power Cable Engineers Association)-NEMA Standard S-19-81. Do not use white coatings on ungrounded conductors.

(4) Color code as required by WSEC using the insulation color the plans show.

(5) When there is more than one circuit, bundle the circuit conductors with nylon cable ties or engineer-approved electrical tape at all access points. At each hand-hole, identify the line side of each circuit with a tape colored as the plans specify.

655.2.7 Loop Detector Lead In Cable

(1) Furnish shielded, 14 AWG, 2 conductor, polyethylene insulated, with 16 AWG drain wire, conforming to IMSA Specification Number 50-2 for loop detector lead-in cable.

655.2.8 Loop Detector Wire

(1) Furnish black 12 AWG, XLP insulated, USE rated, single conductor, stranded copper wire with 7 or more strands for loop detector wire.

655.2.9 Emergency Vehicle Preemption Detector Cable for Traffic Signals

(1) Furnish 3-conductor shielded, 600 volt, type B control cable conforming to IPCEA-5-61-402/NEMA WC5 with a foil shield, 20 AWG stranded conductors and ground wire, and rated for 75 degrees C. Ensure that the conductors are color coded with 1 blue, 1 orange, and 1 yellow conductor.

655.3 Construction

655.3.1 General

(1) Do not splice underground in pull boxes or conduit, except that the contractor may splice underground loop detector lead-in cable to loop wire. Do not leave wire or cable ends uncovered or submerged in water. If the engineer observes this condition, the engineer may reject the entire length of cable or wire. Make electrical connections and splices with a UL or NRTL approved mechanical type connector.

(2) Cover tape with a liberal coating of an engineer-approved electrical varnish or sealant providing flexible protection from oil, moisture, and corrosion. Make electrical connections in the traffic signal base with spring wound wire nuts, insulated with a soft flexible covering or as detailed on the plans. Extend wire for termination 18 inches beyond the pole or traffic signal standard access point. Provide 60 inches of cable wire to be pulled into cabinets and left for terminations.

(3) For cables entering each pull box, except loop detector lead in cables, provide an extra loop, approximately 16 feet long, to remain in each pull box. This loop of cable is in addition to the quantity needed to reach from the entrance conduit raceway end to the opening in the exiting conduit raceway.

(4) Install conductors in continuous lengths without splices from termination to termination. The contractor may splice only at hand-holes in the bases of the traffic signal standards or poles. At locations where no transformer bases exist, splice at the hand-holes in poles.

655.3.2 Cable In Duct

(1) Under the Cable In Duct bid items, provide underground cable in duct of the specified quantity and wire size of conductors.

(2) Locate the cable as the plans show. Locate underground cable to preclude damage resulting from other construction operations.

(3) Install cable in duct at least 30 inches below the finished grade or within the protection of conduit as the plans show. Should physical conditions at the cable location preclude placing to this depth, the contractor may modify the depth requirement as the WSEC allows. Place the cable in rigid steel conduit conforming to 652.2.2 for metallic conduit.

(4) Set the underground cable in duct assembly 3 feet above the top of each light base or finished grade. Cap or seal the duct until completion of the electrical connections.

(5) Continue the polyethylene duct to within 6 inches of a terminal connection.

(6) If the size of the cable in duct prevents insertion through the conduit in a concrete base, the contractor may cut the duct off the assembly to allow for wire installation. In this case, after placing the wire, ensure at least one foot of intact duct remains in the conduit to protect the wires at the conduit entrance.

(7) It is the intent of this specification that the cable duct will form a usable raceway as well as protection for the cable. Unreel the cable in duct, do not take off the side of the reel. Install the duct so it is free of kinks, sharp radii, and unnecessary wiggles. At the engineer's request, demonstrate free movement of the conductors within the duct after installation, and demonstrate the easy removal and replacement of the conductors within the duct.

(8) If installing cable in duct by plowing, use round duct free of kinks or constrictions while fed into the plowing mechanism. At the engineer's request, excavate the cable in duct to check for depth violations. Correct depth variations as specified in 105.3.2. Do not splice the cable in duct; replace it to the previous termination point.

(9) Before installing cable in duct by trenching, remove rocks, stones, and concrete chunks from the trench, and place a layer of foundation backfill conforming to 520.2 from 6 inches below to 12 inches above the duct. Use select backfill material, with 100 percent passing a one-inch sieve.

(10) Install ungrounded conductors or grounded circuit conductors in continuous lengths without splices from terminal to terminal. Splice only in hand-holes of poles, transformer bases, sign bridge columns, or junction boxes as the plans show. Do not splice in pull boxes.

655.3.3 Traffic Signal Cable

(1) Under the Traffic Signal Cable bid item, provide multi-conductor cable for traffic signals and make all connections.

(2) Numbers of conductors, in excess of those required are for future use.

(3) Wrap back the conductors from spare multi-conductor cables along the multi-conductor cable and tape to the cable.

(4) Effectively ground spare or unused conductors in the signal control cabinet to the equipment grounding terminal strip.

(5) Group and identify sets of conductors in signal cables, per signal phase, whether insulated with red, yellow, green, or other colors at each pertinent termination. Unless the plans show otherwise, use conductors colored to match lens colors.

(6) Tag traffic signal cables terminating in the signal control cabinet with waterproof tape and mark with indelible ink. Tape a plastic coated copy of the cable routing diagrams to the inside cabinet wall. Ensure markings indicate the geographical location. Indicate NW quadrant, S median, etc. The engineer will approve the method of identification.

(7) Ensure that the grounded conductor in feeder cables is 12 inches longer than the ungrounded conductors. Also ensure that the pole cable from the signal heads to the signal base extends 24 inches beyond the access door.

(8) If mounting more than one signal head on a standard or pole, wire each head with a separate cable from the mounting base to the appropriate terminal strips.

655.3.4 Type UF Cable

(1) Under the Cable Type UF bid items, provide the underground cable network for highway lighting at traffic signal installations.

(2) If installing lighting in conjunction with traffic signals, use type UF, 2 conductor with ground, solid or stranded copper conductor cable, sized as the plans show, from the traffic signal control cabinet to the pertinent light pole base or bases.

(3) Strip the minimum length of jacket necessary to make terminations in a neat and technically proficient manner.

655.3.5 Communication Cable

(1) Under the Communication Cable Plowed bid item, furnish communication cable for interconnecting traffic signals, and install the cable by plowing.

(2) If installing communication cable by plowing, install at least 32 inches below finished grade.

(3) Under the Communication Cable Trenched bid item, furnish communication cable for interconnecting traffic signals, construct a trench, and install the cable in the trench.

(4) Install trenched communication cable as specified in 652.3.1.2 for underground installation except do not install less than 32 inches below finished grade.

(5) During installation, prevent damage to the communication cable.

(6) Under the Communication Cable Installed in Conduit bid item, furnish communication cable for interconnecting traffic signals, and install the cable in new or in existing, in place traffic signal conduit.

(7) If installing communication cable in conduit, do not damage or disturb existing cable within the conduit. Use wire lube on the full length of installed communication cable, if wire or cables exist in conduit.

(8) Install communication cable without splices between traffic signal control cabinets. Extend cable into each signal control cabinet for 6 feet. Provide an extra loop, approximately 4 feet in length, to remain in each pull box.

(9) Test the communication cable following installation. Use a megger to perform ground resistance testing of conductors including the shield, and conductor-to-conductor, including individual conductors to the shield. Ensure that all conductor tests, including the shield, read greater than 500 mega ohms to ground, and from conductor to conductor and individual conductors to the shield, read greater than 500 mega ohms. Replace cable with one or more failing tests.

655.3.6 Grounded Conductor and Equipment Grounding Conductor for Traffic Signals

(1) Connect the white 14 AWG wires in the signal head mounting base to the white grounded conductor in the feeder cable.

(2) Terminate grounded conductors on a bus mounted in the cabinet and isolated from the cabinet and equipment grounding conductor. Terminate the grounded conductor bus at the grounding lug in the electrical service meter pedestal or meter socket.

(3) Terminate equipment grounding conductors on the equipment grounding bus that is isolated from the grounded conductor bus. Terminate the equipment grounding bus at the grounding lug in the electrical service meter breaker pedestal service disconnect, or meter socket, or terminate at the grounding lug of the breaker enclosure if the service is unmetered.

(4) Make the equipment grounding connection in the signal pedestal base, or in a pole transformer base, with a pigtail and wire nut or split bolt to an equipment grounding conductor. Extend the equipment

grounding conductor from the equipment grounding bus in the traffic signal cabinet, from base to base around the intersection in a complete closed circuit. Ensure that the pull box is bonded to the frame and the cover is bonded to the frame with a jumper from the nearest signal base.

(5) Under the Electrical Wire Traffic Signals bid items, provide electrical wire for traffic signals and make all connections.

(6) Make electrical connections in the traffic signal base with spring wound wire nuts, insulated with a soft flexible covering.

(7) For the pigtail, use 10 AWG, bare copper wire or green XLP insulated, a minimum 16 inches in length. Attach one end of the pigtail to an engineer-approved mechanical connector, lug, and place the connector inside the base under the head of a 1/4” -20 x 3/4” hex-head stainless steel cap screw tapped into the base.

655.3.7 Electrical Wiring for Lighting

(1) Under the Electrical Wire Lighting bid items, provide electrical wire of the specified conductor size for lighting, and make all connections.

(2) Provide an 18 inch length of wire in each hand-hole for termination. For all wires entering each pull box, provide an extra loop, approximately 6 feet in length, to remain in each pull box. This loop of wire is in addition to the quantity needed to reach from the entrance conduit raceway end to the opening in the exiting conduit raceway.

(3) Install conductors in continuous lengths without splices from the cabinet terminal to pole hand-hole or transformer base. Do not splice in pull boxes.

(4) Install conductors from the luminaire to the fuse assembly using a continuous length of 12 AWG, XLP wire without splices. Provide sufficient length in the pole shaft to allow easy removal and subsequent servicing of the fuse assembly through the pole hand-hole.

655.3.8 Loop Detector Lead In Cable

(1) Under the Loop Detector Lead In Cable bid item, provide loop detector lead in cable as well as splice loop and lead in cable together in the pull box. Connect the lead in cable to proper terminals in the control cabinet.

(2) Install the loop detector lead in cable in electrical conduit furnished under other bid items. For lead in cable from the pull box to the control cabinet, install lead in cable in conduit either with or without other cables. Do not provide an extra length of loop lead in cable in pull boxes. For each loop, use a separate lead in cable to the control cabinet. Cut the drain wire flush with the lead in cable jacket.

(3) Splice cables using cast in place splice kits from an engineer-approved manufacturer. Make splices as soon as possible after installing loop detector lead in cable.

(4) If unable to splice to the lead in cable the day installing the wire, seal the cable ends with tar or electrical sealant to keep water out of the insulating jacket of the cable. If water does enter the insulating jacket, remove the cable and replace with new cable at no expense to the department.

(5) A splice consists of a non-insulated butt connector connecting one loop wire to one loop lead-in cable wire. Crimp and solder this connection with electrical multi-flux core. Crimp and solder the second 2 wires in the same manner. Half lap tape the solder connections with an engineer-approved rubber high voltage tape. Half lap tape each connection with an engineer-approved vinyl electrical tape and insulate connections from each other before placing in the splice kit. Coat each connection with an engineer-approved electrical varnish and allow the coating to dry. After drying, install the splice capsule conforming to the manufacturer's instructions.

(6) If the engineer directs, open one randomly selected loop detector splice and inspect it for compliance with installation specifications. If the engineer determines the splice is non-compliant with the specifications, replace all loop detector splices on the project at no expense to the department.

(7) After splicing the loop wire to the loop lead in cable, measure inductance, ground resistance, and wire resistance at the cabinet end of the lead in cable. Furnish a copy of the readings to the engineer for evaluation.

655.3.9 Loop Detector Wire

(1) Under the Loop Detector Wire bid item, provide loop detector wire.

(2) Install the loop detector wire in one-inch loop detector PVC conduit furnished under another bid item. The contractor may install loop wire before placing the conduit.

(3) Do not provide an extra length of loop detector wire in the pull boxes.

(4) Install the loop wire from the pull box at the side of the road, around the loop in the number of turns the plans show, and back to the pull box at the side of the road, in one continuous non-spliced length.

(5) If unable to splice to the lead in cable the day installing the wire, seal the wire ends with tar or electrical sealant to keep water out of the insulating jacket of the wire. If water does get into the insulating jacket, remove the wire and replace with new wire at no expense to the department.

(6) Measure the loop inductance, ground resistance, and loop wire resistance at the pull box end of the loop wire immediately after installation. Furnish a copy of the readings to the engineer for evaluation.

(7) Measure ground resistance using a megger. Replace loop wire not attaining greater than 500 mega ohms to ground.

655.3.10 Emergency Vehicle Preemption (EVP) Detector Cable for Traffic Signals

(1) Under the Traffic Signal EVP Detector Cable bid item, provide the EVP cable and mount department-furnished brackets. The department will determine the exact location to ensure that the installation does not create a sight obstruction. The department will mount the heads, terminate the ends, and install the discriminators and card rack in the cabinet.

(2) Ensure that the cable runs continuously without splicing from the pull box closest to the cabinet including the specified extra cable. Do not splice EVP cable from the detector assembly to the controller terminations. Provide 8.5 feet of extra cable at the mounting bracket with 6 feet at the bracket and 2.5 feet extending out of the mounting bracket. Provide 6 feet of extra cable in each pull box plus an additional 20 feet at the nearest pull box to signal base where the EVP detector head is mounted.

(3) Mark each end of the lead as the plans show. Notify the department to gain access to the control cabinet. The department will only provide access while a department electrician is present.

(4) Notify the engineer upon completion of the installation at each intersection.

655.4 Measurement

(1) The department will measure the Cable In Duct bid items by the linear foot acceptably completed. This measurement includes conductors that had the duct cut away.

(2) The department will measure the Cable Traffic Signal bid items, the Cable Type UF bid items, Communication Cable Plowed, Communication Cable Trenched, Communication Cable Installed in Conduit, and Traffic Signal EVP Detector Cable by the linear foot acceptably completed.

(3) The department will measure the Electrical Wire Traffic Signals and Electrical Wire Lighting bid items by the linear foot acceptably completed, measured separately for each conductor.

(4) The department will measure Loop Detector Lead In Cable by the linear foot acceptably completed, measured from the splice with the loop lead in wire along the centerline of the conduit to its connection with terminals in the control cabinet.

(5) The department will measure Loop Detector Wire by the linear foot acceptably completed, measured around the loop, including the number of turns and its lead to and from the splice with the lead in cable.

655.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
655.0100 - 0199	Cable In Duct (# of conductors) (AWG)	LF
655.0200 - 0299	Cable Traffic Signal (# of conductors) (AWG)	LF
655.0300 - 0399	Cable Type UF (# of conductors) (AWG)	LF
655.0400	Communication Cable Plowed	LF
655.0405	Communication Cable Trenched	LF
655.0410	Communication Cable Installed in Conduit	LF
655.0500 - 0599	Electrical Wire Traffic Signals (AWG)	LF
655.0600 - 0699	Electrical Wire Lighting (AWG)	LF
655.0700	Loop Detector Lead In Cable	LF
655.0800	Loop Detector Wire	LF
655.0900	Traffic Signal EVP Detector Cable	LF

(2) Payment for the Cable In Duct bid items is full compensation for providing materials, including cables and duct; for excavating trenches; for placing cable in duct; for providing rigid steel conduit as needed;

for backfilling; for restoring disturbed or damaged areas, including seeding and sodding; for making connections and testing installed cable system; and for disposing of surplus material.

(3) Payment for the Cable Traffic Signal bid items, is full compensation for providing cable; for making connections; for providing connectors, including wire nuts; and for testing the circuits. The department will pay for wiring from the signal head terminal strip to the mounting base under the Cable Traffic Signal bid items appropriate for the conductor number and wire size the plans show.

(4) Payment for the Cable Type UF bid items is full compensation for providing the cable; for making connections; for providing connectors, including wire nuts, splices, tape, insulating varnish, or sealant; and for testing the circuits.

(5) Payment for Communication Cable Plowed is full compensation for providing materials including cable; for plowing in the cable; for making connections; for testing the installed cable; for restoring damaged or disturbed areas, including seeding or sodding; and for disposing of surplus material.

(6) Payment for Communication Cable Trenched is full compensation for providing materials including cable and backfill material; for constructing the trench, installing the cable in the trench, and backfilling; for making connections; for testing the installed cable; for restoring disturbed or damaged areas, including seeding or sodding; and for disposal of surplus material.

(7) Payment for Communication Cable Installed in Conduit is full compensation for providing materials including cable; for installing the cable in existing conduit; for making connections; and for testing the installed cable.

(8) Payment for the Electrical Wire Traffic Signals bid items is full compensation for providing electrical wire; for making connections; for providing connectors, including wire nuts and lugs; and for testing the circuits.

(9) Payment for the Electrical Wire Lighting bid items is full compensation for providing electrical wire; for making connections; for providing connectors, including wire nuts, fuses, fuse holders, splices, tape, insulating varnish or sealant; and for testing the circuits. The department will pay for wiring from the underground feeder system to the luminaire under the Electrical Wire Lighting bid item appropriate for the wire size the plans show.

(10) Payment for Loop Detector Lead In Cable is full compensation for providing the lead-in cable; for making necessary cabinet connections; and for furnishing splice kits and splicing to the loop detector wire.

(11) Payment for Loop Detector Wire is full compensation for providing loop detector wire.

(12) Payment for Traffic Signal EVP Detector Cable is full compensation for providing emergency vehicle preemption detector cable for traffic signals.

(13) The department will not pay for replacing cable or wire not attaining a required resistance greater than 500 mega ohms.

(14) Pedestrian push button wiring is incidental to the Pedestrian Push Buttons bid item under 658.

Section 656 Electrical Service

656.1 Description

(1) This section describes providing an electrical service, of the specified type.

656.2 Materials

656.2.1 General

(1) Install the electrical service conforming to local utility requirements. Furnish the utility with a wiring affidavit certifying that the service conforms to the WSEC and then verbally notify the engineer that the utility received the wiring affidavit.

(2) For grounding electrodes for the electrical service, use engineer-approved 5/8-inch diameter copper clad grounding electrodes. Furnish the number and length of grounding electrodes as required to install the service conforming to the WSEC and the local utility.

(3) If required by the local utility, provide a manual bypass meter socket. Obtain the local utility's approval of the manual bypass meter socket.

(4) If an overhead service is required, provide the riser, weatherhead, wiring, and necessary fittings as incidental to the electrical service bid item.

656.2.2 Meter Socket Service

(1) Furnish an engineer-approved service having a meter socket, NEMA 3R breaker enclosure, 22,000-AIC circuit breakers unless the local utility requires otherwise, grounding electrodes and connections, conduit and fittings, and necessary conductors and equipment required by the WSEC and the utility for a service connection. Use circuit breakers with an amperage capacity of 50 A, unless specified otherwise in the contract.

656.2.3 Meter Breaker Pedestal Service

(1) Furnish an engineer-approved service having a meter breaker pedestal, 22,000-AIC circuit breakers unless the local utility requires otherwise, grounding electrodes and connections, conduit and fittings, and necessary conductors and equipment required by the WSEC and the utility for a service connection. Use circuit breakers with an amperage capacity 50 A, unless specified otherwise in the contract. When the meter breaker pedestal is energized, install an engineer-approved meter seal at access points on the meter trough.

656.2.4 Unmetered Service

(1) Furnish an engineer-approved service conforming to 656.2.2, except do not supply a meter socket.

656.2.5 Main Lugs Only Meter Pedestal Service

(1) Furnish an engineer-approved service having grounding electrodes and connections, conduit and fittings, and necessary conductors and equipment required by the WSEC and the utility for a service connection. Provide a lug amperage capacity, and the number of phases, and service voltage rating as the plans show.

656.2.6 Breaker Disconnect Box Service

(1) Furnish a 100 A outside rated breaker box with space for 6 circuits, but no main breaker; to 50 A single circuit breaker (22, 000 AIC or larger as required by power companies), conduit fittings, grounding electrodes, and connections and necessary conductors and equipment required to provide power to the cabinet.

656.3 Construction

656.3.1 General

(1) Install the electrical service conforming to local utility requirements. Furnish the utility with a wiring affidavit, certifying that the service was installed conforming to the WSEC.

(2) All above ground electrical service conduit and fittings shall be rigid metal conduit.

656.3.2 Service Lateral

(1) The local utility will provide a 100 A, 120/240 volt AC, single phase, 3-wire underground electrical service lateral, unless specified otherwise in the contract documents. Arrange and assume responsibility for the timely installation of the service lateral by the utility. Terminate the lateral at a meter socket, meter breaker pedestal, a NEMA 3R Breaker Enclosure, or a main lugs only meter pedestal, as the plans show.

656.3.3 Meter Socket Service

(1) If 2 or more grounding electrodes are required, space them at least 6 feet apart and drive them near the termination point. Run a grounding conductor, from grounding electrode to grounding electrode if

more than one is required. Then, connect to the meter socket and terminate at the grounding lug in the NEMA 3R Breaker Enclosure. Provide connections and wiring to provide 120 volt AC power, or as the plans show, to the circuit breakers in the cabinets. If only one grounding electrode is required, exothermically weld the stranded copper wire to it and then connect to the grounding lug in the NEMA 3R Breaker Enclosure.

(2) Provide an appropriately sized equipment grounding conductor from the grounding lug in the NEMA 3R Breaker Enclosure to an equipment grounding bus mounted in the control cabinet.

(3) If installing intersection lighting along with the signal installation, feed lighting power to street lights from a separate circuit breaker. Use a common trip breaker rated at 15 amps or more.

656.3.4 Meter Breaker Pedestal Service

(1) If 2 or more grounding electrodes are required, space them 6 feet apart and drive them outside the concrete base and near the electrical service meter breaker pedestal. Run a grounding conductor, from grounding electrode to grounding electrode if more than one is required. Then, terminate at the grounding lug in the meter breaker pedestal. Provide connections and wiring to provide 120 volt AC power, or as the plans show, to the circuit breakers in the cabinet. If only one grounding electrode is required, exothermically weld the stranded copper wire to it and then connect to the grounding lug in the meter breaker pedestal.

(2) Provide an equipment grounding conductor, appropriately sized. Run the conductor from the grounding lug in the meter breaker pedestal to an equipment grounding bus mounted in the control cabinet.

(3) If providing intersection lighting along with the signal installation, feed lighting power to street lights from a separate circuit breaker. Use a common trip breaker for 240 volt AC installations. Size the breaker conforming to code requirements, 15 amp, minimum.

656.3.5 Unmetered Service

(1) Conform to 656.3.3, except no meter is required.

656.3.6 Main Lugs Only Meter Pedestal Service

(1) Conform to 656.3.4.

656.3.7 Breaker Disconnect Box Service

(1) Furnish connections and wiring to provide 120 volt AC power to the circuit breaker in the cabinet from the bus located within the breaker disconnect box.

(2) Furnish connections and wiring to provide 120 volt AC power from the bus bar located within the meter breaker pedestal to the 50 amp single circuit breaker within the breaker disconnect box and then to the circuit breaker in the control cabinet.

(3) Mount the breaker disconnect box to the cabinet as the plans show.

656.4 Measurement

(1) The department will measure the Electrical Service bid items as a single lump sum for each service acceptably completed.

656.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
656.0100	Electrical Service Meter Socket (location)	LS
656.0200	Electrical Service Meter Breaker Pedestal (location)	LS
656.0300	Electrical Service Unmetered (location)	LS
656.0400	Electrical Service Main Lugs Only Meter Pedestal (location)	LS
656.0500	Electrical Service Breaker Disconnect Box (location)	LS

(2) Payment for Electrical Service Meter Socket is full compensation for providing the meter socket; and for manual bypass meter socket, NEMA 3R breaker enclosure, conduit and fittings, circuit breakers, grounding electrodes and connections.

(3) Payment for Electrical Service Meter Breaker Pedestal is full compensation for providing materials including the meter breaker pedestal, manual bypass meter socket, conduit and fittings, circuit breakers, grounding electrodes and connections.

(4) Payment for Electrical Service Unmetered is full compensation for providing materials including the NEMA 3R breaker enclosure, conduit and fittings, circuit breakers, grounding electrodes and connections.

(5) Payment for Electrical Service Main Lugs Only Meter Pedestal is full compensation for providing materials including the main lugs only meter pedestal, disconnect, manual bypass meter socket, grounding electrodes and connections.

(6) Payment for Electrical Service Breaker Disconnect Box is full compensation for providing materials including the breaker box, circuit breakers, 10 AWG wire, grounding electrodes, cadwelding, conduit, fittings, wiring, connections, grounding electrodes and connections; for excavating, bedding, backfilling, and restoration of ground to original condition including any sand, concrete, or other required materials; for disposing of surplus materials.

(7) Coordinate with the engineer to determine how to handle the electrical service lateral installation costs. If the electrical utility bills the contractor directly, pay the utility promptly. The department will reimburse the contractor for invoice costs under the Electrical Service Lateral administrative item.

Section 657 Poles, Arms, Standards, and Bases

657.1 Description

(1) This section describes providing poles, arms, standards, and bases for lighting and traffic signals.

657.2 Materials

Revise 657.2 to require contractor furnished monotube poles and arms.

657.2.1 Poles

657.2.1.1 General

(1) Furnish poles from the department's QPL. Submit a materials list and accompanying certificate of compliance certifying that the poles incorporated into the work conform to the specified design criteria and other contract requirements.

(2) Include hand holes with a bolt-on access cover as the plans show. Provide a grounding L-clip welded directly opposite the hand hole on the inside wall of the pole.

(3) Weld base plates to the pole shaft. Identify the pole type and wall thickness using 1/2-inch lettering stamped under the hand-hole before galvanizing steel poles.

(4) Complete welding before galvanizing steel poles. Clean exterior surfaces of steel poles after welding to ensure they are free of loose rust and mill scale, dirt, oil or grease, and other contaminants before zinc coating. Zinc coat as specified in 641.2.8. Ensure that the coating is tight, free from rough areas or slag, and presents a uniform appearance. Clean after manufacturing is complete to remove loose and foreign material.

(5) Furnish aluminum or galvanized steel shims matching the pole material.

(6) Furnish identification plaques as the plans show.

657.2.1.2 Monotube Poles

(1) Furnish steel monotube poles zinc coated according to ASTM A123. Design conforming to the edition of AASHTO design specifications and fatigue category the plans show.

657.2.1.3 Type 2 and 3 Poles

(1) For Types 2 and 3 poles, design support structures conforming to the AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals as published in the 1994, Third Edition. Design for the following:

- A wind speed of 80 mph with a 1.3 gust factor.
- Dead and live load related to a 25-foot trombone mast arm with 5-section signal head and a pair of twin 15-foot luminaire arms mounted on the pole as the plans show.

657.2.1.4 Other Pole Types

(1) Design support structures, consisting of poles and arms, conforming to the minimum wall thickness the plan details show and to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, and Interim Revisions. Use a design life of 50 years. Design to withstand a 3 second gust wind speed of 90 mph. Do not use the alternative method for wind pressures described in appendix C of those AASHTO standard specifications. No fatigue analysis is required.

(2) Construct poles of materials having sufficient rigidity that, with material installed as the plans show, the centerline of the shaft is vertical. Ensure that lighting poles nominally 40 feet or less in length are made of one piece and round in cross-section.

(3) Incorporate vibration dampeners as the plans show.

657.2.2 Monotube Arms

(1) Furnish steel monotube arms zinc coated according to ASTM A123. Design conforming to the edition of AASHTO design specifications and fatigue category the plans show.

(2) Furnish monotube arms from the department's QPL. Submit a materials list and accompanying certificate of compliance certifying that the arms incorporated into the work conform to the specified design criteria and other contract requirements.

1. Furnish a mounting device welded to the pole end of the monotube arm that allows the attachment of the arm to a pole as the plans show.
2. Furnish stiffeners or gussets if required between the arm tube and the arm mounting device to provide adequate strength to resist side loads.
3. Furnish a clean, uniform natural finish. No paint or other corrosion preventive maintenance coating is required.

(3) After welding and before zinc coating, clean the exterior surfaces of each arm free of all loose rust and mill scale, dirt, oil or grease, and other foreign substances.

(4) Apply zinc coating as specified for sign bridge components in 641.2.9 Ensure that the zinc coating is tight, free from rough areas or slag, and presents a uniform appearance.

(5) After manufacturing is complete, clean the exterior surfaces of each pole free of all loose scale, dirt, oil or grease, and other foreign substances.

657.2.3 Trombone Arms

(1) Design aluminum trombone arms as specified in 657.2.1.3 based on the completed maximum loading configuration the plans show. Furnish shop drawings conforming to 105.2.1 that show the width, depth, length, and thickness of all members. Also list the ASTM alloy designation and strength of each aluminum member on the shop drawings.

(2) Submit a materials list and accompanying certificate of compliance certifying that the trombone arms incorporated into the work conform to the specified design criteria and other contract requirements. Also send a copy of the certificate of compliance and a copy of the shop drawings to the department's electrical engineer for informational review.

(3) Ensure that the design incorporates all of the following:

1. Round or oval upper and lower aluminum members welded to one or more tubular vertical struts.
2. A mounting clamp welded to the pole end of the trombone arm for attachment to a round pole.
3. Gussets at the joints between the main arm tubes and the arm clamps designed to resist side loads.
4. A horizontally adjustable strut to allow mounting five 12-inch signal faces with backplates.
5. A clean, uniform, natural aluminum finish. Do not paint or apply other anti-corrosion coatings.
6. A wiring raceway entrance through the upper mounting bracket.
7. Vertically adjustable through plus or minus 10 degrees as the plans show.

657.2.4 Luminaire Arms

657.2.4.1 Aluminum Luminaire Arms

(1) Design aluminum luminaire arms as specified in 657.2.1.3 to withstand in-service field loadings including loads imposed by components attached to the arms. Furnish shop drawings conforming to 105.2.1. Include the dimensions of all members, list the ASTM alloy designation of aluminum members, and show weld details.

(2) Submit a materials list and accompanying certificate of compliance certifying that the luminaire arms incorporated into the work conform to the specified design criteria and other contract requirements. Also send a copy of the certificate of compliance and a copy of the shop drawings to the department's electrical engineer.

(3) Make luminaire arms out of extruded aluminum. Ensure that the arms are clean with a uniform natural aluminum finish. Do not paint or apply other anti-corrosion coatings.

(4) Furnish an extruded aluminum fixture welded to the pole end of the luminaire arm that allows the arm to be clamped to a round pole dimensioned as the plans show. Furnish mounting clamps with stainless steel bolts, nuts, and washers conforming to ASTM A320.

657.2.4.2 Luminaire Arms Steel

(1) Under the Luminaire Arms Steel bid items provide steel luminaire arms conforming to 657.2.2.

657.2.5 Traffic Signal Standards

(1) Furnish standards consisting of extruded seamless aluminum alloy 6061-T6 manufactured conforming to ASTM B241, or porthole extruded aluminum alloy 6061-T6 manufactured conforming to ASTM B429. Also conform to the following:

1. Threaded on one end, tapered, and conforming to national pipe threading dimensions and normal practice.
2. Outside dimension of 4 1/2 inches.
3. Schedule 80 aluminum pipe.

(2) Ensure that the manufacturer has indent printed the ASTM and alloy designations 2 inches above the threading on the outside of each standard using 1/4-inch dies.

657.2.6 Bases

(1) Furnish cast aluminum alloy pedestal and transformer bases from the department's QPL and meeting the design criteria specified in 657.2.1.3. Ensure that castings are true to pattern in form and dimensions and free from defects affecting strength or service life.

(2) Submit a materials list and accompanying certificate of compliance certifying that the bases incorporated into the work conform to the specified design criteria and other contract requirements.

(3) If the engineer requests, provide one randomly selected sample pedestal base per traffic signal location. The department will base acceptance of all pedestal bases at that traffic signal location on destructive tests of that sample base.

(4) Thread casting collars for pedestal bases to mate with the traffic signal standards furnished under the contract.

(5) Use mounting washers for transformer bases conforming to the manufacturer's instructions.

657.2.7 High-Strength Bolts

(1) Furnish zinc-coated type 1 bolt/nut/washer assemblies conforming to 506.2.5 and as follows:

- Furnish 2 flat washers with each bolt/nut/washer assembly. Use the size, number, type, and configuration of hardened flat washers the DTI manufacturer recommends for bolt diameters greater than 1 1/8 inches.
- Ensure that all bolt/nut/washer assemblies of a given size come from the same rotational-capacity lot, are shipped in sealed and labeled containers, and are accompanied by a certified report of test or analysis giving the results of the supplier's rotational-capacity testing. No field rotational-capacity testing is required.
- Furnish 3 or more additional bolt/nut/washer assemblies of each size for pre-installation testing.
- Submit 2 or more additional bolts and 3 or more additional nuts and washers of each size for department mechanical testing. The contractor need not submit components from a lot and heat the department previously approved.

(2) Furnish zinc-coated direct tension indicating (DTI) washers conforming to ASTM F959 type 325. Ensure that DTIs have identifying marks applied by the manufacturer. Provide the engineer with 2 copies of the DTI manufacturer's instructions showing acceptable installation configurations. Provide 3 or more additional DTIs as required for pre-installation testing. Also provide the engineer with at least two 0.005-inch metal feeler gauges.

657.2.8 Anchor Assemblies for Light Poles on Structures

(1) Furnish anchor rods conforming to ASTM F1554, grade 55 and Supplementary Specification S4, ASTM A563 heavy hex nuts, and ASTM F436 washers all hot-dip galvanized according to ASTM A153, class C, supplemented by ASTM F2329.

(2) For each rod, furnish 4 nuts for securing the top and bottom anchor plate-templates, a leveling nut, bottom washer, top washer, and 2 top nuts. Do not use lock washers.

(3) Furnish a steel top and bottom anchor plate-template as part of each anchor assembly. Provide a top template of sufficient gauge to hold the anchor rods securely in position at the top, and resist racking or twisting during the pour. Do not weld templates to anchor rods.

657.3 Construction

657.3.1 General

657.3.1.1 Installation

(1) Install a grounding lug either inside the base or pole as required to connect equipment grounding conductors.

657.3.1.2 Welding

(1) Perform shop welding as the plans show and conforming to the following:

For steel poles and arms: AWS D 1.1, Structural Welding Code - Steel.

For aluminum poles and arms: AWS D 1.2, Structural Welding Code - Aluminum.

(2) Do not weld in the field without the engineer's written approval. The engineer will only allow field welding for repairs in noncritical locations and when a department-approved individual competent to perform inspections is present during the welding. Perform field welding using personnel qualified under AWS D 1.5, Bridge Welding Code for steel or AWS D 1.2, Structural Welding Code - Aluminum for aluminum.

657.3.2 Poles

(1) Clean each pole before installation.

(2) Secure type 9, 10, 12, and 13 structures to anchor assemblies conforming to the procedures enumerated in department form DT2321. Complete department form DT2321 for each structure. Indicate the parties responsible for the installation and submit the form to the engineer for inclusion in the permanent project record.

(3) After completing erection using normal pole shaft raking techniques, ensure that the centerline of the shaft is vertical.

(4) Install identification plaques as the plans show.

657.3.3 Arms

657.3.3.1 General

(1) Install trombone, monotube, and luminaire arms to supporting structures at the height and alignment the plans show. Clamp luminaire arms to the pole and rake so the initial level of the luminaire tenon is plus 3 degrees.

(2) Install traffic signal heads within 5 days after monotube arms are erected to control vibration. Contact the bureau of structures if signal heads cannot be installed within those 5 days.

657.3.3.2 High-Strength Bolts

657.3.3.2.1 Handling and Storage

(1) Store bolts/nut/washer assemblies and DTIs in closed containers in a protected shelter to protect them from dirt and moisture until used. Maintain fastener system components as nearly as possible in the as-manufactured condition until installed. Remove from storage only as needed and promptly return unused components to storage.

657.3.3.2.2 Pre-installation Testing

(1) Notify the engineer before performing the required field pre-installation testing.

(2) Lubricate high-strength bolt threads with a wax-based lubricant before testing. Test bolt/nut/washer assemblies with DTIs in all the configurations used for installation.

(3) Perform pre-installation testing in the field conforming to the procedures enumerated in department form DT2322 for each bolt/nut/washer/DTI size and configuration installed. Provide the engineer with the test results by submitting 2 copies of department form DT2322.

657.3.3.2.3 Bolt Installation

(1) Do not begin bolt installation without the engineer's approval.

(2) Lubricate high-strength bolt threads with a wax-based lubricant before installation.

(3) Tension high-strength bolts using DTIs. Install the DTI on the bolt with the protrusions facing away from the connected materials. Install bolt/nut/washer assemblies with DTIs in the same configuration used for pre-installation testing.

(4) Tighten conforming to department form DT2322 to provide the correct installation tension. During the operation, ensure no rotation of the part not turned by the wrench. Snug systematically from the most rigid part of the connection to the free edges. Repeat until the full connection is in a snug condition and the faying surfaces are in firm contact. Systematically tighten the connection required number of refusals is achieved. If the gaps on the DTI are completely closed, discontinue tightening.

(5) Perform QC testing as specified in 506.3.12.3.3.3 for tensioning with DTIs. The engineer may verify bolt installation by periodically testing with a feeler gauge.

657.3.4 Standards

(1) Thread traffic signal standards into their pedestal bases without damaging the threads. Ensure that the base is level on its concrete foundation and the standard is vertical after all connections are tight.

657.3.5 Bases

(1) Before installing, clean the mill scale, oil, and foreign material off transformer bases, traffic signal pedestal bases, and other aluminum bases.

(2) Install transformer bases conforming to the manufacturer's instructions.

657.3.6 Anchor Assemblies for Light Poles on Structures

(1) Install anchor rods and templates conforming to plan details and the light standard manufacturer's recommendations.

657.4 Measurement

(1) The department will measure the bid items under this section as each individual unit acceptably completed.

657.5 Payment

Revise 657.5 to change install bid items to contractor-provided for poles, monotube arms, and steel luminaire arms.

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
657.0100	Pedestal Bases	EACH

657.0200 - 0299	Transformer Bases Breakaway (size)	EACH
657.0300 - 0399	Poles (type)	EACH
657.0400 - 0499	Traffic Signal Standards Aluminum (length)	EACH
657.0500 - 0559	Monotube Arms (length)	EACH
657.0560 - 0599	Trombone Arms (length)	EACH
657.0600 - 0699	Luminaire Arms Single Member (clamp size) (length)	EACH
657.0700 - 0799	Luminaire Arms Truss (type) (clamp size) (length)	EACH
657.0800 - 0825	Luminaire Arms Steel (length)	EACH
657.6005	Anchor Assemblies Light Poles on Structures	EACH

(2) Payment for Pedestal Bases and the Transformer Bases bid items is full compensation for providing the pedestal base including grounding lugs and related mounting hardware; for leveling shims; and for corrosion prevention. The department will pay for sample pedestal bases, provided under 657.2.6, at the contract unit price for Pedestal Bases.

(3) Payment for the Poles bid items is full compensation for providing poles including grounding lugs and related mounting hardware; for hardware and fittings necessary to install the pole; for leveling shims; and for corrosion prevention.

(4) Payment for the Traffic Signal Standards Aluminum bid items is full compensation for providing the standards.

(5) Payment for the Trombone Arms and Luminaire Arms bid items is full compensation for providing arms including related mounting hardware and leveling shims.

(6) Payment for the Monotube Arms and Luminaire Arms Steel bid items is full compensation for providing arms; for high-strength bolt/nut/washer assemblies and DTIs including those required for testing; and for providing related mounting hardware, leveling shims.

(7) Payment for Anchor Assemblies Light Poles on Structures is full compensation for furnishing and installing the anchors assemblies on structures. For other installations, the department will either furnish anchor assemblies or include them as incidental to the Concrete Bases bid items as specified in 654.

(8) The department will pay separately for concrete foundations under 654.

Section 658 Traffic Signals

658.1 Description

(1) This section describes providing traffic signal faces, pedestrian signal faces, programmable traffic signal faces, push buttons, and signal mounting hardware.

658.2 Materials

(1) Submit a complete list of traffic signal components and hardware provided under the contract.

(2) Furnish materials from the department's QPL as follows:

- Traffic signal faces including signal housing, backplates and LED modules.
- Pedestrian signal faces including signal housing and LED modules.
- Pedestrian push buttons.
- Signal mounting hardware.

(3) For traffic signal faces: furnish signal housings, visors, LED modules, backplates, and cut away or tunnel type visors as the plans show.

(4) For pedestrian signal faces: furnish signal housings, LED modules, and visors. For 16-inch heads, furnish a z-crate visor.

(5) For Pedestrian push buttons: furnish a standard R 10-3b or R 10-3e series sign. Include directional arrows on the sign as the plans show.

(6) For programmable traffic signal faces: furnish electronically programmable traffic signal faces, visor, and backplate with LED illumination sources conforming to the following:

- Fully programmable with a portable electronic device.
- Programmable for both horizontal and vertical viewing angles.
- Programmable light intensity.

(7) For signal mounting hardware: furnish weather tight mounting hardware. Protect mounting hardware from the elements before installation. Use corrosion resistant poly bracket shims.

658.3 Construction

(1) Cover traffic signal faces and pedestrian signal faces with a hood or turn away from view by the traveling public until the signal is accepted for use and activated.

(2) For pedestrian signal faces: allow for side-fire connection without conflict between the mounting bracket and the door hinge.

(3) For Pedestrian push buttons: provide a 3/4-inch diameter push button mounting hole for wiring purposes in standards or poles. De-burr the holes after sawing and before installing the wire. Use IMSA 50-2 loop lead-in cable to wire the push button to the conductors in the base. Band R 10-3b or R 10-3e series sign directly above each push button.

(4) For signal mounting hardware: seal voids using silicon or rubberized caulking or similar material as the engineer approves. Mount traffic and pedestrian signal faces so that they are immovable.

658.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed.

(2) The department will measure the Signal Mounting Hardware bid items as a single lump sum unit for each intersection acceptably completed.

658.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
658.0100 - 0199	Traffic Signal Face (sections) (size)	EACH
658.0400 - 0499	Pedestrian Signal Face (inch)	EACH
658.0500	Pedestrian Push Buttons	EACH
658.1100 - 1199	Programmable Traffic Signal Face (sections) (size)	EACH
658.5069	Signal Mounting Hardware (location)	LS

(2) Payment for the Signal Face bid items and Pedestrian Push Buttons is full compensation for providing a complete and functioning assembly.

(3) Payment for the Signal Mounting Hardware bid items is full compensation for providing mounting hardware, including spacers.

(4) The department will pay for wiring from the signal face terminal strip to the underground feeder cables at the top of the concrete base separately under the appropriate Cable Traffic Signal bid item as specified in 655.5.

Section 659 Lighting

659.1 Description

(1) This section describes providing highway, walkway, and other outdoor lighting.

659.2 Materials

(1) Furnish lighting components from the department's QPL.

659.3 Construction

659.3.1 General

(1) Keep the luminaires in their shipping cartons and protect against contamination until use. Wear clean gloves when installing luminaires. Provide circuit identification plaques and luminaire sequence decals suitable for outdoor construction on the support poles as the plans show.

659.3.2 Wiring and Fusing

(1) Use 12 AWG, stranded copper, XLP insulated, single conductor, USE rated, 600 volt AC wire from pole hand holes to luminaires, unless sized otherwise on the plans.

(2) For fusing in transformer bases, hand-holes, or junction boxes, install fuse holder assemblies from a department-approved manufacturer. Use in-line 600 volt AC breakaway fuse holder assemblies with waterproof insulating boots and midget 13/32-inch by 1 1/2-inch time delay fuses. Fuse as follows:

- Use 600 or 500 volt AC rated fuses for 480/240 volt systems.
- Use 250 volt AC rated fuses for 240/120 volt systems.
- If luminaires are double-fused in 240 volt AC 2-wire systems, or 480 volt AC 3-phase delta systems, use two-pole fuse holders.

(3) Individually fuse the luminaires at 5 amp unless the plans show otherwise. Locate fusing at the pole hand-hole. Fuse walkway lighting units at 5 amp, in the hand-hole of the pole. Fuse underdeck lighting at 5 amp per luminaire, located as the plans show.

(4) For underdeck lighting, provide a separate equipment grounding conductor, equal in size to the ungrounded conductors, in all runs.

(5) For hand-hole or junction box splices and fuse assemblies, provide a neatly trained loop of each conductor to facilitate removing each splice and each fuse assembly from the hand-hole or the junction box for servicing. Ground each hand-hole or junction box as the plans show.

(6) Connect the equipment grounding conductor to the grounding lug in each metal lighting pole. If transformer bases are required, make the grounding connection to the transformer base.

(7) Make lighting conductor splices in breakaway bases or hand holes electrically secure using UL or NRTL approved insulated multi-tap terminal block type connectors.

659.3.3 Luminaires

(1) Provide luminaires together with the hardware and fittings the plans show.

(2) Install utility luminaires on luminaire arms with an initial rake of plus 3 degrees, this measurement includes the rake of the arm. Install luminaires on luminaire arms level in the longitudinal direction of the highway. Except on segments where the profile is sloped greater than 3 degrees, then the engineer will determine the longitudinal level of the luminaires.

659.3.4 Underdeck and Walkway Lighting

(1) Under the Underdeck Lighting bid item, provide lighting systems under highway bridges together with the hardware and fittings as plans show.

(2) Under the Lighting Units Walkway bid item, provide standards and post-top luminaires, together with the hardware and fittings the plans show.

(3) Make wires continuous without splices from the fuses to the first luminaire and from luminaire to luminaire.

(4) For underdeck lighting, use one-inch reinforced thermosetting resin conduit conforming to 652. For condulets and covers, conform to the requirements for loop detector conduit in 652.2.4.

(5) Install junction boxes for underdeck lighting as the plans show and as specified in 653. For underdeck luminaire mounting boxes, if necessary to mount the luminaire, use boxes made of highly corrosion resistant metal and listed for outdoor use.

659.3.5 Lighting Control Cabinet

(1) Provide lighting control cabinets together with the circuit wiring connections, hardware, and fittings the plans show.

659.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed.

(2) The department will measure the Underdeck Lighting bid items as a single lump sum unit for each structure acceptably completed.

659.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
659.0400	Luminaires High Mast Lighting LED	EACH
659.0600	Underdeck Lighting (location)	LS
659.0700	Lighting Units Walkway	EACH
659.1100-1199	Luminaires Utility LED (Category)	EACH
659.1200 - 1299	Luminaires Underdeck LED (Category)	EACH
659.2000 - 2999	Lighting Control Cabinets (voltage)(width)	EACH

(2) Payment for the Luminaires bid items is full compensation for providing materials including luminaires, fittings, brackets, hardware and attachments; and for luminaire fusing.

(3) Payment for the Underdeck Lighting bid items is full compensation for grounding; for junction boxes; for luminaire mounting boxes as required; for conduit, condulets, and junction box fusing; and for hardware and fittings.

(4) Payment for Lighting Units Walkway is full compensation for providing materials, including pedestal base standards, luminaires, fuses, fuse holders, and all hardware and fittings needed to integrate the components into units connected to lighting branch circuit. The department will pay for the concrete base under a separate bid item.

(5) The department will pay for wiring from the lighting underground feeder systems to any luminaires under the separate contract bid item.

(6) Payment for the Lighting Control Cabinets bid items is full compensation for providing cabinets including circuit wiring connections, hardware, and fittings the plans show.

Section 660 High Mast Lighting

660.1 Description

(1) This section describes constructing a caisson or pile foundation for a high mast light tower, and providing a high mast lighting tower.

660.2 Materials

660.2.1 General

(1) Furnish materials conforming to the following:

Concrete 501
Luminaires 659
Steel piling 550
Steel reinforcement 505

(2) If not furnished as part of an assembly, use stainless steel threaded fasteners.

(3) Use grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to 501 as modified in 716. Provide QMP for class II ancillary concrete as specified in 716.

660.2.2 Pole Shafts

(1) Furnish pole shafts constructed of structural steel conforming to ASTM A709 grade 50 or engineer-approved equivalent and zinc coated conforming to ASTM A123. Furnish pole shafts with a consistent taper from bottom to top, except the lower section may be expanded to accommodate the required apparatus. Furnish poles constructed in 40-foot to 50-foot sections using single thickness steel plate, except the length of the top section may be shorter to provide the required pole height. Provide the engineer with 3 copies of mill test reports that show the material used in pole shafts, anchor bases, and anchor rods conforms to this specification.

(2) Provide a reinforced access door opening in the base of the pole shaft that secures with a cover. Furnish a cover made with stainless steel hinges that bolts shut with stainless steel hex bolts and is weather tight. Fit the cover with a stainless steel padlock hasp and install a department-furnished padlock.

(3) Secure the opening below the base plate with a stainless steel or galvanized steel rodent screen.

(4) Design the base plate so water does not accumulate on the top surface of the base plate inside the pole.

(5) Before zinc coating of the pole or base plate, number each anchor rod hole in sequence on the base plate or around the bottom of the pole. Locate the numbers so they are not obscured by the zinc coating or covered by installed nuts.

660.2.3 Anchor Rods, Templates, Washers, and Nuts

(1) Attach the pole to the concrete base with at least 8 anchor rods. For each rod, furnish 2 nuts for securing the bottom anchor plate-template, a leveling nut, bottom washer, top washer, and 2 top nuts. Do not use lock washers.

(2) Furnish anchor rods conforming to ASTM F1554 grade 55 and Supplementary Specification S4, ASTM A563 heavy hex nuts, and ASTM F436 washers.

(3) Furnish anchor rods with the top 12 inches and bottom 6 inches having a Unified National Radius roll thread.

(4) Furnish anchor rods, washers, leveling nut, and 2 top nuts hot-dip zinc coated conforming to ASTM A153, class C, supplemented by ASTM F2329. As a minimum, zinc coat the top threaded portion of the rod plus one inch.

(5) Furnish a steel top template and a steel bottom anchor plate-template as part of each anchor assembly. Provide a top template of sufficient gauge to hold the anchor rods securely in position at the top, and resist racking or twisting during the pour. Remove the top template after the concrete has set. Use a 1/2-inch-thick bottom anchor-plate template and secure it to each anchor rod. Do not weld templates to anchor rods. Install anchor rods and templates conforming to plan details.

660.2.4 Lowering Device

(1) Equip the poles with a mechanical lowering system that allows servicing the luminaires and associated electrical and mechanical apparatus from the ground. Furnish lowering devices from a department-approved series and manufacturer and with a 10-year warranty against failure of its components.

(2) When fully raised, provide a method of securing the luminaire ring to the fixed head assembly. Show either a bottom latch or a top latch system for securing the luminaire ring on the drawings submitted for the engineer's review.

(3) Design top latch systems to provide the operator with a way to determine whether the raising operation is complete and the luminaire ring is secure. The operator observing clutch slippage does not meet this requirement.

(4) If securing the luminaire ring to the fixed head assembly, provide a means to relieve tension from the lowering cables onto the winch assembly. Provide strain relief devices that allow removing the winch assembly for servicing while the luminaire ring is fully lowered and blocked up.

(5) Ensure that the lowering device operates off one leg of the line feeding the pole and uses a portable drive motor that plugs into the line.

(6) Provide adjustable torque limiters in the winch system or drive motor to prevent excessive stress on the lowering cables, and to allow for proper tensioning against the fixed head assembly.

(7) For systems where the lifting cables meet on a transition plate, provide access to the top of the plate from the hand-hole, when the ring is fully raised, to allow cable tension adjustment. Furnish 7x9 stainless steel lifting cables. Do not use antirotational cables.

660.2.5 Fixed Head Assembly

(1) The fixed head assembly shall include no moving parts, except for the necessary pulleys, rollers, and sheaves that guide the lowering ring, lowering cables and electrical conductors during the lowering operation. For the fixed head assembly, use chromated or stainless steel. Use pulleys, rollers, sheaves, and associated bearings, bushings, and shafts made of corrosion-resistant materials. Use permanently lubricated and sealed bearings and bushings.

(2) For systems that use a roller assembly to support the power chord at the head frame, use an assembly made of rollers mounted between highly corrosion resistant steel plates. Ensure the power chord rides on at least 6 rollers made from acetate resin mounted on stainless steel pins. Furnish a roller assembly with a minimum bending radius of 7 inches. If using a pulley, use a minimum radius of 8 inches.

(3) Furnish stainless steel lifting cable sheaves with a minimum radius of 3 inches. Use sheaves with permanently lubricated bronze bearings and a stainless steel pin. For the depth of the vee on the pulley, use at least the diameter of the cable. Provide guards to prevent the cable from lifting off the pulley.

(4) Protect all of the head assembly with covers, screens, or shields, to prevent entrance of dirt, moisture, ice accumulation, nesting of insects or birds or other contaminants that may harm the head assembly and operation of the lowering device.

660.2.6 Luminaire Ring

(1) If the plans show unused luminaire tenons, install a counterweight equal in weight to a luminaire, and close the unused tenon off with a threaded cap.

(2) Furnish either a stainless steel, or a structural steel zinc coated ring. Zinc coat conforming to ASTM A123.

(3) Furnish a luminaire ring centering system designed to protect both the pole shaft and the luminaire ring assemble and with a 10-year warranty against failure of its components. Ensure that the system operates successfully in winds up to 30 mph. Also ensure that the ring can travel smoothly and unimpeded over the entire length of the pole shaft.

660.2.7 Aviation Lights

(1) Furnish aviation lights, associated electrical circuits, and detailing the plans show.

660.2.8 Lightning Rod

(1) Furnish silver tipped lightning rod of engineer-approved design mechanically attached to the pole shaft or head assembly, and electrically connected to the pole shaft.

660.2.9 Miscellaneous Fittings

(1) Use stainless steel miscellaneous fittings, fasteners, and hardware.

660.2.10 Drive Motor Set

(1) Furnish a universal portable motor system compatible with the particular lowering system used and capable of powering that system for any combination of the pole height and luminaire load configuration. Ensure that the drive motor set consists of a 120 volt AC motor, a matching transformer, power connection cables, and a motor control switch.

660.3 Construction

660.3.1 Design Calculations and Shop Drawings

(1) Design high mast lighting support structures conforming to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, and Interim Revisions. Design the completed unit to withstand static and dynamic loads the unit will be subjected to in service. Use a design loading that provides for installation of the full complement of 6 luminaires and the operation of the lowering device.

(2) Design the high mast light tower and foundation using a design life of 50 years with a wind importance factor of 1.00. Design to withstand a 3 second gust wind speed of 90 mph. Do not use the alternative method for wind pressures described in appendix C of the AASHTO standard specifications.

(3) Design the pole and its connections, including but not limited to the welds and anchor rods, to the AASHTO fatigue category I criteria. Use the fatigue importance factors for category I tabulated in the AASHTO standards.

(4) Use poles that are round or polygonal in section, and designed so that the horizontal pole deflection in any direction at the design wind velocity with a gust effect factor does not exceed 5 percent of the pole height. Measure the horizontal deflection from the vertical plane passing through the centerline of the pole at its base. The pole height is the distance from the bottom of the base plate to the top of the shaft, excluding the fixed head assembly.

(5) Submit for review, 2 sets of structural design calculations for each type of pole and anchor assembly showing that the design conforms to the specifications. Submit to the engineer for review, 5 complete sets of shop drawings and component lists, showing the pole, its alloy identification, plate thickness, weld details, weld procedures, and tolerances; the anchor assembly; the fixed head assembly; the lowering device; luminaire ring; other required apparatus; and tightening procedures for bolted connections other than the mast-to-anchor assembly connection. Ensure that design calculations and shop drawings are signed, sealed, and dated by a professional engineer registered in the state of Wisconsin.

(6) If any substantial changes from previously submitted calculations and drawings are made, submit the revisions to the engineer for review.

660.3.2 High Mast Foundations

660.3.2.1 General

(1) If any twisting, racking, or other movement of the anchor rods out of plumb, projection, or pattern, or any damage to the threads exists the engineer will reject the entire base.

(2) Maintain the clear distance between the soil and the reinforcing steel cage using the means the plan detail shows. Do not weld the anchor rods to each other, the reinforcing steel cage, and the templates or to any other component of the foundation. Protect anchor rod threads above the top of the foundation level from concrete splash.

(3) Place the concrete in one continuous pour without construction joints. Cure exposed portions of concrete foundations as specified in 502.3.8.1. Wait until the concrete has attained 3500 psi compressive strength or 7 equivalent days as specified in 502.3.10 before erecting the tower.

660.3.2.2 Augured Foundations

(1) Construct as specified for concrete bridges in 502.3.

(2) Produce the holes for foundations by auguring. The contractor may install a suitable casing at the same time as the auguring. Make the augured hole vertical and uniform in section. Fill irregularities in the cylindrical surface of uncased holes outside the nominal diameter with concrete. If the top of the hole caves in, the engineer may require the contractor to auger the hole deeper to obtain the required depth and section.

660.3.2.3 Pile Type Foundations

(1) Drive piles as specified in for steel piling in 550.

660.3.3 Pole Shafts

660.3.3.1 General

(1) Weld or telescope pole sections together so that the splice length is equal in strength and rigidity to the remainder of the pole shaft.

(2) Before and during erection, examine the pole sections for scratches and mars, and treat them by first removing rust and then coating the damaged area with an engineer-approved cold zinc coating compound. Remove markings placed on the pole for purposes of fabrication, shipping, or erection.

(3) After erecting and plumbing, ensure the completed pole, with attachments, appears straight and vertical throughout its height, except if distorted by the effects of wind or sunlight or both. Do not perform the final plumbing of the pole on a sunny day.

660.3.3.2 Telescoped Poles

(1) Overlap the sections at least 1 1/2 times the outside diameter of the larger section at the joint. Test fit the sections at the factory to ensure pole straightness and accuracy of the mating surfaces.

(2) In the field, measure the joint overlap as follows: On the male end, make a chalk mark at a distance from the end equal to the required overlap plus one foot. Then make the connection so that the distance from the end of the female section to the chalk mark is one foot.

(3) Upon erection, ensure the surface of the telescoped sections present a permanent barrier to moisture entering the faying surfaces.

660.3.3.3 Welded Poles

(1) Shop weld pole shafts and attachments conforming to AWS D 1.1, Structural Welding Code - Steel and as follows:

1. Use complete-penetration welds for pole sections joined by circumferential welds and inspect all welds.
2. Inspect all circumferential welds, all full penetration welds, and a random 25 percent of partial penetration longitudinal welds.
3. Inspect full penetration welds by either radiographic or ultrasound inspection methods.
4. The contractor may inspect partial penetration welds by the magnetic particle method.
5. Make longitudinal welds to 60 percent depth penetration, except in any location within 6 inches of a circumferential weld or within the joint overlap area plus 6 inches, then make these welds to 100 percent depth penetration.
6. The contractor may repair a circumferential weld once without the engineer's permission.
7. Ensure that other weld repairs are engineer-approved.

(2) Do not weld in the field without the engineer's written approval. The engineer will only allow field welding for repairs in noncritical locations and when a department-approved individual competent to perform inspections is present during the welding. Perform field welding using personnel qualified under AWS D 1.5, Bridge Welding Code for steel.

660.3.4 Anchor Assembly

(1) Secure masts to anchor assemblies conforming to the procedures enumerated in department form DT2321. Complete department form DT2321 for each structure. Indicate the parties responsible for the installation and submit the form to the engineer for inclusion in the permanent project record.

660.3.5 Lowering Device, Head Assembly and Luminaire Ring

(1) Construct conforming to plan details and manufacturer's instructions.

(2) Before erecting the fixed head assembly, the engineer will inspect it on the ground.

660.3.6 Acceptance

(1) Before acceptance each high mast lighting tower demonstrate to the engineer that electrical and mechanical systems function properly.

660.4 Measurement

(1) The department will measure the High Mast Foundation bid items as a single lump sum unit for each foundation acceptably completed.

(2) The department will measure the High Mast Lighting Tower bid items as a single lump sum unit for each tower acceptably completed.

660.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
660.0100	High Mast Foundation (location)	LS
660.0200	High Mast Lighting Tower (location)	LS

(2) Payment for the High Mast Foundation bid items is full compensation for providing steel piling and concrete, including extra concrete required around uncased holes, for reinforcing steel; for anchor rods, templates, nuts, and washers; for electrical conduit; for excavating and auguring; and for backfilling, disposing of surplus material, and restoring the site.

(3) Payment for the High Mast Lighting Tower bid items is full compensation for providing the pole; for providing a drive motor set, fixed head assembly, luminaire ring, and lowering mechanism with associated mechanical and electrical components, an electrical grounding system, the pole sequence and circuit identification plaques, nuts, and washers, fittings, hardware, aviation lights, and lightning rod; for connecting to the electrical distribution system; and for providing slugging wrenches for each size of nut.

(4) The department will pay separately for luminaires under the Luminaires bid items of 659.

Section 661 Temporary Traffic Signals and Temporary Ramp Meters

661.1 Description

(1) This section describes providing, maintaining, and removing bridge and intersection temporary traffic signals, and temporary ramp meters.

661.2 Materials

661.2.1 General

(1) Furnish control cabinet, signal controller, and control equipment. Provide a cabinet with a Corbin #2 door lock and an access door that allows placing the controller in emergency flash. Provide keys to the access door to the engineer and law enforcement agencies as required. Also provide a manual control accessible by the police. Supply a controller capable of executing the timing program supplied in this contract for this temporary traffic signal. Test traffic signal control cabinets before installation. The department may request timing interval changes during the project as required by construction or traffic conditions. Make engineer-requested changes within 24 hours.

(2) Ensure that the signal controller is capable of operating with a non-intrusive detection system and emergency vehicle preemption (EVP) system. Furnish a NEMA monitor for the controller. Test the monitor with an automated programmed testing system. Test annually if used for more than one year. This test verifies that the monitor complies with the intersection requirements. Attach a copy of the monitor test report to the monitor, and provide a copy to the authority having jurisdiction of the intersection.

(3) Provide the temporary electrical service for temporary traffic signals according to the requirements of the applicable electrical utility. Provide an affidavit to the electrical utility in a timely manner so the electrical utility can schedule service turn on. If the control cabinet is not mounted on the electrical service pole, add a second electrical service disconnect to the outside of the control cabinet for the convenience of emergency personnel. If required, install the electrical service.

(4) Furnish traffic signal components from the department's QPL and conforming to 658.2. The contractor may furnish engineer-approved used components.

(5) Provide equipment to establish detection zones as the temporary signal plans show. Submit a list of proposed equipment and locations to the engineer for approval; do not install before the engineer approves.

661.2.1.1 Wood Poles Class 4

(1) Furnish jack pine, Norway pine, or western red cedar poles conforming to ANSI O5.1.

(2) Trim or shave poles by machine or hand to leave a smooth surfaced pole exterior.

(3) Use marking code letters to provide the minimum information as follows: supplier's name or trademark, plant location and year of treatment, code letters denoting the pole species and preservative used, and class numeral and pole length. The engineer may refuse the pole upon inspection depending on the physical condition of the pole.

(4) Burn above information legibly, permanently, and squarely on the face of each pole, 10 feet +/- 2 inches from the butt of each pole. Make these letters not less than 5/8 inch high.

(5) Brand, hammer-stamp, or die-stamp these same 4 items into the bottom of each pole butt. Make these letters not less than 5/8 inch high. Attach a metal tag with these same 4 items to the wood pole.

(6) Provide a definition sheet explaining code letters and numbers to the engineer.

661.2.1.2 Cable

(1) For traffic control cable, furnish 600 volt AC 14 AWG, solid copper conductor, according to IMSA 20-1.

(2) Wire sizes called for under the various Cable bid items are minimum requirements; the department will determine if larger wire size is needed to keep the voltage drop below 5 percent.

661.2.1.3 Guy, Span, and Messenger Wire

(1) Furnish 3/8-inch nominal diameter, 7-strand, zinc-coated steel wire conforming to ASTM A475, with a utility grade breaking strength of 15,400 pounds.

661.2.1.4 Guy, Span, and Messenger Wire Mounting Hardware

(1) Furnish engineer-approved hardware consisting of the following: machine bolts, 1 1/2-inch curved square washers, straight to angle thimbleye bolts, thimble eyenuts, angle thimbleye eyes, ovaleye bolts, standard eye nuts, twisted loop dead-end grips, 3 bolt guy clamps, bolted deadends, serving sleeves, messenger hangers, drive hooks, sidewalk guy fittings, guy wire thimbles, guy strain insulators, guy safety markers, anchor bolts, guy adapters, expanding anchors, and screw anchors. Remove screw anchors upon completion.

(2) Furnish 5/8-inch minimum diameter bolts with square nuts. For eye hardware, use dropforged steel. Use galvanized metal hardware.

(3) For straight-line bolted deadends, furnish malleable iron with steel hardware and a minimum breaking strength of 11,500 pounds. Fasten to the span pole using an ovaleye bolt.

(4) For twisted loop dead-end grips, furnish the same material as specified in 661.2.1.3. Use grips with a nominal diameter of 3/8 inch that accommodate 7-strand wire and have a minimum breaking strength of 11,500 pounds.

(5) Furnish 3 bolt guy clamps having a minimum breaking strength of 11,500 pounds.

(6) For guy strain insulators, furnish ANSI class 54-2 insulators with maximum wire diameter of 1/2 inch and minimum tensile strength of 12,000 pounds.

(7) Separate sidewalk guy fittings by no more than 6 feet of 2-inch rigid metallic galvanized conduit. Attach the pole plate to the pole with one 5/8-inch machine bolt and two 1/2-inch by 4-inch minimum lag bolts.

(8) For guy safety markers, use yellow or orange plastic a minimum of 7 feet long.

(9) For anchor bolts, furnish 5/8-inch minimum diameter rods with a minimum breaking strength of 11,500 pounds.

(10) Use expanding anchors having a minimum expanded area of 125 square inches.

(11) Use screw anchors having a minimum helix area of 78 square inches 10-inch diameter with a minimum rod diameter of 1 1/4 inches and 66 inches long.

661.2.1.5 Tether and Messenger Wire

(1) Furnish 1/4-inch nominal diameter, 7-strand, zinc coated steel tether wire conforming to ASTM A475 with common grade breaking strength of 1900 pounds.

661.2.1.6 Temporary Traffic Signal Control Cabinet Base

(1) Furnish a 3/4-inch by 4-foot by 6-foot sheet of exterior grade plywood for the base. Provide wooden stringers 4-inch square by a specified length as needed. Seal bases to prevent rodents from entering the cabinets.

661.2.1.7 Control Cabinet Approval

(1) Submit a certificate of compliance from the contractor or company that wired the cabinet certifying that the cabinet and equipment conform to the contract. Submit copies to the region and to the department electrical engineer.

(2) Demonstrate to the engineer that the installed controller is programmed and functions as designed, electronic components are in proper working condition, and the installation conforms to the contract.

661.2.2 Temporary Traffic Signals for Intersections

(1) Furnish galvanized wire rope tether wire clips, drive hooks, serving sleeves.

(2) Furnish only fittings designed for span wire mounting applications. The contractor may also use these fittings for the tether wire connection, or the contractor may use a tether clamp assembly. Use hardware of unpainted aluminum or that is yellow, Federal Standard 595 - FS13538, in color. For traffic signal head mounting lock nuts, use 1 1/2-inch hexagon, galvanized malleable iron. Use nuts 1/2 inch thick and measuring 2 1/2 inches across flat to flat.

(3) Use reinforcement plates, stiffener plates, or both, as the signal head manufacturer recommends.

661.2.3 Temporary Traffic Signals for Bridges

(1) Furnish 4 x 6 wood posts conforming to 634.

(2) Furnish LED modules as specified in 658.

(3) Furnish mounting hardware referenced in 661.2.1.4, properly sized for wire diameter being used.

(4) Furnish traffic signal mounting hardware as specified in 658.2.

(5) If mounting the control cabinet to a wood pole or post, mount it with two 3/8-inch by 3-inch lag bolts.

661.2.4 Temporary Ramp Meters

661.2.4.1 Cable

(1) For signal current carrying neutral condition, furnish 10 AWG, rated USE, RHH, RHW, copper single conductor, 600 volt AC, cross-linked polyethylene insulated. Ensure that the 10 AWG USE current carrying neutral wire is white in color.

661.2.4.2 Span Wire and Tether Wire Signal Head Mounting Hardware

(1) Furnish fittings designed for span wire mounting applications. The contractor may also use these fittings for the tether wire connection, or the contractor may use a tether clamp assembly. Use hardware of unpainted aluminum or that is yellow, Federal Standard 595 - FS13538, in color. For traffic signal head mounting lock nuts, use 1 1/2-inch hexagon, galvanized malleable iron, class 150 pipe fitting. Use nuts 1/2 inch thick and measuring 2 1/2 inches across flat to flat.

(2) Use reinforcement plates, stiffener plates, or both, as the signal head manufacturer recommends.

661.2.4.3 Splice Box

(1) Furnish PVC or metal with a minimum size of 8 X 6 X 4-inch. Use a waterproof box with a hinged cover.

661.3 Construction

661.3.1 General

(1) Perform work according to the WSEC. Provide and install wood poles, posts, tether wire, messenger wire, tether wire hardware, messenger wire hardware, guy wire, span wire, guy wire hardware, and span wire hardware, traffic signal cable, traffic signal faces mounting hardware, electrical service, traffic signal faces, traffic signal faces with backplates, including providing, installing, and programming the controller with control cabinet as the plans show.

(2) Request a signal inspection of the complete temporary traffic signal installation. Make this request to the engineer at least 5 working days before the requested inspection. Department region electrical personnel will perform the inspection.

(3) The engineer will not grant turn on approval until the contractor corrects discrepancies.

661.3.1.1 Wood Poles, Class 4

(1) The engineer will determine final pole positions after marking the utilities.

(2) Place the pole in the ground to no less than 1/5 of the pole's length as the plans show.

(3) Remove loose materials from the hole before setting the pole. Tamp bank run gravel backfill every foot of fill. Before attaching span wires or messenger wires, rake poles one foot at the top of the pole and guy if needed.

(4) Review the plans before pole installation to ensure adequate pole height.

661.3.1.2 Wire and Cable

(1) Ensure traffic signal cables and lighting cable contain the number of conductors indicated on the traffic signal wiring diagrams.

(2) Attach cables to the span wire or messenger wire, at 3-foot or less intervals with 4 wraps of a department-approved adhesive tape or UV resistant, outdoor rated nylon lock fasteners.

(3) Install cable in continuous lengths without splices in any cable run. Only splice cable on the pole. If any opening in the insulation occurs other than the end of the wire or cable, replace the wire or cable.

(4) Make splices using a twist locked, wire nut, type connection. Point the spliced conductors upward and cover with plastic. Place the splice a minimum of 11 feet above finished grade level.

(5) Feed traffic signal cables to signal faces as the detail drawings show.

(6) If anticipating freezing weather during the term of this contract, use weatherproof splice boxes.

661.3.1.3 Temporary Traffic Signal Control Cabinet Base

(1) Attach the plywood to the stringers with nails or lag bolts. If using lag bolts, countersink the washer and the bolt head flush with the plywood surface. Arrange stringers to be underneath all 4 sides of the cabinet.

(2) Secure the cabinet base using an anchor mounted on each corner and make flush with the top of the temporary cabinet platform.

(3) For anchors, use 4-inch by 4-inch wood post, or a galvanized 1 5/8-inch by 1 5/8-inch channel with a minimum length of 3 feet. Secure the anchors to the cabinet base with lag bolts.

661.3.1.4 Maintenance

(1) Maintain minimum and maximum heights to the signal faces as the plans show. Verify the span heights throughout the project duration.

(2) Place signal faces as the plans show. Make every effort to give maximum visibility to signals intended for view by the motoring public.

(3) Provide a primary contact as well as a backup contact assigned to and qualified to maintain temporary traffic signals. Submit names, addresses, and telephone numbers of contact persons to the engineer, local police, and county sheriff. Also post contact information on temporary traffic signal control cabinets and cover with weatherproof material. Ensure that a contact person is available 24 hours a day, 7 days a week, from the start of the project until the temporary traffic signal is not needed. Ensure that emergency calls are received by an individual and not by an answering machine.

661.3.2 Temporary Traffic Signals for Intersections and Temporary Ramp Meter

661.3.2.1 Tether Wire Mounting Hardware

(1) Form loops on the end of the tether wire, hook over drive hooks, and hold in place using wire rope tether clips. Secure loose tether wire ends using serving sleeves.

661.3.2.2 Tether Wire

(1) Keep tether wire free of splices or kinks.

(2) Install the tether wire at 17 feet to 19 feet over the roadway.

(3) Install the tether wire in direct vertical alignment with the guy wire.

(4) If no signal heads are attached between the span wire and tether wire, attach a tension control cable. Use the tension control cable to maintain minimum height. Use a tension control cable consisting of tether wire and wire rope tether wire clips. Use 1/4-inch galvanized U-bolts on both ends, top and bottom, of the tension control cable to prevent movement.

661.3.2.3 Wire and Cable

(1) Ground metallic parts including span, tether, and guy wire with hardware, light arms and luminaires, splice boxes and pole guards. Ground each electrically isolated assembly at one end by mechanically attaching (lug or split bolt) the equipment-grounding conductor (6 AWG stranded copper wire) that terminates at a 5/8-inch by 8-foot. grounding electrode installed at the wood pole base. For the equipment-grounding conductor use an exothermic weld or clamp to the grounding electrode. Ensure grounding hardware is UL or NRTL listed.

661.3.2.4 Span Wire

(1) Install the span wires free of any splices or kinks. Install the span wire mounted signal faces so the bottom is a maximum of 19 feet above the roadway (minimum height is 17 feet). Compute the vertical height of the span wire on the span pole using the following formula:

$$HD\ (0.05) + RC + HH = SH$$

(2) HD equals the horizontal distance between the span poles.

(3) RC equals the roadway clearance. If lowering the proposed roadway under the span wire, use minimum clearance over the roadway value.

(4) HH equals the head length (height) including span wire mounting hardware.

(5) SH equals the span wire height above the roadway.

(6) To use the value SH from the formula, mark from the elevation of the roadway on the span pole and measure up the pole the distance SH from this mark. This is where the top span wire should dead end on the span pole.

(7) Review the plans before pole installation to ensure adequate pole height due to grade changes.

661.3.2.5 Span Wire and Tether Wire Signal Head Mounting Hardware

(1) Support each signal head by a span wire-mounting bracket and attach to the tether wire.

(2) Feed span wire signals through the top span wire-mounting bracket. Provide sufficient cable slack to enable moving the signal head along the span as the engineer directs. Neatly coil and attach the extra signal cable to the upper span wire until it is needed.

(3) Mount the heads vertically and plumb.

661.3.2.6 Implementation and Removal

(1) Before activating the temporary traffic signal or temporary ramp meter, verify the signal indications and operation of the signal to the engineer.

(2) Upon acceptance of new signal and completion of work, the department will switch control of the intersection over to the permanent cabinet installation. Remove signal cable and wires, wood poles, wood posts, control cabinet, control equipment, and incidental materials. Upon deactivation of the controller, call the electrical utility immediately for the temporary electrical service disconnect.

(3) Remove the temporary traffic signal faces the same day the permanent traffic signal is turned on.

(4) Immediately remove the wood poles and wood posts obstructing the view of the new permanent signal faces. Remove remaining wood poles and wood posts within 3 working days of new permanent signal activation.

(5) Immediately after removing the wood poles and wood posts, backfill the holes, compacting every 12 inches with engineer-approved material.

661.3.2.7 Maintenance

(1) Correct LED outages within 24 hours of the reported outage.

(2) Respond within one hour of notification to provide corrective action to any emergency such as but not limited to knockdowns, signal cable problems, and controller equipment failures. If equipment becomes damaged or faulty beyond repair, replace it within one working day. In order to fulfill this requirement, maintain, in stock, sufficient materials and equipment to provide repairs. Replace the traffic signal control equipment including the cabinet, controller, and cabinet accessories within 4 hours.

(3) All far through indications suspended on the span wire shall be located above the center of the controlled lane. The far right signal shall be mounted over the center of the right through lane. The far left turn signals shall be suspended straight ahead of the left turn lane.

661.3.3 Temporary Traffic Signals for Bridges

661.3.3.1 General

(1) If the contract requires attaching the support cable to a bridge, protect the cable with rigid nonmetallic conduit.

(2) If using trailer mounted traffic signals from the department's QPL, provide a battery power supply with a solar powered charging system and a backup power source. Do not use gasoline powered equipment.

(3) Maintain and operate the generators on a 24-hour a day, 7 days a week basis. This includes having a responsible contact person respond to the project site, within 1/2 hour of receiving a call, for any emergency to the electrical supply system.

(4) If the temporary traffic signal is not operable, provide flaggers until normal operation resumes.

(5) Furnish the electrical cable and the required electrical connections, conforming to the WSEC, to connect the generators to the temporary traffic bridge signal. The engineer will determine the location of the generators in the field.

661.3.3.2 Messenger Wire

(1) Use 1/4-inch wire as specified in 661.2.1.5 or 3/8-inch wire as specified in 661.2.1.3.

661.3.3.3 Messenger Wire Hardware

(1) Use dead-end hardware sized for the messenger wire used as the plans show.

661.3.3.4 Wood Posts

(1) The engineer will determine final postpositions after marking the utilities.

(2) Place 4 x 6 wood posts in the ground to no less than 1/5 of the post length or as the engineer directs.

(3) Remove loose materials from the hole before setting the post. Tamp bank run gravel backfill every foot of fill.

(4) Review the plans before post installation to ensure adequate post height.

661.3.3.5 Implementation and Removal

(1) Before activating the bridge temporary traffic signal, verify the signal indications and operation of the signal to the engineer.

(2) Upon completing the repair work on the bridge, and if the engineer determines the bridge temporary traffic signal is no longer needed, remove the signal cable, messenger wire, wood poles, wood posts, control cabinet, control equipment, and incidental materials. Upon deactivation of the controller, call the electrical utility immediately for the temporary electrical service disconnect.

(3) Immediately after removing the wood poles and wood posts, backfill the holes with engineer-approved material. Compact the material in 12-inch lifts.

661.3.3.6 Maintenance

(1) Immediately correct LED outages.

(2) Respond within one hour of notification to provide corrective action to any emergency such as but not limited to knockdowns, signal cable problems, and controller equipment failures. If equipment becomes damaged or faulty beyond repair, replace it. In order to fulfill this requirement, maintain, in

stock, sufficient materials and equipment to provide repairs. Replace the traffic signal control equipment including cabinet, controller, and cabinet accessories within 2 hours.

661.3.4 Temporary Ramp Meter

(1) Notify the engineer 10 days before starting any temporary ramp meter work. The engineer will notify the region freeway operations personnel who will verify ramp timings and validate communications.

(2) Load the timing parameters into the controller the department provides.

(3) Minimum mounting height of the box is 11 feet. Ground splice box if made of metal.

661.4 Measurement

(1) The department will measure the Temporary Traffic Signals for Bridges, Temporary Traffic Signals for Intersections, and Temporary Ramp Meter bid items as a single lump sum unit for each structure or intersection acceptably completed.

(2) The department will measure Generators by the day acceptably completed, based on a 24 hours per day operation.

661.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
661.0100	Temporary Traffic Signals for Bridges (structure)	LS
661.0200	Temporary Traffic Signals for Intersections (location)	LS
661.0300	Generators	DAY
661.0700	Temporary Ramp Meter (location)	LS

(2) Payment for the Temporary Traffic Signals for Bridges, Temporary Traffic Signals for Intersections, and Temporary Ramp Meter bid items is full compensation for providing, operating, maintaining, and repairing the complete temporary installation; and for removal. Payment also includes the following:

1. Providing replacement equipment.
2. All utility charges for installation, disconnection, and energy service through project completion.
3. The cost of delivery and pick-up of the cabinet assemblies for department testing.

(3) Payment for Generators is full compensation for providing, maintaining, and operating generators, including fuel and oil; for providing and locating a backup generator at the site; and for providing flaggers.

Section 670 General Requirements for Intelligent Transportation Systems (ITS)

670.1 Description

(1) This section describes additional personnel qualifications, construction methods, and testing requirements used to perform ITS work.

670.2 Materials

(1) Furnish ITS materials conforming to the general requirements for electrical work as specified in 651.2.

670.3 Construction

670.3.1 General

(1) Perform ITS work conforming to the general requirements for electrical work as specified in 651.3.

670.3.2 Personnel Qualifications

670.3.2.1 Field System Integrator

(1) Perform ITS work with onsite assistance and under the supervision of a qualified field system integrator selected from the department's approved field system integrator list. The field system integrator provides assistance and expertise to the contractor in the areas of equipment installation, operation, integration with existing equipment, testing, and network management for ITS installations including traffic signal communications.

(2) The field system integrator is responsible for ensuring that equipment is installed as the plans show and functions properly. The field system integrator also helps submit material lists, shop drawings, documentation, as-builts, test results, training and operation manuals as well as associated presentations, wiring schematics, and equipment test procedures.

(3) Ensure that the field system integrator schedules, manages, and documents periodic ITS focused progress meetings beginning within one month after ITS work under the contract begins. Hold additional meetings at least monthly while ITS work under the contract is scheduled. The department defines ITS work as operations required under the contract related to electrical work.

670.3.2.2 Certified Fiber Optic Technician

(1) Have a certified fiber optic technician perform work for fiber optic terminations, splicing, and testing. Have a certified fiber optic technician supervise all fiber optic cable installation.

(2) Submit material to certify technicians meet the following requirements:

- Education: attend and successfully complete at least one 4-day class on installation of fiber optic products conducted by major manufacturer and have FOA certification.
- Work history: demonstrate a minimum of 2 years work experience in the last 5 years with splicing, termination, and testing of fiber optic cable.

(3) Remove, replace, and reinstall work performed by non-certified technicians for fiber optic communications equipment and material.

670.3.3 Testing

670.3.3.1 Contractor-Furnished Equipment and Materials

(1) Furnish equipment necessary to test the completed installation. Test and demonstrate to the engineer's satisfaction that equipment is calibrated and in working order.

(2) Submit documentation required that demonstrates component performance and operation as specified in contract.

(3) The field system integrator will approve final set up and testing of all equipment and materials.

(4) Perform tests on weekdays during normal working hours. Obtain the engineer's approval for test times and dates.

(5) Resubmittal of rejected equipment or material is allowed for consideration with proof of correction and testing. The department may approve rejected material but is not considered acceptance for equipment or material until final post-installation testing.

670.3.3.2 Department-Furnished Equipment and Materials

(1) Have the field system integrator inspect department-furnished equipment and materials to ensure that they conform to contract requirements and function properly. Notify the department within 3 days if the inspection identifies defective equipment or materials. The department will replace whatever is defective.

(2) Do not take possession of defective equipment or materials. Once possession is taken, the contractor is responsible for replacing defective equipment and materials.

670.3.3.3 Post-Installation Testing

(1) Furnish test procedures for each component in the contract. A component is defined as a subsystem confined to the end functionality of the device. Components include field devices, processor, assemblies, cabling, connections, communications, and any additional elements associated with proper operation and full functionality of the field device.

(2) Submit 1 hard copy and 1 electronic copy of component test procedures to the department. The field system integrator and contractor shall develop test procedures 30 days before initial installation. The department will approve test procedure within 30 days of the date received and provide a written approval.

(3) Resubmit rejected test procedures within 15 days of notification. The department will provide written approval of resubmitted test procedures within 30 days of the date received.

670.3.4 ITS Documentation

670.3.4.1 Preconstruction Work

(1) For contractor furnished equipment, submit 1 hard copy and 1 electronic copy of equipment list, catalog cut-sheets, and drawings within 28 days after notice of award to the engineer. The engineer will review the equipment list and drawings within 30 days of submittal. Obtain the engineer's written approval before procuring equipment and beginning the work.

(2) Include bid item names, the name and address of the manufacturer, catalog tear sheets showing catalog numbers, and manufacturer specifications. Resubmit a new alternative for partial or totally rejected equipment within 15 days of written notice. The engineer will review within 30 days of submittal.

(3) Do not make substitutions or changes to engineer-approved materials without the engineer’s written approval. Check the availability, price, and delivery date before making submittal of equipment or material.

670.3.4.2 Post-Construction Work

(1) Submit 1 hard copy and 1 electronic copy of ITS installation including traffic signal communications documentation including but not limited to the following:

- Operator's manual: for contractor furnished equipment, submit a manual containing detailed operating instructions for each different type or model of equipment and or operation performed.
- Maintenance procedures manuals: for contractor furnished equipment, submit a manual containing detailed preventive and corrective maintenance procedures for each type or model of equipment furnished.
- Cabinet fiber optic wiring diagram: submit a cabinet wiring diagram, identified by location for each cabinet. Include both electrical wiring and fiber optic conductor and cable connections. Place one copy of the fiber optic wiring diagram in a weatherproof holder in the cabinet. Deliver the other copies to the engineer.
- As-built drawings: submit final as-built drawings that detail the final placement of conduit, cabling, equipment, and geometric modifications within the contract. Provide documentation in an electronic format adhering to the region’s ITS computer aided drafting standards and according to the department’s as-built requirements. The department will review the as-built drawings for content and electronic format. Modify both the content and format of as-built drawings until meeting all requirements.
- Equipment inventory list: submit an inventory list including serial number, make, model, date installed, and location installed of equipment installed under the contract.

670.4 Measurement

(1) The department will measure Field System Integrator and ITS Documentation as a single lump sum unit for all services acceptably completed under the contract.

670.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
670.0100	Field System Integrator	LS
670.0200	ITS Documentation	LS

(2) Payment for Field System Integrator and ITS Documentation is full compensation for providing specified expertise, assistance, and documents. The department will pay separately for other ITS work under the various ITS bid items of 671 through 678.

(3) The department will not pay for removing, replacing, and reinstalling work performed by non-certified technicians as required under 670.3.2.2.

Section 671 Intelligent Transportation Systems - Conduit

671.1 Description

(1) This section describes providing conduit for ITS work and providing permanent flexible above ground markers along a path of any fiber optic cabling and new or existing manholes.

671.2 Materials

671.2.1 Conduit

(1) Furnish orange, smooth, high-density polyethylene (HDPE), solid-wall conduit rated for outdoor and underground use conforming to ASTM F2160. Use the size the plans show with a size-to-diameter ratio (SDR) of 11 and conforming to the following:

NOMINAL INSIDE DIAMETER	NOMINAL OUTSIDE DIAMETER
1.25 inches	1.660 inches
2 inches	2.375 inches
3 inches	3.50 inches

(2) The construction and testing of the conduit shall comply with applicable EIA/TIA, ANSI, and ASTM standards.

(3) Furnish bends, adapters, couplings, fittings, and other materials used to install conduits. Meet of the duct manufacturer's installation recommendations. Furnish anodized aluminum reverse threaded couplers sized as appropriate.

671.2.2 Woven Pull Tape

(1) Provide woven pull tape for empty ducts in the run. The woven pull tape shall have documentation as duct cutting resistant, tensile strength of greater than 1100 pounds, nominal width of 1/2 inch, and maximum allowable elongation under pulling tension of 10 percent.

671.2.3 Fiber Optic Cable Marker

(1) Furnish fiber optic cable markers as the plans show.

671.2.4 Tracer Wire

(1) Furnish 12 AWG stranded copper tracer wire conforming to 655 in at least one conduit for each run. Connect the tracer wire using a wire nut at each pull box, manhole, or other access point. Alternatively, use a single wire through the access points.

671.3 Construction

671.3.1 Installing Conduit

(1) Install conduit by plowing or trenching.

(2) Do not exceed the minimum bending radius of the cable installed in the conduit. Do not pull cable over edges or corners, over or around obstructions, or through unnecessary curves or bends.

(3) Use directional bore installations if the contract specifies.

(4) Repairs are not allowed. Remove broken, chipped, cracked, or impaired lengths of fittings or conduit and replace with new materials. Do not install conduit above ground or on structures.

(5) Provide information to the engineer as specified in 107.22. Expose the main to provide visual inspection by the utility owner for gas mains of 100 psi or greater, or 12 inches in diameter or greater.

671.3.2 Woven Pull Tape

(1) Provide woven pull tape at each raceway point in acceptable to the engineer. If cables are blown directly through the ducts, woven pull tape for those sections of individual ducts is not required. Spare conduits shall have woven pull tape installed in the duct.

671.3.3 Fiber Optic Cable Marker

(1) Provide installation at locations the plans show and as the engineer directs. Installation should be adequate so that marker cannot be pulled out or removed manually. The marker should self erect after vehicle impact.

(2) Install markers so that all lengths of installed fiber optic cables in new conduit have a minimum of one marker. Install a minimum of 2 markers along each fiber optic cable path in new conduit so that one forward and one behind are always visible. Install a marker at each point along the fiber optic cable path where a 45-degree or greater change in direction occurs.

(3) Install a marker at each handhole at locations where the fiber optic cabling is installed into existing conduit networks. Install markers a maximum of 24 inches lateral displacement from the actual placement of the conduit and fiber optic cabling.

(4) Install markers no later than 3 days following the installation of conduit to contain fiber optic cables, or of direct buried fiber optic cables. Safeguard the conduit and cables during the installation of the markers. Remove and replace any conduit or cables as the plans show that are damaged during marker installation at no additional cost to contract.

671.4 Measurement

(1) The department will measure the Conduit HDPE and Conduit HDPE Directional Bore bid items by the linear foot acceptably completed, measured along the centerline of the conduit from centerline of fitting to centerline of fitting or end of conduit, or between ends of conduit, or between ducts.

(2) The department will measure Fiber Optic Cable Marker as each individual marker acceptably completed.

671.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
671.0100 - 0199	Conduit HDPE (duct) (size)	LF
671.0200 - 0299	Conduit HDPE Directional Bore (duct) (size)	LF
671.0300	Fiber Optic Cable Marker	EACH

(2) Payment for the Conduit HDPE and Conduit HDPE Directional Bore bid items is full compensation for providing, hauling, and installing materials including conduit, fittings, couplers, and bends; for pull wires or ropes; for expansion fittings and caps; for excavating, bedding, backfilling, and restoration of ground to original condition including sand, concrete, or other required materials; for disposing of surplus materials; and for making inspections.

(3) Payment for Fiber Optic Cable Marker is full compensation for providing and installing materials including restoration of ground to original condition including topsoil, sand, concrete, or other required materials; and for disposing of surplus materials.

(4) The department will pay separately for conduit tracer wire as specified in 671.2.4 under the appropriate 655 bid item.

Section 673 Communication Vaults

673.1 Description

(1) This section describes providing communication vaults and associated tracer wire marker posts.

673.2 Materials

673.2.1 General

(1) Furnish fiber optic cable support assemblies consisting of the brackets, racks, and rails required to suspend surplus cabling and splice enclosures for a communication vault. Ensure that support assemblies are made from or coated with a corrosion resistant material.

(2) Furnish self-curing, permanent bonding, flexible gray rubber caulk. Ensure that the caulk is mildew-resistant, non-flammable, and is unaffected by sunlight, water, oils, mild acids, or alkali.

(3) Furnish fade resistant, ultraviolet stable, high-impact polycarbonate tracer wire marker posts a minimum of 62 inches long with an outside diameter of 3.5 inches with "WARNING FIBER OPTIC CABLE BELOW" molded into the marker. Ensure that posts have stainless steel hardware, five standard terminals, a terminal enclosure for cathodic protection, and an anchor bar.

673.2.2 Rectangular Vaults

(1) Furnish one-piece gray, polymer concrete rectangular communication vaults measuring 30 inches by 48 inches and at least 48 inches high. Stackable vaults are not allowed.

(2) Furnish a two-piece lid with a 15,000 pound minimum design load stamped permanently with "WISDOT ITS" or as the plans show. Ensure that vault lids have water resistant gaskets, 2 slots measuring 1/2 inch by 4 inches for a pull out, and enough metal to detect with a metal detector.

673.2.3 Round Vaults

(1) Furnish round communications vaults from the department's QPL.

673.3 Construction

(1) Provide additional conduit openings in vaults using a manufacturer-approved knockout punch driver. Ensure that gaps between the conduit and vault are not greater than 1/2 inch. Caulk gaps both on the inside and the outside of the vault. Cure caulk according to manufacturer's specifications before backfilling.

(2) Lock vault lids with two 3/8-inch 16 UNC stainless steel pentahead bolts with washers. Anchor support assemblies to vaults using stainless steel hardware.

(3) Install tracer wire marker posts so that they cannot be pulled out or removed manually. Install conduit into the access point and connect the tracer wire to the tracer wire marker post terminals.

673.4 Measurement

(1) The department will measure the EACH bid items under this section as each individual unit acceptably completed.

673.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
673.0100 - 0199	Communication Vault (type)	EACH
673.0200	Tracer Wire Marker Posts	EACH

(2) Payment for the Communication Vault bid items is full compensation for providing vaults; and for excavating, backfilling, and restoring the grade.

(3) Payment for Tracer Wire Marker Posts is full compensation for providing markers; and for excavating, backfilling, and restoring the grade.

Section 674 Intelligent Transportation Systems - Cable

674.1 Description

(1) This section describes providing, removing, and reinstalling ITS electrical wire and communications cable.

674.2 Materials

674.2.1 ITS Communication Cable

(1) Furnish communication cable conforming to IMSA 20-6. Use 6 pairs of 18 AWG in each cable. Turn individual pairs 12 turns per foot within the cable.

(2) Furnish ITS communication cable and terminations conforming to Rural Electrification Administration (REA) specification PE-22. Use 6-pair, 12-pair, or 25-pair communications cable 19 AWG solid copper with color-coded polyethylene insulation, black polyethylene outer jacket, and aluminum tape shield between jackets required to connect ramp meter and detector processor assemblies.

674.2.2 Microwave Detector Cable

(1) Furnish 12 twisted pairs, 19 AWG, solid copper or color-coded polyethylene insulation, black polyethylene outer jacket, aluminum tape shield between jackets, and gel filled. The pair-utilization shall be as follows:

Pair 1: power.

Pairs 2 and 3: RS-232 bus for laptop computer.

Pair 4: detection zone contact closure.

Pair 5: detection zone contact closure.

Pair 6: detection zone contact closure.

Pair 7: detection zone contact closure.

Pair 8: detection zone contact closure.

Pair 9: detection zone contact closure.

Pairs 10 through 12: spare.

674.3 Construction

674.3.1 ITS Communication Cable

(1) Under the Cable ITS Communication bid items, install 6 pair, 12 pair, and 25 pair copper communication cable as the plans show.

(2) Install, terminate, and test twisted pair copper communications cable in the processor cabinets in order to transmit and share data communications between cabinets.

(3) Prevent copper communication cable from damage during installation and storage. Do not step on or run over by any vehicle or equipment. Do not pull along the ground, or over or around obstructions.

(4) Seal copper communication cable ends during installation using a heat shrinkable end cap. Do not use tape. Keep sealed until termination. For cable not immediately terminated, provide a 4-foot length of cable extending out of the cabinet opening.

(5) Use cable grip to pull cable through conduit designed to provide a firm hold on exterior covering of cable.

(6) Do not pull copper communication cable through any intermediate junction box, pull box, or any other opening in conduit or duct, unless the engineer approves. Pull the necessary length to be installed from the pull box or cabinet to the immediate next downstream pull box or cabinet. Carefully store remaining length of copper communication cable to prevent damage and in a manner not hazardous to pedestrian or vehicular traffic. Cable shall enter a pull box or cabinet directly from the cable reel or storage directly out of the immediate downstream pull box or cabinet.

(7) Install copper communication cable without splices between hub or processor assembly cabinets.

(8) Do not exceed the minimum bending radius at anytime during installation. Do not pull over edges or corners, over or around obstructions, or through unnecessary curves or bends. Copper communication cable shall be looped in and out of cabinets and pull boxes to provide adequate slack and minimize stress on conductors.

(9) Use manufacturer’s recommended pulling tension for pulling copper communication cable by the outer jacket or 80 percent of the manufacturer's maximum pulling tension whichever is smaller.

(10) Use engineer-approved lubricant at manufacturer's recommended quantity to facilitate pulling cable. Lubricate as it is fed off of the cable reel or storage stack into the cable feeder. Place lubricator funnel around the cable just ahead of the feeder. After installation, clean the copper communication cable with a cloth at a pull box or cabinet before leaving.

(11) Unless the plans show otherwise, provide slack in the cable of one full turn in box for pull boxes and a minimum of 6 feet for cabinets.

(12) Terminate cable pairs entering a cabinet on termination blocks located in cabinets in a neat and orderly fashion and according to the REA color code. Ground cable shield for each run at only one of the termination locations. Attach 8 AWG grounding wire to the shield with an engineer-approved clamp according to REA PC-2.

(13) Test the copper communication cable following installation:

- Use a megger to test the ground resistance of all conductors including the shield, and conductor-to-conductor, including all individual conductors to the shield. Ensure that conductor tests, including the shield, read greater than 500 mega ohms to ground, and from conductor to conductor and all individual conductors to the shield, read greater than 500 mega ohms. Replace cable with one or more failing tests.
- Test continuity of each pair to show a resistance of not more than 8 ohms per 1000 feet of conductor. Use meter with a minimum input resistance measurement of 20,000 ohms per volt.

674.3.2 Microwave Detector Cable

(1) Install and test cables and connectors required to connect the microwave detector assembly with the processor assembly as the plans show.

(2) Prevent cable from damage during installation and storage. Do not step on or run over by any vehicle or equipment. Do not pull along the ground, or over or around obstructions.

(3) Seal cable ends at all times during installation using a heat shrinkable end cap. Do not use tape. Keep sealed until connectors are installed.

(4) Install cable without splices between microwave detectors and processor.

(5) Provide slack in the cable as the plans show. Provide a minimum of 6 feet for cabinets.

(6) Test the cable following installation as follows:

- Use a megger to test the ground resistance of conductors including the shield, and conductor-to-conductor, including all individual conductors to the shield. Ensure that all conductor tests, including the shield, read greater than 500 mega ohms to ground, and from conductor to conductor and all individual conductors to the shield, read greater than 500 mega ohms. Replace cable with one or more failing tests.
- Test continuity of each pair to show a resistance of not more than 8 ohms per 1000 feet of conductor. Use meter with a minimum input resistance measurement of 20,000 ohms per volt.

674.3.3 Removing Cable

(1) Remove the existing group of cables within a section of existing conduit as the plans show.

(2) Use caution not to damage any remaining cables from existing conduits as the plans show. Remove existing cable connections from the cabinet or remove splices.

(3) Test cable continuity, and identify and mark cables before removal to ensure proper reconnection.

(4) Demonstrate and document existing damage to engineer. Non-compliance to demonstrate and document existing damage shall make repair the responsibility of the contractor.

674.3.4 Reinstalling Cable

(1) Reinstall existing group of cables removed within a section of conduit as the plans show.

(2) Provide a liberal coating of an engineer-approved electrical varnish or sealant to allow flexible protection from oil, moisture, and corrosion.

(3) Provide a pressure or compression fitting for electrical splices and connections from the department's QPL.

(4) Replace damaged cables in kind at no additional expense to the department.

(5) Remake all cable connections.

674.4 Measurement

(1) The department will measure the Cable ITS Communication bid items by the linear foot acceptably completed, measured along the centerline of the conduit, including slack between terminations within the ramp meter processor assemblies.

(2) The department will measure Cable Microwave Detector by the linear foot acceptably completed, measured along the centerline of the conduit, including slack to its connection with the proper terminals in the processor assembly cabinet.

(3) The department will measure Remove Cable by the linear foot acceptably completed, measured along the centerline of the conduits removed between 2 points such as pull boxes, manholes, or other points defined.

(4) The department will measure Reinstall Cable by the linear foot acceptably completed, measured along the centerline of the conduit run in which the group of cables was reinstalled.

674.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
674.0100 - 0199	Cable ITS Communication (pairs)	LF
674.0200	Cable Microwave Detector	LF
674.0300	Remove Cable	LF
674.0400	Reinstall Cable	LF

(2) Payment for the Cable ITS Communication bid items is full compensation for providing cables; for making connections and testing installed cable system; and for disposing of surplus material.

(3) Payment for Cable Microwave Detector is full compensation for providing cable and connectors; for making necessary connections; and for testing.

(4) Payment for Remove Cable is full compensation for removing existing cables; for undoing connections and terminations, including wire nuts, splice kits, tape, insulating varnish or sealant, and ground lug fasteners; and for testing.

(5) Payment for Reinstall Cable is full compensation for reinstalling existing cables; for remaking connections, including wire nuts, splice kits, tape, insulating varnish or sealant, and ground lug fasteners; and for testing.

(6) The department will not pay for replacing cable not attaining a required resistance greater than 500 mega ohms.

Section 675 Controllers and Detectors

675.1 Description

(1) This section describes installing department-furnished controllers for ramp meters, detector processor assemblies, and microwave detectors.

675.2 Materials

(1) The department will furnish controllers as specified in the contract special provisions.

675.3 Construction

(1) Perform a series resistance test and resistance to ground test at each loop/lead-in circuit before starting any work as specified in 670.

(2) For new loop/lead-in circuits, perform a series resistance test and resistance to ground test. Ensure that the series resistance of each circuit is less than 5 ohms. Ensure that the insulation resistance of loop conductors to ground, and between adjacent loops/lead-in circuit is greater than 500 mega ohms as measured with a 500 volt megger test meter.

(3) If any work proceeds at a location without completion of the loop detector testing, assume responsibility for the ultimate correct operation of the loop/lead-in.

(4) Secure ramp meter processor assembly cabinets on new, modified, or existing concrete bases at locations the plans show. Provide bolted stainless steel connections with lock washers, locking nuts, or other engineer-approved means to prevent the connection nuts from backing off. Isolate dissimilar materials from one another by stainless steel fittings.

(5) Make power connections to the processor assembly cabinet as specified in 656.

(6) Make detector cable and communications cable connections to the processor assembly cabinet to provide the required operation.

(7) Make traffic signal cable connections and electrical wire connections to the processor assembly cabinet as specified in 658.

(8) Terminate signal current carrying neutral conductors on a neutral strip mounted in the cabinet. Isolate the neutral bus from the cabinet and equipment ground. Terminate the neutral bus at the neutral lug ultimately attached in the meter pedestal.

(9) Ground all cable grounding shields and any spare or unused conductors in the ramp meter processor assembly cabinet to the equipment-grounding terminal strip.

(10) Isolate the equipment-grounding strip from the cabinet and current carrying neutral. Terminate the cabinet current carrying neutral at the current carrying neutral ground lug in the meter pedestal or breaker disconnect box.

(11) Reuse existing wiring to the existing, modified, or new concrete control cabinet base unless the engineer directs otherwise. Wiring includes bonding wire, conductors and loop detector lead-in cable, and loop detector wire.

(12) Make connections among the processor assembly, multipoint device interface units, and telephone interface modems at locations the plans show.

(13) The department will provide processor assembly firmware. The department will install the processor firmware on contractor-supplied EPROM's. Pick up the EPROM's with firmware from the department, and install it into each controller before installation.

(14) Upon completing installation work at a location, before detector verification and conducting the testing procedure, perform the new loop/lead-in circuit series resistance test and resistance to ground test. Ensure that the series resistance of each circuit is less than 5 ohms. Ensure that the insulation resistance of loop conductors to ground, and between adjacent loop/lead-in circuit, is greater than 500 mega ohms as measured with a 500 volt megger test meter. Document the test results, and submit them to the engineer as part of the set up to begin the testing procedure.

(15) Demonstrate the functionality and accuracy of the vehicle detectors connected to each location. Verify that the traffic flow information obtained from each detector is within +/- 5 percent of each of two 10-minute manual data periods.

(16) After installing the processor assembly; installing other ramp control signal assembly hardware, detection hardware, communications hardware, power supply, and connecting cabling; and successfully completing, documenting and presenting, to the engineer, testing and verification, the field system integrator, following the contractor-submitted and engineer-approved testing procedure, shall successfully conducted a field test for each processor assembly. The test is designed to demonstrate that hardware, cable, and connections furnished and installed by the contractor operates

correctly and that all functions are in conformance with the specifications. It is not necessary to test all locations concurrently.

(17) Do not begin ramp meter processor assembly test until the following have been accomplished:

- Testing of new and existing loop detectors.
- Testing of ramp control signal wiring.
- Submission of documented results to the engineer.
- Installation of ramp signing and pavement marking, including HOV and trailblazing.

(18) The contractor may conduct the test within 48 hours after the field system integrator advises the engineer that it is ready to begin the test, the processor is communicating to central, and documentation has been presented. Begin the test once the field system integrator has satisfied itself that work has been completed at each processor assembly location. After the processor assembly has been placed in operation, the field system integrator shall demonstrate that equipment furnished and installed by the contractor operates as specified.

(19) After successful completion of the test procedure, test each processor assembly for proper operation for 30 consecutive days. During the testing period, ensure that contractor-provided equipment at the assembly location operates without failures of any type. If any component malfunctions or fails to provide the specified capabilities, during the 30-day test period, the field system integrator shall replace or repair the defective equipment within 48 hours of the engineer's notification.

(20) After the component malfunction has been corrected to the satisfaction of the engineer, begin a new 30-day test period. The 30-day test applies only to contractor-furnished hardware. In the event of a failure of hardware furnished by others that prevents the 30-day test from continuing, the engineer will suspend the 30-day test until the other hardware failures are corrected, at which time the test will resume.

675.4 Measurement

(1) The department will measure the bid items under this section as each individual assembly acceptably completed.

675.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
675.0100	Install Controller Ramp Meter Processor Assembly	EACH
675.0200	Install Controller Detector Processor Assembly	EACH
675.0300	Install Mounted Controller Microwave Detector Assembly	EACH

(2) Payment for Install Controller Ramp Meter Processor Assembly and Install Controller Detector Processor Assembly is full compensation for installing the processor assembly, for making connections, and for testing.

(3) Payment for Install Mounted Controller Microwave Detector Assembly is full compensation for installing the mounting brackets on poles, for installing the microwave detector on the bracket, for making connections, for positioning the detector to provide the optimum field of view, for setting up and programming the detector, and for testing.

(4) The department will not pay for correcting the loop/lead-in or for correcting component malfunctions exposed during the 30-day testing period. The department will not make complete payment under a bid item in this section until each processor assembly completes a successful test over 30 consecutive days without interruption by any contractor-furnished component malfunction.

Section 677 Cameras

677.1 Description

(1) This section describes installing camera assemblies and associated poles, base plates, and camera lowering systems.

677.2 Materials

(1) The department will furnish camera assemblies and poles as specified in the contract special provisions.

(2) Under the Install Camera Assembly bid item, furnish cables and connectors required to transmit video and camera control data between the camera assembly and the camera controller assembly. Conform to the following:

1. Outdoor rated category 5e, or better, UTP cable with water-blocking flooded core and UV-resistant polyethylene jacket. Furnish cable consisting of 4-pairs of 24 AWG solid copper conductors and according to ANSI/TIA/EIA 5 68A Category 5e, CENELEC EN50173, ICEA S-90-661, and ISO/IEC 11801.
2. Outdoor rated CSA, certified for outdoor use, 3-conductor 16 AWG power, UL listed cable in a UV resistant jacket. Furnish MSHA approved and RoHS compliant cable according to CSA flexible cord - C22.2-49.

677.3 Construction

(1) Under the Install Camera Pole bid item, install department-furnished camera poles on new concrete bases at locations the plans show and conforming to 657. Install contractor-furnished identification plaques as the plans show.

(2) Secure camera poles to anchor assemblies conforming to the procedures enumerated in department form DT2321. Complete department form DT2321 for each structure. Indicate the parties responsible for the installation and submit the form to the engineer for inclusion in the permanent project record.

(3) Provide incidental items, such as wire nuts, grommets, tape connectors, electrical nuts, etc., necessary to make the proposed closed circuit television (CCTV) system complete from the source of supply to the most remote unit.

(4) Assemble the camera, zoom lens, camera enclosure, and pan/tilt unit before delivery to the job site. Deliver the assemblies to the job site as complete units, and install units on top of the camera poles using a pole mounting adapter as the plans show.

(5) Mount camera enclosures directly to the mounting plates of the pan/tilt drives.

(6) Mount pan and tilt drives to the poles as the plans show. Electrically bond the pole-mounting adapter to the pole. Electrically bond the pan/tilt drive to the mounting adapter.

(7) Mount the camera assembly so that when the pan and tilt unit is at the mid-point of its mechanical motion, the orientation of the camera's line of sight is as the plans show.

(8) Provide camera cables in conduit and poles as the plans show. Provide continuous cable runs without splices between the camera assembly and the camera controller assembly.

(9) Take every precaution to ensure that the cable is not damaged during storage or installation. Workmen should not step on cable or run over by any vehicle or equipment. Do not pull the cable along the ground or over or around obstructions.

(10) Keep cable ends sealed at all times during installation using a cable end cap from the department's QPL. Do not use tape to seal the cable end. Keep the cable end sealed until connectors are installed.

(11) Do not exceed the minimum-bending radius of the cable at any time.

(12) Provide 6 feet of cable slack within cabinets

(13) The contractor or field system integrator shall furnish equipment, appliances, and labor necessary to test the installed camera cable between the camera assembly and the camera controller assembly. Successfully perform the following tests before any connections are made.

(14) Perform continuity tests on the coax element of the camera cable using a metallic time domain reflectometer (MTDR) with chart recorder. Camera cable shall not exhibit any discontinuities such as opens, shorts, crimps, or defects.

(15) Use a purpose built “Pass-Fail” network cable tester to test the network cable installation for category 5, class E compliance. Repair connections or cable as needed for the test to register a “Pass”.

(16) Measure the insulation resistance between conductors, and between each conductor, ground, and shielding using a megger. Ensure that the resistance is greater than 500 mega ohms.

(17) Should any cable fail to meet the test parameters, or should any testing reveal defects in the cable, replace the cable at no expense to the department. Retest the new cable as specified above.

(18) The ATMS field system integrator shall submit copies of the test results, including any unsuccessful and subsequently successful tests to the engineer before any field operations testing.

(19) Either shelf mount the control receivers or mount them directly into the 19-inch rack in the cabinet.

(20) Make all camera cable connections among the camera, camera power source, ethernet switch, and other associated devices.

(21) Field test at the camera controller assembly cabinet including the following:

1. Verification of installation of specified cables and connections between camera, pan and tilt unit, and control receiver.
2. Local operation of CCTV equipment exercising the pan, tilt, zoom, focus, iris opening, and manual iris control selection and operation, washer/wiper, and power on/off functions while observing the video picture on a portable video and waveform monitor.
3. Demonstration of camera sensitivity at low light levels to meet the specified requirements.
4. Demonstration of pan/tilt speed and extent of movement to meet the specified requirements.
5. Measurement of video signal level at the network interface (input to video transmitter) with a waveform monitor to verify NTSC Standards.

(22) After all field CCTV equipment and telephone interface devices have been installed and successfully tested and the new cameras have been integrated into the existing central camera controller, the ATMS field system integrator shall test the intertie with the central camera control hardware and new CCTV system components installed under this contract. The tests shall include the following:

1. Verification that interconnecting cable installations (video transmitter, camera's and camera controller) conform to the specifications.
2. Operation of camera assemblies from the central camera controller exercising the pan, tilt, zoom, focus, iris opening, and washer and wiper functions while observing the video picture on the local monitor and on monitors at central.
3. Verification of camera and lens preset programming.

(23) Following successful completion of the above tests, activate the entire CCTV subsystem and leave it on for 30 consecutive days. During this period, ensure that materials and components of the CCTV subsystem furnished and installed operate as specified and without any failure.

(24) In the event that any contractor-provided component of the CCTV subsystem malfunctions or operates below the level specified, the department will terminate the test period, and will require the ATMS field system integrator to determine and correct the problems, including repair or replacement of equipment, at no cost to the department. Upon correction of the problems, the engineer will start a new 30-day test period. If a malfunction is the result of equipment not installed by the contractor, the engineer will suspend the acceptance test period until the responsible party corrects these problems.

677.4 Measurement

(1) The department will measure the Install Camera Pole bid items and Install Camera Assembly as each individual unit acceptably completed.

677.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
677.0100 - 0199	Install Camera Pole (length)	EACH
677.0200	Install Camera Assembly	EACH

(2) Payment for the Install Camera Pole bid items is full compensation for installing department-furnished poles including materials, mounting adapter, and camera lowing system, hardware, and fittings necessary to completely install the pole.

(3) Payment for Install Camera Assembly is full compensation for installing department-furnished camera assemblies on camera poles; for providing camera cables; and for installing the camera controller assembly, control receiver, and connections.

Section 678 Communication Systems

678.1 Description

(1) This section describes the furnishing, installing, and testing of communication systems.

678.2 Materials

678.2.1 Department-Furnished Materials

(1) The department will furnish fiber optic cable, splice enclosures, termination panels, ethernet switches, wireless antennas, and cellular modems.

(2) Furnish cables and connectors required to connect department-furnished components as follows:

- Furnish cables between ethernet switches and terminal servers or other devices.

  Furnish outdoor rated cables between wireless antennas and other devices.

  Furnish Rs-232 patch cables and Cat 5 (E10/100) cables as well as connectors between cellular modems and other devices. Furnish a 19-inch rack mountable shelf.

678.2.2 Fiber Optic Terminations

(1) Furnish type ST fiber optic connectors that use epoxy or hot melt adhesive and include a ceramic ferrule.

678.2.3 Communication System Testing

(1) Supply materials and equipment necessary to perform the tests as described in these specifications. Test equipment will remain contractor's property. Use equipment consisting of, but not limited to, the following:

- Optical time domain reflectometer (OTDR).
- Optical source/power meter.
- Patch cabling.
- OTDR software.

678.3 Construction

678.3.1 Fiber Optic Cable

(1) Install cables into the conduit using a flat woven pull tape. Optionally, install the cable via forced air and a track pushing mechanism. Do not use a single pull tape for more than a single cable pull. Install the pull tape and fiber optic cables according to the testing procedures completed for this project and the pull tape and cable manufacturer’s recommendations.

(2) Install cable according to Siecor recommended procedure SRP 005-011 for fiber optic cable placing - duct. Follow these procedures regardless of the manufacturer of the cable. If the cable manufacturer recommends an operation in conflict with these procedures, submit a request for installation procedure change to the department for approval. Do not exceed a maximum pulling tension of 608 pounds-force during installation and 200 pounds-force after installation.

(3) If the total signal loss exceeds the allowable loss specified under 678.3.4, replace or repair that cable run. If elevated attenuation due to exceeding the pulling tension during installation is determined, replace that cable run.

678.3.2 Fiber Optic Splices

(1) Use only fusion splicing for splices. Ensure that each splice does not exceed the attenuation limits set forth in 678.3.4.

(2) Do not make mechanical splices.

(3) Protect each splice in a protective sleeve and secure in the splice tray. Protect bare fibers with a heat-shrink coating before placement in a sleeve or housing. Install the heat-shrink coating in to protect the fiber from scoring, dirt, accumulation, moisture intrusion, and micro bending.

(4) Install the fiber optic splice enclosure according to the manufacturer's recommended guidelines.

(5) Perform end-to-end splicing according to the manufacturer’s instructions for the supplied splice enclosure units.

(6) Perform mid-span splicing, drop splicing, for each device location at locations the plans show. Splice according to Siecor recommended procedure SRP-004-013 for mid-span access of fiber optic cable with cable slack present, or appropriate manufacturer instructions. Contain mid-span splices within enclosures.

(7) Do not deviate from the splice details as the plans show without the engineer’s approval.

678.3.3 Fiber Optic Terminations

(1) Install type ST connectors to the fiber optic cable.

(2) Terminate fibers on the rear of the termination panel with type ST connectors.

(3) Install fiber optic jumpers of sufficient length to connect the front side of the termination panel to the fiber equipment contained within the cabinet.

(4) Ensure that each termination does not exceed the attenuation limits specified in 678.3.4.

678.3.4 Communication System Testing

(1) Perform communication system testing using certified fiber optic technicians approved under 670.3.2.2.

(2) Provide the date, time, and location of required tests to the engineer at least 24 hours before performing the test.

(3) After completing cable installation, splicing, and termination, test all fibers for continuity, events losses, and total attenuation of the cable as follows:

1. Test each individual fiber for event losses using an OTDR. Conduct the test using the standard operating procedure as defined by the manufacturer of the test equipment.
2. Connect the OTDR and the cable with a factory patch cord of a length equal to the dead zone of the OTDR. Optionally, the technician can use a factory fiber box of 325 feet minimum with no splices within the box.
3. Test each individual fiber for total segment attenuation loss using an optical source/power meter. Conduct the test using the standard operating procedure as defined by the manufacturer of the test equipment.
4. Conduct both tests, OTDR and optical source/power meter, at 1310 nm and 1550 nm for each fiber in the cable.
5. Conduct both tests bi-directionally for each fiber in the cable.

(4) After completing the tests, submit 1 hard copy and 1 electronic copy of the test results to the engineer documenting the following test parameters:

Operator name	Setup parameters	Pulse width OTDR	Range OTDR
Date and time	Wavelength	Refractory index OTDR	Scale OTDR

(5) Summarize the results of both the OTDR and optical source/power meter tests in spreadsheet/tabular format adhering to the following requirements:

- List fiber optic segment name including route, start point, and end point.
- List all fibers by number.
- List direction of test as NB, SB, EB, or WB.
- List total fiber optic cable length for each fiber as documented in the OTDR test.
- List attenuation in dB of gain or loss for each fiber optic event in the OTDR test.
- List fiber optic loss event descriptions and locations including splices, miscellaneous events, and terminations.
- List the attenuation across the cable in dB/mile for each fiber tested.
- List the total segment loss for each fiber as determined by the optical source/power meter test.
- Provide bi-directional data including event distances, event descriptions, and attenuation losses for each fiber corresponding to a common start point
- Provide bi-directional data on separate lines, side-by-side within the same sheet.
- Provide 1310 nm and 1550 nm test results on separate sheets in identical formats.

(6) Provide copies of the fiber cable traces taken during the OTDR test to the department on diskette for review. Provide electronic files in a universal file format, or with software to view the files.

(7) Ensure that test results demonstrate that the dB/mile loss does not exceed plus 3 percent of the factory test or plus one percent of the cable's published production loss. The department will consider the error rate for the test equipment in evaluating results.

(8) Event losses are an average for each direction tested, and are limited to the following:

EVENT TYPE	ALLOWABLE LOSS
Fusion Splicing	0.10 dB
ST Connector	0.50 dB
Other miscellaneous events	0.10 dB
Total loss across the cable[1]	1 dB/mile

[1] Including events and cable attenuation.

678.3.5 Ethernet Switch

(1) Install ethernet switches in new or existing field cabinets. Connect to the devices the plans show or engineer directs.

678.3.6 Wireless Antenna

(1) Pole mount wireless antennas as the plans show and conforming to manufacturer's recommendations. Connect to the devices the plans show or engineer directs.

678.3.7 Cellular Modem

(1) Meet with the engineer and field system integrator to discuss specific requirements of the cellular modem and converter before installation. Make electrical and communication network connections to the cellular modem. Mount the cellular modem in a 19-inch rack using a rack or shelf.

(2) Program and configure the cellular modem according to the manufacturer's instructions. Connect to devices as the plans show.

(3) Activate the cellular modem and converter for 30 consecutive days. During this period, ensure that the cellular modem operates as specified. If a failure occurs, the engineer will suspend the test until the failure is corrected. Resume testing until 30 days of successful operation is achieved.

678.4 Measurement

(1) The department will measure the Install Fiber Optic Cable Outdoor Plant bid items by the linear foot acceptably completed.

(2) The department will measure the EACH bid items under this section as each individual unit acceptably completed.

(3) The department will measure Communication System Testing as a single lump sum unit for each service acceptably completed.

678.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
678.0000 - 0199	Install Fiber Optic Cable Outdoor Plant (count)	LF
678.0200	Fiber Optic Splice Enclosure	EACH
678.0300	Fiber Optic Splice	EACH
678.0400	Fiber Optic Termination	EACH
678.0500	Communication System Testing	LS
678.0600	Install Ethernet Switches	EACH
678.0700	Install Wireless Antennas	EACH
678.0800	Install Cellular Modems	EACH

(2) Payment for the Install Fiber Optic Cable Outdoor Plant bid items is full compensation for installing and testing department-furnished cabling.

(3) Payment for Fiber Optic Splice Enclosure and Fiber Optic Splice is full compensation for all work required under the individual bid items.

(4) Payment for Fiber Optic Termination is full compensation for providing connectors and jumper cables; and for completing the installation using department-furnished termination panels.

(5) Payment for Communication System Testing is full compensation for testing and required documentation and certifications.

(6) Payment for Install Ethernet Switches and Install Wireless Antennas is full compensation for installing the devises; for cables and connectors; and connecting the devises.

(7) Payment for Install Cellular Modems is full compensation for installing the modem; for cables and connectors including rack mountable shelf; for connecting the devises; for programming and configuration; and for testing.

(8) The department will not pay for replacements or repairs required under 678.3.1.

Section 690 Sawing

690.1 Description

(1) This section describes sawing of existing concrete or asphalt including pavement, curb & gutter, driveways, sidewalks, and similar work.

690.2 (Vacant)

690.3 Construction

690.3.1 Equipment

(1) Use diamond blades for sawing concrete where a full-depth cut is required. The contractor may use carbide cutting wheels to saw concrete that will be overlaid or for full-depth cuts where the cut face does not join the new concrete.

690.3.2 Sawing Asphalt

(1) Make straight saw cuts at least 2 inches deep. Saw so the surface remaining is generally vertical over its full depth. Saw to the depth the plan indicates or as the engineer directs or allows.

690.3.3 Sawing Concrete

(1) Do not extend saw cuts into newly placed concrete pavement or into existing pavements more than 12 inches beyond the limits the engineer designates. Saw full-depth unless the plans indicate otherwise or the engineer directs or allows otherwise.

(2) Remove sawing sludge after completing each saw cut. Minimize sludge on live traffic lanes. Remove sludge from all traffic control devices each day before dark. Dispose of sludge at an acceptable material disposal site or on engineer-approved areas of the roadway or roadside.

690.4 Measurement

(1) The department will measure Sawing Asphalt and Sawing Concrete by the linear foot acceptably completed. The department will not measure overcuts beyond the limits the plans show or the engineer directs.

(2) If performing Sawing Concrete in conjunction with concrete pavement repair and replacement or concrete base patching, the department will measure the applicable total quantity of the following:

1. One full-depth longitudinal cut through the repair area if the engineer deems that cut necessary.
2. Two full-depth transverse cuts, one at each limit of the repair area.
3. Additional transverse cuts as necessary to reduce the removal slabs to a transportable size. The department will not measure cuts made to reduce removal slabs to a width less than 7 feet.
4. Additional full-depth cuts the engineer directs to extend the repair limits, unless those cuts were required because of damage contractor operations caused.

(3) The department will measure and pay for composite cuts through both asphalt and concrete as concrete.

690.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
690.0150	Sawing Asphalt	LF
690.0250	Sawing Concrete	LF

(2) Payment is full compensation for sawing and sludge removal.

Part 7 Quality Management Program

Section 701 General QMP Requirements

Rewrite and reorganize section 701 to coordinate with the addition of sections 730 and 740 for base aggregate and ride.

701.1 Description

701.1.1 General

(1) This section describes contractor responsibilities common to QMPs under part 7 including quality control plans; personnel and laboratory certification; quality control testing; data submission; and record keeping. This section also describes department responsibilities, common to all QMPs under part 7, for verification and quality assurance testing. Exceptions and additional requirements under the QMP program are specified in the individual QMP provisions.

701.1.2 Quality Control Program

701.1.2.1 General

(1) Provide and maintain a quality control program, defined as all contractor activities and documentation of the following:

1. Gradation and mix design.
2. Control and inspection of production and placement processes.
3. Material sampling, testing, and correction of in-place work.

(2) CMM chapter 8 provides additional detailed guidance for QMP work and describes required sampling and testing procedures.

(3) The department's materials reporting system (MRS) software allows contractors to submit selected data to the department electronically, estimate pay adjustments, and print reports. Qualified personnel may obtain MRS software at:

http://www.atwoodsystems.com/

701.1.2.2 Quality Control Plan

Revise 701.1.2.2(1) to require project-specific QC plans for each individual QMP specification and require engineer approval for changes.

(1) Prepare a project-specific written quality control plan for each individual QMP specification and construct the project as that plan provides. Submit each individual quality control plan to the engineer no later than 10 business days before placing the respective material. Obtain engineer approval before making process or material changes that differ from those provided in approved QC plans. Update QC plans with changes as they become effective. Provide current plans to the engineer and post in each contractor laboratory before producing material and as changes are adopted.

Revise 701.1.2.2(2) to add aggregate source certification numbers and batch plant & processing locations.

(2) Ensure that quality control plans include the following elements:

1. Organizational chart including names, telephone numbers, current certifications, and roles and responsibilities of quality control personnel.
2. Process for disseminating quality control and corrective action information to appropriate persons. Include a list of recipients, the communication means used, and action time frames.
3. Locations of QC laboratories.
4. Material sources; include unique identifier for each aggregate source.
5. Batch plants and processing locations.
6. Initial and routine equipment checks and documentation.
7. Frequency of contractor quality control testing.
8. Process control testing the contractor intends to perform, and associated control charts or other documentation the contractor will make available to the department.
9. Procedures for identifying and documenting the locations of yielding foundation before placing material.

701.1.2.3 Small Quantities

(1) For contracts with small quantities of material, as defined under specific contract QMP provisions, the contractor may submit an abbreviated quality control plan consisting of only items 1, 4, 5, and 7 of 701.1.2.2(2) or integrate that small-quantity work into another contract QC plan.

701.1.2.4 Personnel Certification

(1) Have personnel that are HTCP-certified at or above the minimum levels specified in table 701-1 perform sampling, testing, and documentation.

(2) A certified technician coordinates and is responsible for work an assistant certified technician (ACT) performs. The certified technician ensures that sampling and testing is performed correctly, analyzes

test results, and posts resulting data. No more than one ACT can work under a single certified technician.

701.1.2.5 Laboratory Qualification

(1) Ensure that contractor portable and fixed laboratories, as well as commercial laboratories performing testing under the contract, are qualified to perform the work in question. Obtain information on the Wisconsin laboratory qualification program from the department's web site at:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/appr-prod/qual-labs.aspx

701.1.2.6 Equipment

(1) Furnish the necessary equipment and supplies for performing quality control testing. The engineer may inspect the measuring and testing devices to confirm both calibration and condition. Calibrate testing equipment according to CMM 8-30 and maintain a calibration record at the laboratory.

701.1.2.7 Documentation

Revise 701.1.2.7(1) to eliminate the same-day submittals; time frames are specified in individual QMP provisions.

(1) Document observations, material adjustments, process adjustments, and nonconforming material investigations daily in a permanent field record. Note additional process control information enumerated in the contractor's quality control plan.

(2) Use forms provided in CMM chapter 8. When electronic reporting is required under QMP provisions, submit the data using the applicable MRS software within 5 business days after results are available.

Revise 701.1.2.7(3) to eliminate the electronic submittal requirement.

(3) Submit final testing records, control charts, source documents, and other documentation in a manner acceptable to the engineer within 10 business days after placement. For long-term test results, submit final records within 10 business days after contract-required information becomes available. The engineer may allow submission of scanned copies of hand-written documentation.

701.2 (Vacant)

701.3 Testing

701.3.1 General

(1) Perform contract required QC tests for samples randomly located according to CMM 8-30. Use the test methods specified in table 701-1.

Revise table 701-1 to include both testing standards & certifications, add random sampling, add additional aggregate QMP tests, add SAM air void testing, and allow plant personnel to sample.

TABLE 701-1 TESTING AND CERTIFICATION STANDARDS

TEST	TEST STANDARD	MINIMUM REQUIRED CERTIFICATION (any one of the certifications listed for each test)
Random Sampling	CMM 8-30.9.2	Transportation Materials Sampling Technician (TMS) Aggregate Technician I (AGGTEC-I) AGGTEC-I Assistant Certified Technician (ACT-AGG) PCC Technician I (PCCTEC-I) PCCTEC-I Assistant Certified Technician (ACT-PCC) Grading Technician I (GRADINGTEC-I) Grading Assistant Certified Technician (ACT-GRADING)
Sampling Aggregates	AASHTO T2[1][4]	TMS, AGGTECT-1, ACT-AGG
Percent passing the No. 200 sieve	AASHTO T11[1]	AGGTEC-I, ACT-AGG
Fine and coarse aggregate gradation	AASHTO T27[1]	
Aggregate moisture content	AASHTO T255[1]	
Fractured faces	ASTM D5821[1]	
Liquid limit	AASHTO T89	Aggregate Testing for Transportation Systems (ATTS) GRADINGTEC-I, or ACT-GRADING
Plasticity index	AASHTO T90[3]	
Sampling freshly mixed concrete	AASHTO R60	PCCTEC-1 ACT-PCC
Air content of fresh concrete	AASHTO T152[2]	
Air void system of fresh concrete	AASHTO TP118	
Concrete slump	AASHTO T119[2]	
Concrete temperature	ASTM C1064	
Making and curing concrete cylinders	AASHTO T23	
Moist curing for concrete cylinders	AASHTO M201	
Concrete compressive strength	AASHTO T22	Concrete Strength Tester (CST) CST Assistant Certified Technician (ACT-CST)
Concrete flexural strength	AASHTO T97	
Profiling	__	PROFILER

[1] As modified in CMM 8-60.

[2] As modified in CMM 8-70.

[3] A plasticity check, if required under individual QMP provisions, may be performed by an AGGTEC-I in addition to the certifications listed for liquid limit and plasticity index tests.

[4] Plant personnel may operate equipment to obtain samples under the direct observation of a TMS or higher.

701.3.2 Contractor QC Testing

(1) Generate random numbers, determine sample and test locations according to CMM 8-30, and provide to the engineer before placing material within the corresponding test increment. Perform contract required QC tests at the predetermined random location. Also, perform other tests as necessary to control production and construction processes, and additional testing enumerated in the contractor's quality control plan or that the engineer directs. Provide test results to the department's project materials coordinator within the timeframe specified in the QMP provisions.

(2) Notify the engineer when an individual test exceeds a spec limit. Material from the first out-of-spec test up to, but not including, material from the first subsequent in-spec test is nonconforming. The department may reject or otherwise determine the final disposition of nonconforming material as specified in 106.5.

(3) The department may periodically observe contractor sampling and testing, and direct additional contractor sampling and testing for department evaluation.

701.3.3 Department Testing

701.3.3.1 General

(1) The department conducts verification testing to validate product quality and independent assurance testing to evaluate sampling and testing. The department will use the same sampling and testing methods required for contractor testing under 701.3.1. The department will provide the contractor with

a list of names and telephone numbers of project verification and independent assurance personnel upon approval of the QC plan.

(2) The department will provide test results to the contractor within the timeframe specified in the individual QMP provisions.

(3) Correct department-identified deficiencies. If the contractor fails to correct deficiencies or resolve discrepancies, the engineer may suspend production.

701.3.3.2 Quality Verification Testing

(1) The department will have an HTCP-certified technician, or ACT working under a certified technician, perform QV sampling and testing. Department QV testing personnel must meet the same certification requirements specified in 701.1.2.4.

(2) The department will sample and test randomly at locations independent of the contractor's QC tests and use separate equipment and laboratories. The department will notify the contractor before sampling so the contractor can observe QV sampling. The department will conduct a minimum of one verification test for each 5 contractor QC tests unless specific QMP provisions specify otherwise.

(3) If verification tests conform to specifications, no further action is required. If verification tests do not conform to specifications, the department will notify the contractor immediately and the two parties will jointly investigate. The investigation may include additional testing as well as review and observation of both department and contractor sampling and testing procedures, equipment, and other documented test results. Both parties will document investigative work.

701.3.3.3 Independent Assurance Testing

(1) The department performs independent assurance testing to evaluate department verification and contractor's QC sampling and testing including personnel qualifications, procedures, and equipment. The department will perform independent assurance reviews according to the department's independent assurance program, which may include one or more of the following:

1. Split sample testing.
2. Proficiency sample testing.
3. Witnessing sampling and testing.
4. Test equipment calibration checks.
5. Reviewing contract-required data and available contractor process control information.
6. Requesting that testing personnel perform additional sampling and testing.

701.3.4 Dispute Resolution

(1) The engineer and contractor will jointly investigate any testing discrepancies and potentially nonconforming materials. Attempt to seek a mutually agreeable solution. Abide to the dispute resolution procedures in 106.3.4.3.5.

701.3.5 Corrective Action

(1) Conform to corrective action specified in the individual QMP provisions or as directed by the engineer.

701.4 (Vacant)

701.5 Payment

(1) Costs for sampling, testing, and documentation under part 7 are incidental to the work. If the contractor fails to perform work required under the contract QMP provisions, the department may reduce the contractor's pay. The department will administer pay reductions under the Non-performance of QMP administrative item.

Section 710 General Concrete QMP

710.1 Description

(1) This section describes contractor QC testing requirements common to all concrete classes under part 7. Exceptions and additional requirements for concrete testing are specified in:

- 715 for class I concrete used in structures and pavement.
- 716 for class II and class III concrete used in ancillary applications.

710.2 Small Quantities

(1) For contracts with only small quantities of material subject to testing, as defined under specific contract QMP provisions, modify the requirements of 710 as follows:

1. The contractor may submit an abbreviated quality control plan as allowed in 701.1.2.3.
2. The engineer may accept aggregate based on documented previous testing.

710.3 Certification Requirements

(1) Have a certified PCC technician I, or ACT-PCC working under a certified technician, present at the project site, prepared and equipped to perform required sampling and testing whenever placing concrete.

710.4 Concrete Mixes

(1) The contractor is responsible for mix performance.

(2) At least 3 business days before producing concrete, provide documentation ensuring that materials conform to 501 unless the engineer allows or specific QMP provisions provide otherwise. Include the following:

1. For mixes: quantities per cubic yard expressed as SSD weights and net water, water to cementitious material ratio, and air content.
2. For cementitious materials and admixtures: type, brand, and source.
3. For aggregates: absorption, SSD bulk specific gravity, wear, soundness, freeze thaw test results if required, and air correction factor. Also include proposed gradation, including P200, limits if using a combined gradation as allowed under 715.2.2.

(3) Do not use any chemical admixtures, other than air-entraining agents, water reducers, or water-reducing retarders from the department's APL, without conforming to the following:

- Obtain the engineer's approval in advance.
- Document, by independent laboratory test reports, that the admixture conforms to AASHTO M194.

(4) Document mix adjustments daily during concrete production.

(5) Prepare and submit modifications to a concrete mix to the engineer for approval before using that modified mix. Modifications requiring the engineer's approval include changes in:

1. Source of any material.
2. Quantities of cementitious materials.
3. Adjustment of fine to total aggregate greater than ±3 percent by weight.
4. Addition or deletion of admixtures. Minor admixture dosage adjustments required to maintain air content or slump do not require engineer review or approval.

(6) When the department requires or allows high early strength concrete, use type III cement or one of the following:

- Add at least 95 pounds but no more than 280 pounds of cement per cubic yard to a previously accepted mix along with enough water to maintain workability without raising the w/cm.
- Substitute regular grade C for grade A or A2 high early strength concrete.
- Substitute regular grade A for grade B high early strength concrete.

710.5 Sampling and Testing

710.5.1 Sampling

(1) Sample fresh concrete at the point of placement.

710.5.2 Slump

(1) Provide material conforming to the slumps specified in 501.3.7.1. The contractor need not test slump for concrete placed by slip-form methods unless the engineer requests. For other placement methods, test slump whenever an air content test is performed, cylinders are made, and as the engineer directs.

710.5.3 Air Content

(1) Provide material conforming to the air contents specified in 501.3.2.4.2. On each day of production, test each mix design at start-up and as frequently as practicable until concrete is conforming and concrete production is under control. Subsequently, test at the QC testing frequency specified in specific contract QMP provisions and as the engineer directs.

(2) If an individual air test is outside the spec limits, notify the engineer and test as often as practicable on subsequent loads until the air content is conforming.

710.5.4 Concrete Temperature

(1) Measure concrete temperature of the same sample used for air content testing and report the results along with the air content.

710.5.5 Compressive Strength

(1) Cast all 6-inch by 12-inch cylinders in a set from the same sample. Do not cast more than one set of cylinders from a single truckload of concrete. Mark each cylinder to identify the lot and sublot or location on the project it represents.

(2) Provide facilities for initial curing. For up to 48 hours after casting, maintain the temperature adjacent to the specimens in the range of 60 to 80 F and prevent moisture loss. Between 24 and 48 hours after casting, transport the specimens to a department-qualified laboratory for standard curing until testing at 28 days.

(3) Determine the 28-day compressive strength of each cylinder in psi. Test each cylinder to failure. Use a compression machine that automatically records the date, time, rate of loading, and maximum load of each cylinder. Provide a printout of this information for each cylinder tested.

710.5.6 Aggregate Testing

710.5.6.1 General

(1) Test each stockpile for each component aggregate during aggregate production or when building stockpiles at the concrete production location. If aggregate was stockpiled before the contract, and test records from production or stockpiling are not available or not acceptable to the engineer, test during concrete production.

(2) For testing performed during aggregate production or stockpiling, conform to the individual gradation limits for the coarse and fine aggregate fractions as specified in the contractor's quality control plan. For testing performed during concrete production, conform to combined gradation limits submitted in the contractor's quality control plan.

710.5.6.2 Gradation Testing During Aggregate Production or Stockpiling

(1) Determine the complete gradation, including P200, using a washed analysis for both fine and coarse aggregates. Test each stockpile for each component aggregate during aggregate production or stockpiling as follows:

TABLE 710-1 AGGREGATE PRODUCTION AND STOCKPILING GRADATION TESTING FREQUENCY

DAILY AGGREGATE PRODUCTION	MINIMUM FREQUENCY PER STOCKPILE
1000 tons or less	One test per cumulative total of 1000 tons
more than 1000 tons through 2000 tons	Two tests per day
more than 2000 tons	Three tests per day

(2) In addition to the testing performed during aggregate production or stockpiling, determine the combined P200 during concrete production. Ensure that the combined P200 is 2.3 percent or less. Use a washed analysis for both fine and coarse aggregates. Randomly, test at least once for each 50 cubic yards of concrete. For daily production greater than 50 cubic yards, one test per day is sufficient for constant mix conditions. The engineer may allow testing to be reduced to a minimum of once per 5 days of concrete production after 5 consecutive tests show that the combined P200 is less than or equal to 1.8 percent.

710.5.6.3 Gradation Testing During Concrete Production

(1) Determine the complete gradation, including P200, using a washed analysis for both fine and coarse aggregates. Test each stockpile for each component aggregate as follows:

TABLE 710-2 CONCRETE PRODUCTION GRADATION TESTING FREQUENCY

DAILY CONCRETE PRODUCTION	MINIMUM FREQUENCY PER STOCKPILE
250 cubic yards or less	One test per cumulative total of 250 cubic yards
more than 250 cubic yards through 1000 cubic yards	One test per day
more than 1000 cubic yards	Two tests per day

(2) Report results for the 1 1/2", 1", 3/4", 1/2", 3/8", #4, #8, #16, #30, #50, #100, and #200 sieves.

Section 715 QMP Concrete Pavement and Structures

715.1 Description

(1) This section describes contractor mix design and testing requirements for class I concrete used in concrete pavement, and concrete structures.

715.1.1 Quality Control Program

715.1.1.1 General

(1) Conform to the general requirements under 701 and 710 as well as the additional specific contract QMP provisions for class I concrete specified here in section 715. The department defines class I concrete as cast-n-place concrete used in pavement or structure applications where all of the following apply:

- Mix design requires review by the engineer.
- The contract defines spec limits for strength.
- The contractor may earn statistically based incentives for superior concrete strength. [1]

[1] HES and SHES concrete are not eligible for 28-day strength incentives.

715.1.1.2 Small Quantities

(1) The department defines small quantities of class I concrete, subject to the reduced requirements under 710.2, as follows:

- Less than 150 cubic yards of structure concrete placed under a single bid item.
- Less than 2500 cubic yards of slip-formed pavement placed using a single mix design.
- Less than 1000 cubic yards of non-slip-formed pavement placed using a single mix design.

715.1.1.3 Pre-Pour Meetings for Structure Concrete

(1) Arrange at least two pre-pour meetings to discuss concrete placement. Discuss the placement schedule, personnel roles and responsibilities, testing and quality control, and how test results will be communicated. Schedule the first meeting before placing any concrete and the second before placing any bridge deck concrete. Ensure that representatives from all parties involved with concrete work, including contractor, sub-contractor, ready-mix supplier, testers, and the project manager, attend these meetings.

715.1.1.4 Quality Control Plan

(1) If a comprehensive quality control plan is required under 701.1.2.2, submit a plan conforming to 701.1.2.2 and include additional concrete mix information as follows:

1. Preliminary concrete mix information including proposed production facilities and sources of materials as well as the name, title, and phone number of the person developing the mix design.
2. Proposed individual and combined aggregate gradation limits.
3. Proposed methods for monitoring and recording batch weights.

715.2 Materials

715.2.1 General

(1) Determine mixes for class I concrete used under the contract using one or more of the following methods:

- Have a HTCP-certified PCC technician II develop new concrete mixes qualified based on the results of mix development tests performed by a department-qualified laboratory.
- Submit previously-used department-approved mixes qualified based on field performance.

(2) The contractor need not provide separate laboratory mix designs for high early strength concrete nor provide routine 28-day compressive strength tests during placement for high early strength concrete.

(3) For lab-qualified or field-qualified mixes, in addition to the mix information required under 710.4, submit 2 copies of a concrete mix report at least 3 business days before producing concrete. For lab-qualified mixes, include strength data, test dates, and the name and location of the laboratory that performed mix development testing. For field-qualified mixes, include historical data that demonstrate acceptable strength and field performance.

(4) Ensure that the concrete mix report includes a cover sheet with signature blocks for both the mix developer and the engineer. Have the mix developer sign and date each copy attesting that all information in the report is accurate. The engineer will sign and date each copy of the report. The engineer's signature verifies that the engineer had the opportunity to review the mix report, to check that it meets the concrete mix requirements, and to comment. The engineer will return a signed copy to the contractor within 3 business days of receiving the report.

715.2.2 Combined Aggregate Gradation

(1) Ensure that the combined aggregate gradation conforms to the following, expressed as weight percentages of the total aggregate:

1. One hundred percent passes the 2-inch sieve.
2. The percent passing the 1-inch sieve is less than or equal to 89. The engineer may waive this requirement for one or more of the following:
   - Clear spacing between reinforcing bars is less than 2 inches.
   - The contractor provides an engineer-approved optimized gradation analysis.
3. The percent passing the No. 4 sieve is less than or equal to 42, except if the coarse aggregate is completely composed of crushed stone, up to 47 percent may pass the No. 4 sieve. For pavement, coarse aggregate may be completely composed of crushed concrete, in which case up to 47 percent may pass the No. 4 sieve.
4. The percent passing the No. 200 sieve is less than or equal to 2.3 percent.

(2) Submit proposed combined gradation limits and target individual gradations along with the mix information required under 710.4.

715.2.3 Class I Concrete Mixes

715.2.3.1 Pavements

(1) Use at least 5 pairs of cylinders to demonstrate the compressive strength of a mix design. Use either laboratory strength data for new mixes or field strength data for established mixes. Demonstrate that the 28-day compressive strength of the proposed mix will equal or exceed the 85 percent within limits criterion specified in 715.5.2.

(2) Provide a minimum cement content of 565 pounds per cubic yard, except if using type I, IL, or III cement in a mix where the geologic composition of the coarse aggregate is primarily igneous or metamorphic materials, provide a minimum cement content of 660 pounds per cubic yard.

(3) The contractor may use class C fly ash or grade 100 or 120 slag as a partial replacement for cement. For binary mixes use up to 30 percent fly ash or slag, except for slip-formed work the contractor may use up to 50 percent slag. For ternary mixes use up to 30 percent fly ash plus slag in combination. Replacement values are in percent by weight of the total cementitious material in the mix.

(4) Ensure that the target ratio of net water to cementitious material for the submitted mix design does not exceed 0.42 by weight. Include free water on the aggregate surface but do not include water absorbed within aggregate particles.

(5) Do not use chloride based accelerators in mixes for new construction.

Add 715.2.3.1(6) to include super air meter (SAM) testing for new lab-qualified pavement mix designs. This change was implemented in ASP 6 effective with the December 2017 letting.

(6) For new lab-qualified mixes, test the air void system of the proposed concrete mix conforming to AASHTO provisional standard TP 118. Include the SAM number as a part of the mix design submittal.

715.2.3.2 Structures

(1) Qualify compressive strength according to ACI 301 - Specifications for Structural Concrete - subsections 4.2.3.1 through 4.2.3.4. Use either laboratory strength data for new mixes or field strength data for established mixes. Demonstrate that the 28-day compressive strength of the proposed mix will equal or exceed the 90 percent within limits criterion specified in 715.5.3.

(2) Provide a mix grade containing fly ash (A-FA), slag (A-S), both fly ash and slag (A-T), or blended cement (A-IP, A-IS, or A-IT) Ensure that the cementitious content equals or exceeds 565 pounds per cubic yard. Unless the engineer approves otherwise in writing, conform to one of the following:

1. Use class C fly ash or grade 100 or 120 slag as a partial replacement for cement. For binary mixes use 15% to 30% fly ash or 20% to 30% slag. For ternary mixes use 15% to 30% fly ash plus slag in combination. Replacement values are in percent by weight of the total cementitious material in the mix.
2. Use a type IP, IS, or IT blended cement.

(3) Ensure that the target ratio of net water to cementitious material (w/cm) for the submitted mix design does not exceed 0.45 by weight. Include free water on the aggregate surface but do not include water absorbed within aggregate particles. Control the w/cm ratio throughout production by adjusting batch weights for changes in the aggregate moisture as required under 715.3.3.2.

(4) Do not use mixes containing accelerators, except the contractor may use mixes containing non-chloride accelerators in substructure elements.

715.3 Testing and Acceptance

715.3.1 Class I Concrete Testing

715.3.1.1 General

Revise 715.3.1.1(1) to include super air meter (SAM) testing for pavements at least once per lot. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) Provide slump, air content, concrete temperature and compressive strength test results as specified in 710.5. Provide a battery of QC tests, consisting of results for each specified property, using a single sample randomly located within each sublot. If a sublot random test location falls within a mainline pavement gap, relocate the test to a different location within the sublot. Cast three cylinders for strength evaluation.

(2) For pavement concrete, also test the air void system conforming to AASHTO provisional standard TP118 at least once per lot and enter the SAM number in the MRS for information only. SAM testing is not required for the following:

- High early strength (HES) concrete pavement
- Special high early strength (SHES) concrete pavement
- Concrete placed under the Concrete Pavement Approach Slab bid items
- For concrete pavement lots with less than 4 sublots

715.3.1.2 Lot and Sublot Definition

715.3.1.2.1 General

(1) Designate the location and size of all lots before placing concrete. Ensure that no lot contains concrete of more than one mix design or placement method defined within 715.3.1.2 as follows:

Mix design change A modification to the mix requiring the engineer's approval under 710.4(5).

For paving mixes, a source change under item 1 of 710.4(5) for fly ash of the same class that does not require a modification under items 2 through 4 of 710.4(5) does not constitute a mix design change.

Placement method Either slip-formed, not slip-formed, or placed under water.

(2) Lots and sublots include ancillary concrete placed integrally with the class I concrete.

715.3.1.2.2 Lots by Lane-Feet

(1) The contractor may designate slip-formed pavement lots and sublots conforming to the following:

- Lots and sublots are one paving pass wide and may include one or more travel lanes, integrally placed shoulders, integrally placed ancillary concrete, and pavement gaps regardless of mix design and placement method.
- Sublots are 1000 feet long for single-lane and 500 feet long for two-lane paving. Align sublot limits with ride segment limits defined in 740.3.2. Adjust terminal sublot lengths to match the project length or, for staged construction, the stage length. Ensure that sublot limits match for adjacent paving passes. Pavement gaps do not affect the location of sublot limits.
- Create lots by grouping 4 to 8 adjacent sublots matching lots created for adjacent paving passes.

(2) If a sublot random test location falls in a pavement gap, test at a different random location within that sublot.

715.3.1.2.3 Lots by Cubic Yard

(1) Define standard lots and sublots conforming to the following:

- Do not designate more than one sublot per truckload of concrete.
- Lots for structures are a maximum of 500 cubic yards divided into approximately equal 50-cubic-yard or smaller sublots.
- Lots for pavement are a maximum of 2000 cubic yards divided into approximately equal 250-cubic-yard or smaller sublots.

(2) The contractor may designate lots smaller than standard sized. An undersized lot is eligible for incentive payment under 715.5 if the contractor defines 4 or more sublots for that lot.

715.3.1.3 Department Verification Testing

Revise 715.3.1.3(1) to require a 1 in 5 QV testing frequency with at least one QV test per lot for class I concrete. This change was implemented in ASP 6 effective with the December 2017 letting.

(1) The department will perform verification testing once for each 5 contractor QC tests with additional testing as required to obtain at least 1 verification test per lot for air content, slump, temperature, and compressive strength.

Add 715.3.1.3(2) to specify time limits for reporting department QV test results to the contractor.

(2) The department will report QV test results to the contractor within 2 business days after the department obtains the sample, or in the case of long-term testing, within 2 business days after conducting the test.

715.3.2 Strength Evaluation

715.3.2.1 General

(1) The department will make pay adjustments for compressive strength on a lot-by-lot basis using the compressive strength of contractor QC cylinders. The department will assess concrete for removal and replacement based on a sublot-by-sublot analysis of core strength. Perform coring and testing, fill core holes with an engineer-approved non-shrink grout, and provide traffic control during coring.

(2) Randomly select 2 QC cylinders to test at 28 days for percent within limits (PWL). Compare the strengths of the 2 randomly selected QC cylinders and determine the 28-day sublot average strength as follows:

- If the lower strength divided by the higher strength is 0.9 or more, average the 2 QC cylinders.
- If the lower strength divided by the higher strength is less than 0.9, break one additional cylinder and average the 2 higher strength cylinders.

715.3.2.2 Removal and Replacement

715.3.2.2.1 Pavement

(1) If a sublot strength is less than 2500 psi, the department may direct the contractor to core that sublot to determine its structural adequacy and whether to direct removal. Cut and test cores according to AASHTO T24 as and where the engineer directs. Have an HTCP-certified PCC technician I perform or observe the coring.

(2) The sublot pavement is conforming if the compressive strengths of all cores from the sublot are 2500 psi or greater or the engineer does not require coring.

(3) The sublot pavement is nonconforming if the compressive strengths of any core from the sublot is less than 2500 psi. The department may direct removal and replacement or otherwise determine the final disposition of nonconforming material as specified in 106.5.

715.3.2.2.2 Structures

(1) The department will evaluate the sublot for possible removal and replacement if the 28-day sublot average strength is lower than f'c minus 500 psi. The value of f'c is the design stress the plans show. The department may assess further strength price reductions or require removal and replacement only after coring the sublot.

(2) The engineer may initially evaluate the sublot strength using a non-destructive method. Based on the results of non-destructive testing, the department may accept the sublot at the previously determined pay for the lot, or direct the contractor to core the sublot.

(3) If the engineer directs coring, obtain three cores from the sublot in question. Have an HTCP-certified PCC technician I perform or observe core sampling according to AASHTO T24. Determine core locations, subject to the engineer's approval, that do not interfere with structural steel.

(4) Have an independent consultant test cores according to AASHTO T24.

(5) If the 3-core average is greater than or equal to 85 percent of f'c, and no individual core is less than 75 percent of f'c, the engineer will accept the sublot at the previously determined pay for the lot. If the 3-core average is less than 85 percent of f'c, or an individual core is less than 75 percent of f'c, the engineer may require the contractor to remove and replace the sublot or assess a price reduction of $35 per cubic yard or more.

715.3.3 Aggregate

715.3.3.1 General

(1) Except as allowed for small quantities in 710.2, provide aggregate test results conforming to 710.5.6.

715.3.3.2 Structures

(1) In addition to the aggregate testing required under 710.5.6, determine the fine and coarse aggregate moisture content for each sample used to test the percent passing the No. 200 sieve.

(2) Calculate target batch weights for each mix when production of that mix begins. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5 percent, adjust the batch weights to maintain the design w/cm ratio.

715.4 Measurement

(1) The department will measure Incentive Strength Concrete Pavement and Incentive Strength Concrete Structures by the dollar, calculated as specified in 715.5.

715.5 Payment

715.5.1 General

(1) The department will pay incentive for compressive strength under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
715.0415	Incentive Strength Concrete Pavement	DOL
715.0502	Incentive Strength Concrete Structures	DOL

(2) Incentive payment may be more or less than the amount the schedule of items shows.

(3) The department will administer disincentives for compressive strength under the Disincentive Strength Concrete Pavement and the Disincentive Strength Concrete Structures administrative items.

(4) The department will adjust pay for each lot using PWL of the 28-day sublot average strengths for that lot. The department will measure PWL relative to the lower specification limit of 3700 psi for pavements and 4000 psi for structures. The department will not pay a strength incentive for concrete that is nonconforming in another specified property, for ancillary concrete accepted based on tests of class I concrete, or for high early strength concrete unless placed in pavement gaps as allowed under 715.3.1.2.1.

(5) Submit strength results to the department electronically using the MRS software. The department will validate contractor data before determining pay adjustments.

(6) All coring and testing costs under 715.3.2.2 including filling core holes and providing traffic control during coring are incidental to the contract.

715.5.2 Pavements

(1) The department will adjust pay for each lot using equation “QMP 3.01” as follows:

Percent within Limits (PWL)	Pay Adjustment (dollars per square yard)
>= 95 to 100	(0.1 x PWL) - 9.5
>= 85 to < 95	0
>= 30 to < 85	(1.5/55 x PWL) - 127.5/55
< 30	-1.50

(2) The department will not pay incentive if the lot standard deviation is greater than 400 psi.

(3) For lots with a full battery of QC tests at less than 4 locations, there is no incentive but the department will assess a disincentive based on the individual sublot average strengths. The department will reduce pay for sublots with an average strength below 3700 psi by $1.50 per square yard.

(4) For integral shoulder pavement and pavement gaps accepted using tests from the adjacent travel lane, The department will adjust pay using strength results of the travel lane for integrally placed concrete shoulders and pavement gaps regardless of mix design and placement method, included in a lane-foot lot.

715.5.3 Structures

(1) The department will adjust pay for each lot using equation “QMP 2.01” as follows:

Percent within Limits (PWL)	Pay Adjustment (dollars per cubic yard)
>= 99 to 100	10
>= 90 to < 99	0
>= 50 to < 90	(7/8 x PWL) - 78.75
< 50	-35

(2) The department will not pay incentive if the lot standard deviation is greater than 350 psi.

(3) For lots with less than 4 sublots, there is no incentive but the department will assess a disincentive based on the individual sublot average strengths. The department will reduce pay for sublots with an average strength below 4000 psi by $35 per cubic yard.

Section 716 QMP Ancillary Concrete

716.1 Description

(1) This section describes contractor mix selection and testing requirements for class II and class III concrete.

716.1.1 Quality Control Program

716.1.1.1 General

(1) Conform to the general requirements under 701 and 710 as modified here in 716 for class II and class III concrete defined as follows:

- Class II: ancillary concrete the department accepts based on field testing during placement.
- Class III: ancillary concrete the department accepts by certification.

716.1.1.2 Quality Control Plan

(1) The contractor need only submit an abbreviated quality control plan as defined in 701.1.2.3.

716.2 Materials

716.2.1 Class II Concrete

(1) Determine mixes for class II concrete used under the contract according to 501. If a grade A mix is allowed under standard spec 501.3.1.3, the contractor may use a class I mix design approved under 715.2. Ancillary concrete placed integrally with mainline pavement is accepted using tests of class I concrete but not eligible for incentive payment under 715.5. Document the locations and quantities of integral concrete and identify the class I sublot tests used for acceptance.

Revise 716.2.1(2) to require air and slump testing every 100 CY and cylinders every 200 CY for base patching.

(2) Perform random QC testing at the following frequencies:

1. Test air content and slump a minimum of once per 100 cubic yards for each mix grade and placement method.
2. Cast one set of 2 cylinders per 200 cubic yards for each mix grade and placement method. Cast a minimum of one set of 2 cylinders per contract for each mix grade and placement method. Random 28-day compressive strength cylinders are not required for HES or SHES concrete.
3. For deck overlays, perform tests and cast cylinders once per 50 cubic yards of grade E concrete placed.
4. For concrete base, one set of tests and one set of cylinders per 250 cubic yards.

(3) Conform to the initial curing requirements under 710.5.5 except the contractor may extend initial curing for 72 hours before transporting the cylinders to a department-qualified laboratory.

(4) Test aggregate gradations, including P200, as specified in 710.5.6 at the frequency listed below which results in the least number of tests:

- A maximum of one test per day.
- A minimum of one test per 400 cubic yards of cumulative concrete placed.

Alternatively the engineer may accept aggregate based on documented previous testing.

(5) Department verification testing is optional for aggregate used in class II concrete.

716.2.2 Class III Concrete

(1) Acceptance of class III concrete is based on a certificate of compliance. Submit the certificate of compliance at least 3 business days before producing concrete along with the initial concrete mix documentation as required under 710.4(2).

(2) Contractor testing for the mix and mix aggregates is not required for the items contained within the certificate of compliance. Conform to 716.2.1 for items not contained within the certificate of compliance.

(3) Department verification testing is optional for class III concrete. Correct any deficiencies found during the QV testing.

716.3 (Vacant)

716.4 (Vacant)

716.5 (Vacant)

Section 730 QMP Base Aggregate

Add section 730 to incorporate STSP 301-010 QMP Base Aggregate.

730.1 Description

730.1.1 General

(1) This section describes contractor QC and department QV testing and documentation for base aggregates. Apply to Base Aggregate Open Graded bid items and to Base Aggregate Dense bid items except reclaimed asphaltic pavement placed under the Base Aggregate Dense bid items.

(2) Do not apply to Aggregate Detours, Breaker Run, Select Crushed, Pit Run, Subbase, or Riprap bid items.

(3) Conform to the general QMP requirements under 701, to the base aggregate requirements under 301, 305, and 310, and to the additional requirements specified here in 730.

730.1.2 Quality Control Program

730.1.2.1 Quality Control Plan

(1) Submit a plan conforming to 701.1.2.2 and include additional information as follows:

1. Section and quarter descriptions for all aggregates that require QC testing.
2. Description of stockpiling and hauling methods.

730.1.2.2 Small Quantities

(1) The department defines a small quantity of base aggregate as a contract quantity of 6000 tons or less placed under a single bid item.

(2) For small quantity contracts:

- An abbreviated quality control plan is allowed under 701.1.2.3.
- Contractor QC placement testing is modified as specified in 730.3.4.1.

730.1.2.3 Documentation

(1) Submit test results for gradation, fracture, liquid limit, and plasticity to the engineer within 1 business day of obtaining the sample.

(2) Maintain standardized control charts according to CMM 8-30.

(3) Maintain separate gradation control charts for each sieve size specified in 305 or 310 for each base aggregate size, source or classification, and type. Set the control limits and warning limits as follows:

1. The control limits are the upper and lower gradation specification limits.
2. Warning limits:
   - There are no upper warning limits for sieves requiring or allowing 100 percent passing.
   - There are no lower warning limits for sieves allowing 0 percent passing.
   - Dense-graded No. 200 sieve: warning limits are 0.5 percent within the upper and lower control limits.
   - Dense-graded for all other sieves: warning limits are 2 percent within the upper and lower control limits.
   - Open-graded 1-inch, 3/8-inch, and No. 4 sieves: warning limits are 2 percent within the upper and lower control limits.
   - Open-graded No. 10, No. 40, and No. 200 sieves: warning limits are 1 percent within the upper and lower control limits.

(4) Maintain a separate fracture control chart for each base aggregate size, source or classification, and type. Set the lower control limit to the value specified in table 301-2. Set the lower warning limit 2 percent above the lower control limit. There is no upper warning limit.

(5) Plot QC and QV test results and the 4-point running average on control charts. Include only QC placement tests in the running average unless a QV test result is out of spec, then include it as specified in 730.3.5(5). Document corrective action on control charts. Update control charts and submit copies to the engineer daily.

730.2 Materials

(1) Provide materials conforming to 301, 305, and 310.

(2) Use the definitions in 301.2.2 and the following:

Stockpile Sampling Coordinated QC/QV sample before beginning placement of aggregate materials.

Loadout Sampling Sample taken from the working face of a stockpile during placement of aggregate materials.

730.3 Testing

730.3.1 General

(1) Test gradation, fracture, liquid limit, and plasticity for each base aggregate size, source or classification, and type. Production tests only apply to small quantity projects under 730.3.4. Use the test methods specified in table 701-1 and conform to the following:

1. Gradation
   - Determine the complete gradation, including P200, using a washed analysis.
   - For 3-inch base, if three consecutive 4-point running averages for percent passing the No 200 sieve are 8.5 percent or less, the contractor may use an unwashed analysis for 9 out of 10 tests; one out of every 10 must be washed. If a single 4-point running average for percent passing the No. 200 sieve exceeds 8.5 percent, resume using a washed analysis until three consecutive running averages are 8.5 percent or less.
2. Fracture
   - Perform fracture testing on the individual component materials before blending.
   - Fracture testing is not required on quarried stone, reclaimed asphalt, or asphalt-coated reprocessed materials.
3. Liquid limit and plasticity
   - Determine the liquid limit and plasticity index using material passing the No. 40 sieve of each individual component material and then on the blended material.
   - Perform plasticity checks, as specified under 730.3.2, by using the Hand Rolling Method detailed in section 5 of AASHTO T90.
   - Liquid limit and plasticity testing are not required on reclaimed asphalt or reprocessed material.

(2) Ensure that both QC and QV stockpile test results conform to the specifications before placing material. If either the QC or the QV test fails, both the QC and QV technicians will resample the stockpile side-by-side and rerun the tests. If either side-by-side test fails, contact the region materials engineer to investigate.

(3) Stockpile tests[1] can be used for multiple projects. If placement on a project does not begin within 60 calendar days after the date the stockpile sample was obtained, retest the stockpile before placement begins.

[1] Replace the stockpile test with an in-place production test for concrete pavement recycled and processed on-site; test on the first day of production.

(4) Obtain placement samples after the material is bladed, mixed, and shaped, but before watering and compacting, except as follows:

1. Sample 3-inch material and lift thicknesses of 3-inch or less from the stockpile at loadout.
2. Do not sample from material used to maintain local traffic or from other areas of temporary base that will not remain in place after the contract.
3. No placement testing is required on days when only temporary base material is placed. Acceptance of temporary base materials is based on visual inspection.

730.3.2 Contractor QC Testing

(1) Provide stockpile test results to the engineer before placing material.

(2) Split and label each QC sample. Retain the split for 7 placement days in a dry, protected location. If requested for department comparison testing, deliver the split to the engineer within one business day.

(3) Perform QC gradation, fracture, liquid limit, and plasticity testing of each base aggregate size, source or classification, and type at the following frequencies:

- One stockpile test before placement including gradation, fracture, and plasticity.
- One gradation test per 3000 tons of material placed, or fraction thereof.
- One fracture test for each gradation test. When the fracture 4-point running average is above the lower warning limit, the testing frequency may be reduced to one fracture test per ten gradation tests or fraction thereof. The reduced test frequency applies only as long as the running average remains above the lower warning limit.
- One plasticity and liquid limit test for the first gradation test. Thereafter, perform one plasticity check, per ten gradation tests or fraction thereof. If the soil cannot be rolled into a 3 mm-diameter thread, then it is non-plastic (NP) and the complete test need not be performed; report the plasticity Index as NP. If the material can be rolled into a thread, then perform both complete tests to determine the liquid limit and the plasticity index.

(4) Submit test results to the engineer within one business day of obtaining the sample.

730.3.3 Department QV Testing

(1) The department will notify the contractor's project materials coordinator before obtaining a sample.

(2) The department will split each sample, test half for QV, and retain the other half for 7 placement days.

(3) The department will conduct QV testing for gradation, fracture, liquid limit, and plasticity of each base aggregate size, source or classification, and type as follows:

1. One stockpile QV test from each source prior to placement.
2. At least one QV test per 30,000 tons of material placed, or fraction thereof.

(4) The department will provide test results to the contractor within 2 business days of obtaining a sample.

730.3.4 Small Quantity Testing

730.3.4.1 Contractor QC Testing

(1) For small quantity contracts with ≤ 6000 tons, do the following:

1. Conduct one QC stockpile test prior to placement.
2. Submit 2 production tests or conduct 1 loadout test instead of placement tests. Production tests are valid for 3 years from the date the production sample was obtained; the first day of placement must be within 3 years of the date sampled.
3. If the actual quantity placed is more than 6000 tons, on the next day of placement perform one additional random QC test for each 3000 tons of overrun, or fraction thereof.

730.3.4.2 Department QV Testing

(1) Conform to the QV testing under 730.3.3; the department may waive QV testing for contract bid item quantities of 500 tons or less.

730.3.5 Corrective Action

(1) Do not blend additional material on the roadbed to correct gradation problems.

(2) Consider corrective action when a running average trends toward a warning limit.

(3) Notify the engineer when a running average exceeds a warning limit. When two consecutive running averages exceed a warning limit, the engineer and contractor will discuss appropriate corrective action. Perform the engineer's recommended corrective action and increase the testing frequency as follows:

1. Increase gradation testing to at least one test per 1000 tons placed.
2. Increase fracture testing to at least one fracture test for each gradation test.

(4) If corrective action improves the property in question such that the running average is within the warning limits, the contractor may return to the testing frequency specified in 730.3.2. If corrective action does not improve the property in question, and the running average is still in the warning band, then repeat the steps outlined above starting with engineer notification.

(5) If a QV test result does not conform to the specifications, the engineer will inform the contractor and the QV test will be added to the QC data and included in the running average, as if it were an additional QC test.

(6) If a running average is never established, individual placement tests are used for acceptance.

(7) If an individual QC or QV test result is significantly out of specification limits, notify the other party, stop placing base, suspend other activities that may affect the area in question, and jointly investigate to determine the extent of nonconforming material. Both parties must document the investigative work.

(8) Test results are considered significantly out of spec limits if meeting one or more of the following:

1. A gradation spec limit for the No. 200 sieve is exceeded by more than 3.0 percent.
2. A gradation spec limit for any sieve, other than the No. 200, is exceeded by more than 5 percent.
3. The fracture spec limit is exceeded by more than 10 percent.

(9) The engineer may direct the contractor to remove and replace any nonconforming material. If the engineer allows the nonconforming material to remain in place, it is subject to a pay reduction.

730.3.6 Nonconforming Material

(1) The department will determine the extent of nonconforming material as follows:

1. If an individual QC or QV gradation or fracture test is out of spec and a 4-point running average is never established, the material starting from the first out-of-spec QC or QV test and ending at the first subsequent QC or QV test that is within spec limits is nonconforming.

2. If a gradation or fracture 4-point running average exceeds a control limit, the material starting from the first running average outside of the control limit and ending at the first subsequent running average that is within the control limit is nonconforming.
3. If any individual QC or QV plasticity test is out of spec, the material starting from the first out-of-spec QC or QV test and ending at the first subsequent QC or QV test that is within spec limits is nonconforming.
4. If an individual QC or QV gradation or fracture test is significantly out of spec, the material starting from the first significantly out-of-spec QC or QV test and ending at the first subsequent QC or QV test that is within spec limits is nonconforming, even if the 4-point running average, that includes the significantly out-of-spec test, is within spec limits.

730.4 (Vacant)

730.5 Payment

Added new Nonconforming QMP Base Aggregate Plasticity administrative item.

(1) The department will administer pay reductions for nonconforming material under the Nonconforming QMP Base Aggregate Gradation, Nonconforming QMP Base Aggregate Fracture, and Nonconforming QMP Base Aggregate Plasticity administrative items.

(2) The department will calculate pay reductions for base aggregate with nonconforming gradation and fracture using the nonconforming quantity that remains in place, the bid item contract unit price, and a pay reduction percentage from table 730-1. The department will administer a 50% pay reduction for base aggregate with nonconforming plasticity or liquid limit that remains in place.

TABLE 730-1 Pay Reductions for Nonconforming Base Aggregate

% PAY REDUCTION[1]	NONCONFORMING GRADATION		NONCONFORMING FRACTURE
	NO 200 SIEVE	SIEVES OTHER THAN NO 200	
5% to 10%	≤ 1.5%	≤ 3%	≤ 5%
10% to 20%	> 1.5% to ≤ 3%	> 3% to ≤ 5%	> 5% to ≤ 10%
SIGNIFICANTLY OUT OF SPEC[2]			
20% to 40%	> 3%	> 5%	> 10%

[1] The engineer will use the guidance provided in CMM 8-10 when determining pay reduction percentages from within a given range.

[2] The engineer may assess pay reductions for individual QC or QV test results that are significantly out of spec even if the running average is within spec limits.

(3) The department will not apply more than one pay adjustment to a given quantity of material. If a quantity of material is nonconforming in more than one property, the department will apply the greater pay reduction.

Section 740 QMP Ride

Add section 740 to move the Ride Quality specifications from 440.

740.1 Description

740.1.1 General

(1) This section describes profiling with a non-contact profiler, locating areas of localized roughness, and determining the International Roughness Index (IRI) for each wheel path.

(2) Profile the final mainline riding surfaces greater than 1500 feet in continuous length. Include bridges, bridge approaches, and railroad crossings in the calculation of IRI. Exclude roundabouts and pavements within their entry and exit curves from the calculation of IRI.

(3) Also profile final riding surfaces of pavement greater than 1500 feet in continuous length for the following:

- Auxiliary lanes in Category I and II segments.
- Mainline pavement on county, state, or U.S. highway crossroads reconstructed under the contract.

(4) The engineer may direct straightedging under 415.3.10 or 450.3.2.9 for pavement excluded from localized roughness under 740.3.4.2(1), for bridges, for roundabouts, and for pavements within 150 feet of the points of curvature of roundabout intersections.

(5) Conform to the general QMP requirements under 701 and to the additional requirements specified here in 740.

740.1.2 Quality Control Program

740.1.2.1 Quality Control Plan

(1) Conform to 701.1.2.2, except omit items 3, 4 and 9; and include the following:

1. The methods and timing used for monitoring and testing ride quality throughout the placement process. Also indicate the approximate timing of acceptance testing in relation to placement operations.
2. The segment locations of each profile run used for acceptance testing.
3. A traffic control plan.

740.1.2.2 Personnel

(1) Have an HTCP-certified profiler operate the equipment, collect the required data, and analyze the results using the methods taught in the HTCP profiling course. Ensure that an HTCP-certified profiler supervises data entry into the department's MRS software.

740.1.2.3 Equipment

(1) Furnish a profile-measuring device capable of measuring IRI from the list of department-approved profilers at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/profilers.pdf

(2) Unless the engineer and contractor mutually agree otherwise, arrange to have a calibrated profiler available when paving the final riding surface.

(3) Verify profiler equipment calibration daily using test methods the profiler manufacturer recommends. Notify the engineer before verifying the calibration. If the engineer requests, arrange to have the engineer observe the calibration verification and profiler operation. Maintain records of calibration verification activities; provide those records to the engineer upon request.

740.1.2.4 Documentation

(1) After profiling, compute the segment IRI for each segment and analyze areas of localized roughness using the ProVAL software available for download at:

http://www.atwoodsystems.com/iibv2/default.cfm

(2) Prepare the ProVAL ride quality module reports showing the segment IRI for each segment and areas of localized roughness exceeding 200 in/mile on pavements that are not continuously diamond-ground or designated for continuous diamond grinding. Generate the ride quality module reports in ProVAL using the following parameters:

	FIXED INTERVAL (segment IRI)	CONTINUOUS (localized roughness)
BASE-LENGTH	500 feet	25 feet
THRESHOLD	140 in/mile	200 in/mile

(3) Field-locate the areas of localized roughness before the engineer's assessment for corrective action. Document the reasons for areas excluded.

(4) Within five business days after completing profile acceptance runs, unless the engineer and contractor mutually agree to a different timeline, upload the electronic ProVAL project file containing the .ppf files for each profiler acceptance run and ride quality module reports, as PDF files, using the MRS software available at:

http://www.atwoodsystems.com/iibv2/default.cfm

(5) Notify the engineer when MRS reporting is complete and profiler acceptance run data and ride quality module reports are uploaded into MRS.

740.2 (Vacant)

740.3 Testing

740.3.1 General

(1) Enter the equipment-specific department-approved filter settings and parameters given in the approved profilers list at:

https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/tools/qmp/profilers.pdf

740.3.2 Contractor QC Testing

(1) Operate profilers within the manufacturer's recommended speed tolerances. Perform profile runs in the direction of travel. Measure the longitudinal profile of each wheel track of each lane. The wheel tracks are 6.0 feet apart and centered in the travel lane.

Revise 740.3.2(2) to require coordination with the engineer 24 hours before making profile runs for acceptance. This change was implemented in ASP 6 effective with the December 2017 letting.

(2) Coordinate with the engineer at least 24 hours before making profile runs for acceptance, unless the engineer approves otherwise. The department may require profiling to accommodate staged construction or if corrective action is required.

(3) Field-locate the beginning and ending points for each profile run. Measure the profiles of each standard and partial segment. Define primary segments starting at a project terminus and running contiguously along the mainline to the other project terminus. When applicable, align segment limits with the sublot limits used for testing under 715. Define segments one wheel path wide and distinguished by length as follows:

1. Standard segments are 500 feet long.
2. Partial segments are less than 500 feet long.

(4) Treat partial segments as independent segments. Document profile runs conforming to 740.1.2.4; categorize segments as follows:

Segments with a posted speed limit of 55 mph or greater:

HMA I	Asphalt pavement with multiple opportunities to achieve a smooth ride. The following operations if performed under the contract are considered as opportunities: - A layer of HMA - A leveling or wedging layer of HMA - Diamond grinding or partial depth milling of the underlying pavement surface.
HMA II	Asphalt pavement with a single opportunity to achieve a smooth ride.
HMA III	Asphalt pavement segments containing any portion of a bridge, bridge approach, railroad crossing, or intersection. An intersection is the area within the points of curvature of the intersection radii.
PCC II	Concrete pavement.
PCC III	Concrete pavement segments containing any portion of a bridge, bridge approach, railroad crossing, intersection, or gap. An intersection is the area within the points of curvature of the intersection radii.
RCDG V	Rural concrete pavement surfaces the contract designates for continuous diamond grinding.

Segments with any portion having a posted speed limit less than 55 mph:

HMA IV	Asphalt pavement including intersections, bridges, approaches, and railroad crossings.
PCC IV	Concrete pavement including gaps, intersections, bridges, approaches, and railroad crossings.
UCDG V	Urban concrete pavement surfaces the contract designates for continuous diamond grinding.

(5) Notify the engineer when the profiling data has been submitted.

740.3.3 Department QV Testing

Revise 740.3.3(1) to clarify that despite program based QV, the department may test ride on any segment at any time.

(1) The department reserves the right to conduct QV testing to validate the quality of the product on any segment at any time. The department will notify the contractor before testing so the contractor can observe the QV testing.

Revise QV reporting requirements to provide more time to analyze and provide data to contractors.

(2) After completing QV profile runs, the department will review the profiling data with the contractor directly on-site and will identify any areas of immediate concern. The department will analyze the data and provide the test results to the contractor within 10 business days of testing, unless the contractor and engineer mutually agree otherwise.

(3) The engineer and contractor will jointly investigate any testing discrepancies. If the contractor does not respond to an engineer request to resolve a testing discrepancy, the engineer may suspend production until action is taken.

740.3.4 Corrective Action

740.3.4.1 General

(1) Recommend corrective action to the engineer.

(2) Before directing corrective action, the engineer will assess whether a repair will help or hurt the long-term performance. Correct the ride as the engineer directs in writing.

740.3.4.2 Corrective Action for Localized Roughness

(1) The engineer will assess each wheel path for areas of localized roughness within 5 business days of being notified that ProVAL reports are uploaded. For each area that exceeds 200 in/mile, the engineer will do one of the following:

1. Direct the contractor to correct the area to minimize the effect on the ride.
2. Leave the area of localized roughness in place with no pay reduction.
3. Assess a pay reduction for each area in each wheel path as follows:

   Length <=25 feet: (localized roughness in/mile - 200) dollars/foot or $250 whichever is least

   Length >25 feet: (localized roughness in/mile - 200) dollars/foot or 10 dollars/foot whichever is least

   The department will not reduce pay for localized roughness within HMA IV and PCC IV segments or on pavements within 25 feet of bridges, bridge approaches, or railroad crossings not constructed under the contract.

(2) Re-profile corrected areas to verify that the localized roughness is less than 140 in/mile. Upload a revised ProVAL ride quality module report for corrected areas into the MRS software.

740.3.4.3 Corrective Action for Excessive Segment IRI

(1) If an individual segment IRI exceeds 140 in/mile for HMA I, HMA II, and PCC II pavements after correction for localized roughness, the engineer may require the contractor to correct that segment's final surface as follows:

HMA I: Correct to an IRI of 60 in/mile using whichever of the following methods the engineer approves:

- Mill and replace the full lane width of the riding surface excluding the paved shoulder.
- Diamond grinding, conforming to 420.3.2 through 420.3.4 except space grooves 0.06 - 0.09 inches apart, or fine-tooth milling the full lane width of the riding surface including adjustment of the paved shoulders.

HMA II: Correct to an IRI of 85 in/mile using whichever of the following methods the engineer approves:

- Mill and replace the full lane width of the riding surface excluding the paved shoulder.
- Diamond grinding, conforming to 420.3.2 through 420.3.4 except space grooves 0.06 - 0.09 inches apart, or fine-tooth milling of the full lane width of the riding surface including adjustment of the paved shoulders.

PCC II: Correct to an IRI of 85 in/mile using whichever of the following methods the engineer approves:

- Diamond grinding, conforming to 420.3.1 through 420.3.4, of the full lane width of the riding surface including adjustment of the paved shoulders.
- Remove and replace the full lane width of the riding surface.

(2) Re-profile corrected segments to verify that the final segment IRI meets the above correction limits and there are no areas of localized roughness. Upload a revised ProVAL ride quality module report for the corrected areas into the MRS software. Segments failing these criteria after correction are nonconforming work under 105.3.

740.3.4.4 Corrective Grinding for Continuous Diamond Ground Work

(1) Do not apply localized roughness criteria to surfaces designated for continuous diamond grinding under 420 or the transitions to existing work not ground under the contract. Instead ensure that the finished ground surface does not include longitudinal surface deviations exceeding 0.3-inch in 25 feet as determined using ProVal's straightedge simulation analysis.

(2) Exclude low areas due to subsidence or other localized causes from the smoothness requirements. The engineer will review each low area and may direct the contractor to perform corrective grinding to reduce the final segment IRI for that segment.

(3) If an individual segment IRI exceeds 65 in/mile for RCDG V or 115 in/mile for UCDG V, perform corrective grinding on that segment. Re-profile corrected segments to verify the final segment IRI. Ensure that each segment has a segment IRI after corrective grinding as follows:

- Segments with a before-grinding IRI less than or equal to 200 in/mile, provide a final segment IRI that does not exceed 65 in/mile for RCDG V or 115 in/mile for UCDG V.
- Segments with a before-grinding IRI greater than 200 in/mile, provide a final segment IRI as follows:
  - Do not exceed 35 percent of the before-grinding IRI for RCDG V.
  - Do not exceed 115 in/mile or 35 percent of the before-grinding IRI, whichever is greater, for UCDG V.

(4) Submit a revised ProVAL smoothness assurance report after corrective grinding for corrected segments to validate the final segment IRI.

(5) If after performing corrective grinding, a segment contains a bump exceeding 0.3 inch in 25 feet or has a final segment IRI greater than specified, that segment is nonconforming work under 105.3.

740.4 Measurement

(1) The department will measure Incentive IRI Ride by the dollar, calculated as specified in 740.5.2.

740.5 Payment

740.5.1 General

(1) Costs for furnishing and operating the profiler, documenting profile results, and correcting the final surface are incidental to the contract. The department will pay separately for engineer-directed corrective action performed within areas excluded under item 3 of 740.3.4.2(1) as extra work.

740.5.2 Pay Adjustment

(1) The department will pay incentive for ride under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
740.0440	Incentive IRI Ride	DOL

(2) Incentive payment may be more or less than the amount the schedule of items shows.

(3) The department will administer disincentives for ride under the Disincentive IRI Ride administrative item.

(4) The department will not assess disincentives on HMA III or PCC III segments. Incentive pay for HMA III and PCC III segments will be based on the category of the adjoining segments.

(5) The department will adjust pay as follows:

- For work placed under the contract: Based on the initial segment IRI for that segment. If corrective action for excessive segment IRI is required, the department will base disincentives on the segment IRI after correction is performed according to 740.3.4.3.
- For continuous diamond grinding of existing concrete: Based on the final segment IRI as specified in 420.3.5.

(6) The department will adjust pay for 500-foot long standard segments nominally one wheel path wide using equation "ride 2.01" as follows:

	Initial IRI (in/mile)	Pay Adjustment (dollars/500 feet)
For HMA I Pavement:	< 30	250
	>= 30 to <35	1750 - (50 x IRI)
	>= 35 to < 60	0
	>= 60 to < 75	1000 - (50/3 x IRI)[1]
	>= 75	-250[1]
For HMA II and PCC II Pavement:	Initial IRI (in/mile)	Pay Adjustment (dollars/500 feet)
	< 50	250
	>= 50 to < 55	2750 - (50 x IRI)
	>= 55 to < 85	0

>= 85 to < 100	(4250/3) - (50/3 x IRI)[1]
>= 100	-250[1]

[1] The department will not assess a ride disincentive for HMA pavement placed in cold weather because of a department-caused delay as specified in 450.5(5).

For HMA IV and PCC IV Pavement:	Initial IRI (in/mile)	Pay Adjustment (dollars/500 feet)
	< 35	250
	>= 35 to < 45	1125 - (25xIRI)
	>= 45	0
For RCDG V Pavement:	Final IRI (in/mile)	Pay Adjustment (dollars/500 feet)
	< 45	125
	>= 45 to < 55	687.5 - (12.5 x IRI)
	>= 55	0
For UCDG V Pavement:	Final IRI (in/mile)	Pay Adjustment (dollars/500 feet)
	< 50	125
	>= 50 to < 75	375 - (5 x IRI)
	>= 75	0

(7) The department will prorate the pay adjustment for non-standard segments based on their length.

Bid Items

Part 1 Bid Items

108.4300	RBC Progress Schedule	EACH
108.4400	CPM Progress Schedule	EACH

Part 2 Bid Items

201.0105	Clearing	STA
201.0110	Clearing	SY
201.0115	Clearing	ACRE
201.0120	Clearing	ID
201.0205	Grubbing	STA
201.0210	Grubbing	SY
201.0215	Grubbing	ACRE
201.0220	Grubbing	ID
202.0105	Roadside Clearing	STA
202.0110	Roadside Clearing	SY
202.0115	Roadside Clearing	ACRE
203.0100	Removing Small Pipe Culverts	EACH
203.0200	Removing Old Structure (station)	LS
204.0100	Removing Pavement	SY
204.0105	Removing Pavement Butt Joints	SY
204.0110	Removing Asphaltic Surface	SY
204.0115	Removing Asphaltic Surface Butt Joints	SY
204.0120	Removing Asphaltic Surface Milling	SY
204.0125	Removing Asphaltic Surface Milling	TON
204.0130	Removing Curb	LF
204.0140	Removing Gutter	LF
204.0150	Removing Curb & Gutter	LF
204.0155	Removing Concrete Sidewalk	SY
204.0157	Removing Concrete Barrier	LF
204.0160	Removing Lip Curb	LF
204.0165	Removing Guardrail	LF
204.0170	Removing Fence	LF
204.0175	Removing Concrete Slope Paving	SY
204.0180	Removing Delineators and Markers	EACH
204.0185	Removing Masonry	CY
204.0190	Removing Surface Drains	EACH
204.0195	Removing Concrete Bases	EACH
204.0200	Removing Railroad Track	LF
204.0205	Removing Utility Poles	EACH
204.0210	Removing Manholes	EACH
204.0215	Removing Catch Basins	EACH
204.0220	Removing Inlets	EACH
204.0225	Removing Septic Tanks	EACH
204.0230	Removing Building (station)	LS
204.0235	Removing Buildings (parcel)	LS
204.0240	Site Clearance (parcel)	LS
204.0245	Removing Storm Sewer (size)	LF
204.0250	Abandoning Manholes	EACH
204.0255	Abandoning Catch Basins	EACH
204.0260	Abandoning Inlets	EACH
204.0265	Abandoning Wells	EACH
204.0270	Abandoning Culvert Pipes	EACH

Bid Items

204.0275	Closing Culvert Pipes	EACH
204.0280	Sealing Pipes	EACH
205.0100	Excavation Common	CY
205.0200	Excavation Rock	CY
205.0300	Excavation Stone Piles and Stone Fences	CY
205.0400	Excavation Marsh	CY
205.1300	Presplitting Rock	LF
206.1000	Excavation for Structures Bridges (structure)	LS
206.2000	Excavation for Structures Culverts (structure)	LS
206.3000	Excavation for Structures Retaining Walls (structure)	LS
206.4000	Excavation for Structures Structural Plate Pipe or Pipe Arches (station)	LS
206.5000	Cofferdams (structure)	LS
208.0100	Borrow	CY
208.1100	Select Borrow	CY
209.1100	Backfill Granular Grade 1	CY
209.1500	Backfill Granular Grade 1	TON
209.2100	Backfill Granular Grade 2	CY
209.2500	Backfill Granular Grade 2	TON
210.1100	Backfill Structure Type A	CY
210.1500	Backfill Structure Type A	TON
210.2100	Backfill Structure Type B	CY
210.2500	Backfill Structure Type B	TON
211.0100	Prepare Foundation for Asphaltic Paving (project)	LS
211.0200	Prepare Foundation for Concrete Pavement (project)	LS
211.0300	Prepare Foundation for Concrete Base (project)	LS
211.0400	Prepare Foundation for Asphaltic Shoulders	STA
211.0500	Prepare Foundation for Base Aggregate	STA
213.0100	Finishing Roadway (project)	EACH
214.0100	Obliterating Old Road	STA

Part 3 Bid Items

305.0110	Base Aggregate Dense 3/4-Inch	TON
305.0115	Base Aggregate Dense 3/4-Inch	CY
305.0120	Base Aggregate Dense 1 1/4-Inch	TON
305.0125	Base Aggregate Dense 1 1/4-Inch	CY
305.0130	Base Aggregate Dense 3-Inch	TON
305.0135	Base Aggregate Dense 3-Inch	CY
305.0410	Aggregate Detours	TON
305.0415	Aggregate Detours	CY
305.0500	Shaping Shoulders	STA
310.0110	Base Aggregate Open-Graded	TON
310.0115	Base Aggregate Open-Graded	CY
311.0110	Breaker Run	TON
311.0115	Breaker Run	CY
312.0110	Select Crushed Material	TON
312.0115	Select Crushed Material	CY
313.0110	Pit Run	TON
313.0115	Pit Run	CY
315.0100	Asphaltic Base	TON
315.0200	Asphaltic Base Widening	TON
320.0105	Concrete Base 4-Inch	SY
320.0110	Concrete Base 4 1/2-Inch	SY
320.0115	Concrete Base 5-Inch	SY
320.0120	Concrete Base 5 1/2-Inch	SY
320.0125	Concrete Base 6-Inch	SY

Bid Items

320.0130	Concrete Base 6 1/2-Inch	SY
320.0135	Concrete Base 7-Inch	SY
320.0140	Concrete Base 7 1/2-Inch	SY
320.0145	Concrete Base 8-Inch	SY
320.0150	Concrete Base 8 1/2-Inch	SY
320.0155	Concrete Base 9-Inch	SY
320.0160	Concrete Base 9 1/2-Inch	SY
320.0165	Concrete Base 10-Inch	SY
320.0170	Concrete Base 10 1/2-Inch	SY
320.0305	Concrete Base HES 4-Inch	SY
320.0310	Concrete Base HES 4 1/2-Inch	SY
320.0315	Concrete Base HES 5-Inch	SY
320.0320	Concrete Base HES 5 1/2-Inch	SY
320.0325	Concrete Base HES 6-Inch	SY
320.0330	Concrete Base HES 6 1/2-Inch	SY
320.0335	Concrete Base HES 7-Inch	SY
320.0340	Concrete Base HES 7 1/2-Inch	SY
320.0345	Concrete Base HES 8-Inch	SY
320.0350	Concrete Base HES 8 1/2-Inch	SY
320.0355	Concrete Base HES 9-Inch	SY
320.0360	Concrete Base HES 9 1/2-Inch	SY
320.0365	Concrete Base HES 10-Inch	SY
320.0370	Concrete Base HES 10 1/2-Inch	SY
325.0100	Pulverize and Relay	SY
330.0100	Mill and Relay	SY
335.0100	Rubblizing	SY
340.0100	Cracking and Seating	SY
350.0102	Subbase	CY
350.0104	Subbase	TON
350.0115	Subbase 6-Inch	SY
350.0120	Subbase 7-Inch	SY
350.0125	Subbase 8-Inch	SY
350.0130	Subbase 9-Inch	SY
350.0135	Subbase 10-Inch	SY
350.0140	Subbase 11-Inch	SY
350.0145	Subbase 12-Inch	SY
390.0103	Base Patching	SY
390.0201	Base Patching Asphaltic	TON
390.0203	Base Patching Asphaltic	SY
390.0303	Base Patching Concrete	SY
390.0403	Base Patching Concrete SHES	SY

Part 4 Bid Items

405.0100	Coloring Concrete WisDOT Red	CY
405.0200	Coloring Concrete Custom	CY
405.1000	Stamping Colored Concrete	CY
415.0060	Concrete Pavement 6-Inch	SY
415.0065	Concrete Pavement 6 1/2-Inch	SY
415.0070	Concrete Pavement 7-Inch	SY
415.0075	Concrete Pavement 7 1/2-Inch	SY
415.0080	Concrete Pavement 8-Inch	SY
415.0085	Concrete Pavement 8 1/2-Inch	SY
415.0090	Concrete Pavement 9-Inch	SY
415.0095	Concrete Pavement 9 1/2-Inch	SY
415.0100	Concrete Pavement 10-Inch	SY

415.0105	Concrete Pavement 10 1/2-Inch	SY
415.0110	Concrete Pavement 11-Inch	SY
415.0115	Concrete Pavement 11 1/2-Inch	SY
415.0120	Concrete Pavement 12-Inch	SY
415.0125	Concrete Pavement 12 1/2-Inch	SY
415.0130	Concrete Pavement 13-Inch	SY
415.0135	Concrete Pavement 13 1/2-Inch	SY
415.0210	Concrete Pavement Gaps	Each
415.0310	Concrete Alley	SY
415.0410	Concrete Pavement Approach Slab	SY
415.1080	Concrete Pavement HES 8-Inch	SY
415.1085	Concrete Pavement HES 8 1/2-Inch	SY
415.1090	Concrete Pavement HES 9-Inch	SY
415.1095	Concrete Pavement HES 9 1/2-Inch	SY
415.1100	Concrete Pavement HES 10-Inch	SY
415.1105	Concrete Pavement HES 10 1/2-Inch	SY
415.1110	Concrete Pavement HES 11-Inch	SY
415.1115	Concrete Pavement HES 11 1/2-Inch	SY
415.1120	Concrete Pavement HES 12-Inch	SY
415.1125	Concrete Pavement HES 12 1/2-Inch	SY
415.1130	Concrete Pavement HES 13-Inch	SY
415.1135	Concrete Pavement HES 13 1/2-Inch	SY
415.1310	Concrete Alley HES	SY
415.1410	Concrete Pavement Approach Slab HES	SY
415.4100	Concrete Pavement Joint Filling	SY
416.0160	Concrete Driveway 6-Inch	SY
416.0170	Concrete Driveway 7-Inch	SY
416.0180	Concrete Driveway 8-Inch	SY
416.0190	Concrete Driveway 9-Inch	SY
416.0260	Concrete Driveway HES 6-Inch	SY
416.0270	Concrete Driveway HES 7-Inch	SY
416.0280	Concrete Driveway HES 8-Inch	SY
416.0290	Concrete Driveway HES 9-Inch	SY
416.0512	Concrete Truck Apron 12-Inch	SY
416.0610	Drilled Tie Bars	EACH
416.0620	Drilled Dowel Bars	EACH
416.1010	Concrete Surface Drains	CY
416.1015	Concrete Surface Drains HES	CY
416.1110	Concrete Shoulder Rumble Strips	LF
416.1180	Concrete Intersection Rumble Strips	SY
416.1710	Concrete Pavement Repair	SY
416.1715	Concrete Pavement Repair SHES	SY
416.1720	Concrete Pavement Replacement	SY
416.1725	Concrete Pavement Replacement SHES	SY
420.1000	Continuous Diamond Grinding Concrete Pavement	SY

Move IRI ride incentive items to 740.

450.4000	HMA Cold Weather Paving	TON
455.0500	Asphaltic Material Seal Coat	TON
455.0505	Asphaltic Material Seal Coat	GAL
455.0600	Tack Coat	TON
455.0605	Tack Coat	GAL
460.2000	Incentive Density HMA Pavement	DOL
460.5223	HMA Pavement 3 LT 58-28 S	TON
460.5224	HMA Pavement 4 LT 58-28 S	TON

460.5225	HMA Pavement 5 LT 58-28 S	TON
460.5243	HMA Pavement 3 LT 58-34 S	TON
460.5244	HMA Pavement 4 LT 58-34 S	TON
460.5245	HMA Pavement 5 LT 58-34 S	TON
460.5424	HMA Pavement 4 LT 58-28 H	TON
460.5444	HMA Pavement 4 LT 58-34 H	TON
460.6222	HMA Pavement 2 MT 58-28 S	TON
460.6223	HMA Pavement 3 MT 58-28 S	TON
460.6224	HMA Pavement 4 MT 58-28 S	TON
460.6225	HMA Pavement 5 MT 58-28 S	TON
460.6242	HMA Pavement 2 MT 58-34 S	TON
460.6243	HMA Pavement 3 MT 58-34 S	TON
460.6443	HMA Pavement 3 MT 58-34 H	TON
460.6244	HMA Pavement 4 MT 58-34 S	TON
460.6245	HMA Pavement 5 MT 58-34 S	TON
460.6424	HMA Pavement 4 MT 58-28 H	TON
460.6425	HMA Pavement 5 MT 58-28 H	TON
460.6444	HMA Pavement 4 MT 58-34 H	TON
460.6445	HMA Pavement 5 MT 58-34 H	TON
460.7222	HMA Pavement 2 HT 58-28 S	TON
460.7223	HMA Pavement 3 HT 58-28 S	TON
460.7224	HMA Pavement 4 HT 58-28 S	TON
460.7225	HMA Pavement 5 HT 58-28 S	TON
460.7242	HMA Pavement 2 HT 58-34 S	TON
460.7243	HMA Pavement 3 HT 58-34 S	TON
460.7244	HMA Pavement 4 HT 58-34 S	TON
460.7245	HMA Pavement 5 HT 58-34 S	TON
460.7422	HMA Pavement 2 HT 58-28 H	TON
460.7423	HMA Pavement 3 HT 58-28 H	TON
460.7424	HMA Pavement 4 HT 58-28 H	TON
460.7425	HMA Pavement 5 HT 58-28 H	TON
460.7442	HMA Pavement 2 HT 58-34 H	TON
460.7443	HMA Pavement 3 HT 58-34 H	TON
460.7444	HMA Pavement 4 HT 58-34 H	TON
460.7445	HMA Pavement 5 HT 58-34 H	TON
460.7624	HMA Pavement 4 HT 58-28 V	TON
460.7625	HMA Pavement 5 HT 58-28 V	TON
460.7644	HMA Pavement 4 HT 58-34 V	TON
460.7645	HMA Pavement 5 HT 58-34 V	TON
460.8424	HMA Pavement 4 SMA 58-28 H	TON
460.8425	HMA Pavement 5 SMA 58-28 H	TON
460.8444	HMA Pavement 4 SMA 58-34 H	TON
460.8445	HMA Pavement 5 SMA 58-34 H	TON
460.8624	HMA Pavement 4 SMA 58-28 V	TON
460.8625	HMA Pavement 5 SMA 58-28 V	TON
460.8644	HMA Pavement 4 SMA 58-34 V	TON
460.8645	HMA Pavement 5 SMA 58-34 V	TON
465.0105	Asphaltic Surface	TON
465.0110	Asphaltic Surface Patching	TON
465.0115	Asphaltic Surface Detours	TON
465.0120	Asphaltic Surface Driveways and Field Entrances	TON
465.0125	Asphaltic Surface Temporary	TON
465.0305	Asphaltic Surface Safety Islands	TON
465.0310	Asphaltic Curb	LF

Bid Items

465.0315	Asphaltic Flumes	SY
465.0400	Asphaltic Shoulder Rumble Strips	LF
465.0425	Asphaltic Shoulder Rumble Strips 2-Lane Rural	LF
465.0450	Asphaltic Intersection Rumble Strips	SY
465.0475	Asphaltic Centerline Rumble Strips 2-Lane Rural	LF
475.0100	Seal Coat	CY
475.0105	Seal Coat	TON

Part 5 Bid Items

502.0100	Concrete Masonry Bridges	CY
502.0200	Concrete Masonry Bridges HES	CY
502.1100	Concrete Masonry Seal	CY
502.2000	Compression Joint Sealer Preformed Elastomeric (width)	LF
502.3100	Expansion Device (structure)	LS
502.3200	Protective Surface Treatment	SY
502.3210	Pigmented Surface Sealer	SY
502.4104	Adhesive Anchors 1/2-Inch	EACH
502.4105	Adhesive Anchors 5/8-Inch	EACH
502.4106	Adhesive Anchors 3/4-Inch	EACH
502.4107	Adhesive Anchors 7/8-Inch	EACH
502.4108	Adhesive Anchors 1-Inch	EACH
502.4109	Adhesive Anchors 1 1/8-Inch	EACH
502.4110	Adhesive Anchors 1 1/4-Inch	EACH
502.4111	Adhesive Anchors 1 3/8-Inch	EACH
502.4112	Adhesive Anchors 1 1/2-Inch	EACH
502.4204	Adhesive Anchors No. 4 Bar	EACH
502.4205	Adhesive Anchors No. 5 Bar	EACH
502.4206	Adhesive Anchors No. 6 Bar	EACH
502.4207	Adhesive Anchors No. 7 Bar	EACH
502.4208	Adhesive Anchors No. 8 Bar	EACH
502.4209	Adhesive Anchors No. 9 Bar	EACH
502.4210	Adhesive Anchors No. 10 Bar	EACH
502.6500	Protective Coating Clear	GAL
503.0128	Prestressed Girder Type I 28-Inch	LF
503.0136	Prestressed Girder Type I 36-Inch	LF
503.0137	Prestressed Girder Type I 36W-Inch	LF
503.0145	Prestressed Girder Type I 45-Inch	LF
503.0146	Prestressed Girder Type I 45W-Inch	LF
503.0154	Prestressed Girder Type I 54-Inch	LF
503.0155	Prestressed Girder Type I 54W-Inch	LF
503.0170	Prestressed Girder Type I 70-Inch	LF
503.0172	Prestressed Girder Type I 72W-Inch	LF
503.0182	Prestressed Girder Type I 82W-Inch	LF
504.0100	Concrete Masonry Culverts	CY
504.0200	Concrete Masonry Culverts HES	CY
504.0500	Concrete Masonry Retaining Walls	CY
504.0600	Concrete Masonry Retaining Walls HES	CY
504.0900	Concrete Masonry Endwalls	CY
505.0100	Bar Steel Reinforcement Structures	LB
505.0400	Bar Steel Reinforcement HS Structures	LB
505.0600	Bar Steel Reinforcement HS Coated Structures	LB
505.0904	Bar Couplers No. 4	EACH
505.0905	Bar Couplers No. 5	EACH
505.0906	Bar Couplers No. 6	EACH
505.0907	Bar Couplers No. 7	EACH

Bid Items

505.0908	Bar Couplers No. 8	EACH
505.0909	Bar Couplers No. 9	EACH
505.0910	Bar Couplers No. 10	EACH
505.0911	Bar Couplers No. 11	EACH
506.0105	Structural Steel Carbon	LB
506.0605	Structural Steel HS	LB
506.1005	Castings Steel	LB
506.1010	Castings Bronze	LB
506.1105	Forgings Steel Carbon	LB
506.1405	Lubricated Plates Bronze	LB
506.1505	Sheet Copper	LB
506.1510	Sheet Zinc	LB
506.2605	Bearing Pads Elastomeric Non-Laminated	EACH
506.2610	Bearing Pads Elastomeric Laminated	EACH
506.3003	Welded Stud Shear Connectors 5/8x4-Inch	EACH
506.3004	Welded Stud Shear Connectors 3/4x4-Inch	EACH
506.3005	Welded Stud Shear Connectors 7/8x4-Inch	EACH
506.3008	Welded Stud Shear Connectors 5/8x5-Inch	EACH
506.3009	Welded Stud Shear Connectors 3/4x5-Inch	EACH
506.3010	Welded Stud Shear Connectors 7/8x5-Inch	EACH
506.3013	Welded Stud Shear Connectors 5/8x6-Inch	EACH
506.3014	Welded Stud Shear Connectors 3/4x6-Inch	EACH
506.3015	Welded Stud Shear Connectors 7/8x6-Inch	EACH
506.3018	Welded Stud Shear Connectors 5/8x7-Inch	EACH
506.3019	Welded Stud Shear Connectors 3/4x7-Inch	EACH
506.3020	Welded Stud Shear Connectors 7/8x7-Inch	EACH
506.3023	Welded Stud Shear Connectors 5/8x8-Inch	EACH
506.3024	Welded Stud Shear Connectors 3/4x8-Inch	EACH
506.3025	Welded Stud Shear Connectors 7/8x8-Inch	EACH
506.3030	Welded Stud Shear Connectors 7/8X9-Inch	EACH
506.3035	Welded Stud Shear Connectors 7/8X10-Inch	EACH
506.4000	Steel Diaphragms (structure)	EACH
506.5000	Bearing Assemblies Fixed (structure)	EACH
506.6000	Bearing Assemblies Expansion (structure)	EACH
507.0200	Treated Lumber and Timber	MBM
509.0200	Preparation Approaches	SY
509.0301	Preparation Decks Type 1	SY
509.0302	Preparation Decks Type 2	SY
509.0500	Cleaning Decks	SY
509.0600	Cleaning Approaches	SY
509.1000	Joint Repair	SY
509.1200	Curb Repair	LF
509.1500	Concrete Surface Repair	SF
509.2000	Full-Depth Deck Repair	SY
509.2500	Concrete Masonry Overlay Decks	CY
509.2600	Concrete Masonry Overlay Approaches	CY
511.1100	Temporary Shoring	SF
511.1200	Temporary Shoring (structure)	SF
511.1300	Temporary Shoring (location)	SF
511.2200	Temporary Shoring Left In Place (structure)	SF
511.2300	Temporary Shoring Left In Place (location)	SF
512.0500	Piling Steel Sheet Permanent Delivered	SF
512.0600	Piling Steel Sheet Permanent Driven	SF
512.1000	Piling Steel Sheet Temporary	SF

Bid Items

Eliminate the structure number requirement from the LF railing bid items.

513.2001	Railing Pipe	LF
513.4051	Railing Tubular Type F	LF
513.4056	Railing Tubular Type H	LF
513.4061	Railing Tubular Type M	LF
513.4066	Railing Tubular Type PF	LF
513.4091	Railing Tubular Screening	LF
513.7006	Railing Steel Type C1	LF
513.7011	Railing Steel Type C2	LF
513.7016	Railing Steel Type C3	LF
513.7021	Railing Steel Type C4	LF
513.7026	Railing Steel Type C5	LF
513.7031	Railing Steel Type C6	LF
513.7051	Railing Steel Type W	LF
513.7083	Railing Steel Type NY3	LF
513.7084	Railing Steel Type NY4	LF

Add a bid item for Type 3T steel railing for bridges.

513.7093	Railing Steel Type 3T	LF
513.8006	Railing Steel Pedestrian Type C1	LF
513.8011	Railing Steel Pedestrian Type C2	LF
513.8016	Railing Steel Pedestrian Type C3	LF
513.8021	Railing Steel Pedestrian Type C4	LF
513.8026	Railing Steel Pedestrian Type C5	LF
513.8031	Railing Steel Pedestrian Type C6	LF
514.0445	Floor Drains Type GC	EACH
514.0450	Floor Drains Type WF	EACH
514.0460	Floor Drains Type H	EACH
514.0900	Adjusting Floor Drains	EACH
514.1000	Railroad Deck Drain System (railroad structure)	LS
514.2608	Downspout 8-Inch	LF
514.2625	Downspout 6-Inch	LF
515.4000	Steel Grid Floor Open (inch)	SF
515.5000	Steel Grid Floor Concrete Filled (inch)	SF
516.0100	Dampproofing	SY
516.0500	Rubberized Membrane Waterproofing	SY
517.0600	Painting Epoxy System (structure)	LS
517.1000	Painting Epoxy System Steel Truss (structure)	LS
520.1012	Apron Endwalls for Culvert Pipe 12-Inch	EACH
520.1015	Apron Endwalls for Culvert Pipe 15-Inch	EACH
520.1018	Apron Endwalls for Culvert Pipe 18-Inch	EACH
520.1021	Apron Endwalls for Culvert Pipe 21-Inch	EACH
520.1024	Apron Endwalls for Culvert Pipe 24-Inch	EACH
520.1030	Apron Endwalls for Culvert Pipe 30-Inch	EACH
520.1036	Apron Endwalls for Culvert Pipe 36-Inch	EACH
520.1042	Apron Endwalls for Culvert Pipe 42-Inch	EACH
520.1048	Apron Endwalls for Culvert Pipe 48-Inch	EACH
520.1054	Apron Endwalls for Culvert Pipe 54-Inch	EACH
520.1060	Apron Endwalls for Culvert Pipe 60-Inch	EACH
520.1072	Apron Endwalls for Culvert Pipe 72-Inch	EACH
520.1084	Apron Endwalls for Culvert Pipe 84-Inch	EACH
520.2012	Culvert Pipe Temporary 12-Inch	LF
520.2015	Culvert Pipe Temporary 15-Inch	LF
520.2018	Culvert Pipe Temporary 18-Inch	LF
520.2021	Culvert Pipe Temporary 21-Inch	LF

Bid Items

520.2024	Culvert Pipe Temporary 24-Inch	LF
520.2030	Culvert Pipe Temporary 30-Inch	LF
520.2036	Culvert Pipe Temporary 36-Inch	LF
520.2042	Culvert Pipe Temporary 42-Inch	LF
520.2048	Culvert Pipe Temporary 48-Inch	LF
520.2054	Culvert Pipe Temporary 54-Inch	LF
520.2060	Culvert Pipe Temporary 60-Inch	LF
520.2072	Culvert Pipe Temporary 72-Inch	LF
520.2084	Culvert Pipe Temporary 84-Inch	LF
520.3142	Culvert Pipe Class III 42-Inch	LF
520.3148	Culvert Pipe Class III 48-Inch	LF
520.3154	Culvert Pipe Class III 54-Inch	LF
520.3160	Culvert Pipe Class III 60-Inch	LF
520.3172	Culvert Pipe Class III 72-Inch	LF
520.3184	Culvert Pipe Class III 84-Inch	LF
520.3312	Culvert Pipe Class III-A 12-Inch	LF
520.3315	Culvert Pipe Class III-A 15-Inch	LF
520.3318	Culvert Pipe Class III-A 18-Inch	LF
520.3321	Culvert Pipe Class III-A 21-Inch	LF
520.3324	Culvert Pipe Class III-A 24-Inch	LF
520.3327	Culvert Pipe Class III-A 27-Inch	LF
520.3330	Culvert Pipe Class III-A 30-Inch	LF
520.3336	Culvert Pipe Class III-A 36-Inch	LF
520.3412	Culvert Pipe Class III-A Non-metal 12-Inch	LF
520.3415	Culvert Pipe Class III-A Non-metal 15-Inch	LF
520.3418	Culvert Pipe Class III-A Non-metal 18-Inch	LF
520.3421	Culvert Pipe Class III-A Non-metal 21-Inch	LF
520.3424	Culvert Pipe Class III-A Non-metal 24-Inch	LF
520.3427	Culvert Pipe Class III-A Non-metal 27-Inch	LF
520.3430	Culvert Pipe Class III-A Non-metal 30-Inch	LF
520.3436	Culvert Pipe Class III-A Non-metal 36-Inch	LF
520.3512	Culvert Pipe Class III-B 12-Inch	LF
520.3515	Culvert Pipe Class III-B 15-Inch	LF
520.3518	Culvert Pipe Class III-B 18-Inch	LF
520.3521	Culvert Pipe Class III-B 21-Inch	LF
520.3524	Culvert Pipe Class III-B 24-Inch	LF
520.3527	Culvert Pipe Class III-B 27-Inch	LF
520.3530	Culvert Pipe Class III-B 30-Inch	LF
520.3536	Culvert Pipe Class III-B 36-Inch	LF
520.3612	Culvert Pipe Class III-B Non-metal 12-Inch	LF
520.3615	Culvert Pipe Class III-B Non-metal 15-Inch	LF
520.3618	Culvert Pipe Class III-B Non-metal 18-Inch	LF
520.3621	Culvert Pipe Class III-B Non-metal 21-Inch	LF
520.3624	Culvert Pipe Class III-B Non-metal 24-Inch	LF
520.3627	Culvert Pipe Class III-B Non-metal 27-Inch	LF
520.3630	Culvert Pipe Class III-B Non-metal 30-Inch	LF
520.3636	Culvert Pipe Class III-B Non-metal 36-Inch	LF
520.4112	Culvert Pipe Class IV 12-Inch	LF
520.4115	Culvert Pipe Class IV 15-Inch	LF
520.4118	Culvert Pipe Class IV 18-Inch	LF
520.4121	Culvert Pipe Class IV 21-Inch	LF
520.4124	Culvert Pipe Class IV 24-Inch	LF
520.4130	Culvert Pipe Class IV 30-Inch	LF
520.4136	Culvert Pipe Class IV 36-Inch	LF

520.4142	Culvert Pipe Class IV 42-Inch	LF
520.4148	Culvert Pipe Class IV 48-Inch	LF
520.4154	Culvert Pipe Class IV 54-Inch	LF
520.4160	Culvert Pipe Class IV 60-Inch	LF
520.4172	Culvert Pipe Class IV 72-Inch	LF
520.4184	Culvert Pipe Class IV 84-Inch	LF
520.5112	Culvert Pipe Class V 12-Inch	LF
520.5115	Culvert Pipe Class V 15-Inch	LF
520.5118	Culvert Pipe Class V 18-Inch	LF
520.5121	Culvert Pipe Class V 21-Inch	LF
520.5124	Culvert Pipe Class V 24-Inch	LF
520.5130	Culvert Pipe Class V 30-Inch	LF
520.5136	Culvert Pipe Class V 36-Inch	LF
520.5142	Culvert Pipe Class V 42-Inch	LF
520.5148	Culvert Pipe Class V 48-Inch	LF
520.5154	Culvert Pipe Class V 54-Inch	LF
520.5160	Culvert Pipe Class V 60-Inch	LF
520.5172	Culvert Pipe Class V 72-Inch	LF
520.5184	Culvert Pipe Class V 84-Inch	LF
520.8000	Concrete Collars for Pipe	EACH
520.8500	Pipe Cattle Pass	LF
520.8700	Cleaning Culvert Pipes	EACH
521.0336	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 36-Inch 4 to 1	EACH
521.0342	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 42-Inch 4 to 1	EACH
521.0348	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 48-Inch 4 to 1	EACH
521.0354	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 54-Inch 4 to 1	EACH
521.0360	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 60-Inch 4 to 1	EACH
521.0436	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 36-Inch 6 to 1	EACH
521.0442	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 42-Inch 6 to 1	EACH
521.0448	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 48-Inch 6 to 1	EACH
521.0454	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 54-Inch 6 to 1	EACH
521.0460	Apron Endwalls for Culvert Pipe Sloped Cross Drains Steel 60-Inch 6 to 1	EACH
521.0535	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 35x24-Inch 4 to 1	EACH
521.0542	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 42x29-Inch 4 to 1	EACH
521.0549	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 49x33-Inch 4 to 1	EACH
521.0557	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 57x38-Inch 4 to 1	EACH
521.0564	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 64x43-Inch 4 to 1	EACH
521.0571	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 71x47-Inch 4 to 1	EACH
521.0635	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 35x24-Inch 6 to 1	EACH
521.0642	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 42x29-Inch 6 to 1	EACH
521.0649	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 49x33-Inch 6 to 1	EACH
521.0657	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 57x38-Inch 6 to 1	EACH
521.0664	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 64x43-Inch 6 to 1	EACH
521.0671	Apron Endwalls for Pipe Arch Sloped Cross Drains Steel 71x47-Inch 6 to 1	EACH
521.1012	Apron Endwalls for Culvert Pipe Steel 12-Inch	EACH
521.1015	Apron Endwalls for Culvert Pipe Steel 15-Inch	EACH
521.1018	Apron Endwalls for Culvert Pipe Steel 18-Inch	EACH
521.1021	Apron Endwalls for Culvert Pipe Steel 21-Inch	EACH
521.1024	Apron Endwalls for Culvert Pipe Steel 24-Inch	EACH
521.1030	Apron Endwalls for Culvert Pipe Steel 30-Inch	EACH
521.1036	Apron Endwalls for Culvert Pipe Steel 36-Inch	EACH
521.1042	Apron Endwalls for Culvert Pipe Steel 42-Inch	EACH
521.1048	Apron Endwalls for Culvert Pipe Steel 48-Inch	EACH
521.1054	Apron Endwalls for Culvert Pipe Steel 54-Inch	EACH

Bid Items

521.1060	Apron Endwalls for Culvert Pipe Steel 60-Inch	EACH
521.1072	Apron Endwalls for Culvert Pipe Steel 72-Inch	EACH
521.1084	Apron Endwalls for Culvert Pipe Steel 84-Inch	EACH
521.1217	Apron Endwalls for Pipe Arch Steel 17x13-Inch	EACH
521.1221	Apron Endwalls for Pipe Arch Steel 21x15-Inch	EACH
521.1224	Apron Endwalls for Pipe Arch Steel 24x18-Inch	EACH
521.1228	Apron Endwalls for Pipe Arch Steel 28x20-Inch	EACH
521.1235	Apron Endwalls for Pipe Arch Steel 35x24-Inch	EACH
521.1242	Apron Endwalls for Pipe Arch Steel 42x29-Inch	EACH
521.1249	Apron Endwalls for Pipe Arch Steel 49x33-Inch	EACH
521.1257	Apron Endwalls for Pipe Arch Steel 57x38-Inch	EACH
521.1264	Apron Endwalls for Pipe Arch Steel 64x43-Inch	EACH
521.1271	Apron Endwalls for Pipe Arch Steel 71x47-Inch	EACH
521.1277	Apron Endwalls for Pipe Arch Steel 77x52-Inch	EACH
521.1283	Apron Endwalls for Pipe Arch Steel 83x57-Inch	EACH
521.1502	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 15-Inch 4 to 1	EACH
521.1503	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 18-Inch 4 to 1	EACH
521.1504	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 21-Inch 4 to 1	EACH
521.1505	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 24-Inch 4 to 1	EACH
521.1506	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 30-Inch 4 to 1	EACH
521.1507	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 36-Inch 4 to 1	EACH
521.1508	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 42-Inch 4 to 1	EACH
521.1509	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 48-Inch 4 to 1	EACH
521.1510	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 54-Inch 4 to 1	EACH
521.1511	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 60-Inch 4 to 1	EACH
521.1515	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 15-Inch 6 to 1	EACH
521.1518	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 18-Inch 6 to 1	EACH
521.1521	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 21-Inch 6 to 1	EACH
521.1524	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 24-Inch 6 to 1	EACH
521.1530	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 30-Inch 6 to 1	EACH
521.1536	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 36-Inch 6 to 1	EACH
521.1542	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 42-Inch 6 to 1	EACH
521.1548	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 48-Inch 6 to 1	EACH
521.1554	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 54-Inch 6 to 1	EACH
521.1560	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 60-Inch 6 to 1	EACH
521.1615	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 15-Inch 10 to 1	EACH
521.1618	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 18-Inch 10 to 1	EACH
521.1621	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 21-Inch 10 to 1	EACH
521.1624	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 24-Inch 10 to 1	EACH
521.1630	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 30-Inch 10 to 1	EACH
521.1636	Apron Endwalls for Culvert Pipe Sloped Side Drains Steel 36-Inch 10 to 1	EACH
521.1704	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 17x13-Inch 4 to 1	EACH
521.1705	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 21x15-Inch 4 to 1	EACH
521.1706	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 24x18-Inch 4 to 1	EACH
521.1707	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 28x20-Inch 4 to 1	EACH
521.1708	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 35x24-Inch 4 to 1	EACH
521.1709	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 42x29-Inch 4 to 1	EACH
521.1710	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 49x33-Inch 4 to 1	EACH
521.1711	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 57x38-Inch 4 to 1	EACH
521.1712	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 64x43-Inch 4 to 1	EACH
521.1717	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 17x13-Inch 6 to 1	EACH
521.1721	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 21x15-Inch 6 to 1	EACH
521.1724	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 24x18-Inch 6 to 1	EACH
521.1728	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 28x20-Inch 6 to 1	EACH

Bid Items

521.1735	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 35x24-Inch 6 to 1	EACH
521.1742	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 42x29-Inch 6 to 1	EACH
521.1749	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 49x33-Inch 6 to 1	EACH
521.1757	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 57x38-Inch 6 to 1	EACH
521.1764	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 64x43-Inch 6 to 1	EACH
521.1817	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 17x13-Inch 10 to 1	EACH
521.1821	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 21x15-Inch 10 to 1	EACH
521.1824	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 24x18-Inch 10 to 1	EACH
521.1828	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 28x20-Inch 10 to 1	EACH
521.1835	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 35x24-Inch 10 to 1	EACH
521.1842	Apron Endwalls for Pipe Arch Sloped Side Drains Steel 42x29-Inch 10 to 1	EACH
521.1900	Pipe Cattle Pass Corrugated Steel	LF
521.3112	Culvert Pipe Corrugated Steel 12-Inch	LF
521.3115	Culvert Pipe Corrugated Steel 15-Inch	LF
521.3118	Culvert Pipe Corrugated Steel 18-Inch	LF
521.3121	Culvert Pipe Corrugated Steel 21-Inch	LF
521.3124	Culvert Pipe Corrugated Steel 24-Inch	LF
521.3130	Culvert Pipe Corrugated Steel 30-Inch	LF
521.3136	Culvert Pipe Corrugated Steel 36-Inch	LF
521.3142	Culvert Pipe Corrugated Steel 42-Inch	LF
521.3148	Culvert Pipe Corrugated Steel 48-Inch	LF
521.3154	Culvert Pipe Corrugated Steel 54-Inch	LF
521.3160	Culvert Pipe Corrugated Steel 60-Inch	LF
521.3172	Culvert Pipe Corrugated Steel 72-Inch	LF
521.3184	Culvert Pipe Corrugated Steel 84-Inch	LF
521.3196	Culvert Pipe Corrugated Steel 96-Inch	LF
521.3717	Pipe Arch Corrugated Steel 17x13-Inch	LF
521.3721	Pipe Arch Corrugated Steel 21x15-Inch	LF
521.3724	Pipe Arch Corrugated Steel 24x18-Inch	LF
521.3728	Pipe Arch Corrugated Steel 28x20-Inch	LF
521.3735	Pipe Arch Corrugated Steel 35x24-Inch	LF
521.3742	Pipe Arch Corrugated Steel 42x29-Inch	LF
521.3749	Pipe Arch Corrugated Steel 49x33-Inch	LF
521.3757	Pipe Arch Corrugated Steel 57x38-Inch	LF
521.3764	Pipe Arch Corrugated Steel 64x43-Inch	LF
521.3771	Pipe Arch Corrugated Steel 71x47-Inch	LF
521.3777	Pipe Arch Corrugated Steel 77x52-Inch	LF
521.3783	Pipe Arch Corrugated Steel 83x57-Inch	LF
521.5112	Culvert Pipe Corrugated Steel Polymer Coated 12-Inch	LF
521.5115	Culvert Pipe Corrugated Steel Polymer Coated 15-Inch	LF
521.5118	Culvert Pipe Corrugated Steel Polymer Coated 18-Inch	LF
521.5121	Culvert Pipe Corrugated Steel Polymer Coated 21-Inch	LF
521.5124	Culvert Pipe Corrugated Steel Polymer Coated 24-Inch	LF
521.5130	Culvert Pipe Corrugated Steel Polymer Coated 30-Inch	LF
521.5136	Culvert Pipe Corrugated Steel Polymer Coated 36-Inch	LF
521.5142	Culvert Pipe Corrugated Steel Polymer Coated 42-Inch	LF
521.5148	Culvert Pipe Corrugated Steel Polymer Coated 48-Inch	LF
521.5154	Culvert Pipe Corrugated Steel Polymer Coated 54-Inch	LF
521.5160	Culvert Pipe Corrugated Steel Polymer Coated 60-Inch	LF
521.5172	Culvert Pipe Corrugated Steel Polymer Coated 72-Inch	LF
521.5184	Culvert Pipe Corrugated Steel Polymer Coated 84-Inch	LF
521.5196	Culvert Pipe Corrugated Steel Polymer Coated 96-Inch	LF
521.5717	Pipe Arch Polymer Coated Corrugated Steel 17x13-Inch	LF
521.5721	Pipe Arch Polymer Coated Corrugated Steel 21x15-Inch	LF

521.5724	Pipe Arch Polymer Coated Corrugated Steel 24x18-Inch	LF
521.5728	Pipe Arch Polymer Coated Corrugated Steel 28x20-Inch	LF
521.5735	Pipe Arch Polymer Coated Corrugated Steel 35x24-Inch	LF
521.5742	Pipe Arch Polymer Coated Corrugated Steel 42x29-Inch	LF
521.5749	Pipe Arch Polymer Coated Corrugated Steel 49x33-Inch	LF
521.5757	Pipe Arch Polymer Coated Corrugated Steel 57x38-Inch	LF
521.5764	Pipe Arch Polymer Coated Corrugated Steel 64x43-Inch	LF
521.5771	Pipe Arch Polymer Coated Corrugated Steel 71x47-Inch	LF
521.5777	Pipe Arch Polymer Coated Corrugated Steel 77x52-Inch	LF
521.5783	Pipe Arch Polymer Coated Corrugated Steel 83x57-Inch	LF
521.6112	Culvert Pipe Corrugated Steel Aluminum Coated 12-Inch	LF
521.6115	Culvert Pipe Corrugated Steel Aluminum Coated 15-Inch	LF
521.6118	Culvert Pipe Corrugated Steel Aluminum Coated 18-Inch	LF
521.6121	Culvert Pipe Corrugated Steel Aluminum Coated 21-Inch	LF
521.6124	Culvert Pipe Corrugated Steel Aluminum Coated 24-Inch	LF
521.6130	Culvert Pipe Corrugated Steel Aluminum Coated 30-Inch	LF
521.6136	Culvert Pipe Corrugated Steel Aluminum Coated 36-Inch	LF
521.6142	Culvert Pipe Corrugated Steel Aluminum Coated 42-Inch	LF
521.6148	Culvert Pipe Corrugated Steel Aluminum Coated 48-Inch	LF
521.6154	Culvert Pipe Corrugated Steel Aluminum Coated 54-Inch	LF
521.6160	Culvert Pipe Corrugated Steel Aluminum Coated 60-Inch	LF
521.6172	Culvert Pipe Corrugated Steel Aluminum Coated 72-Inch	LF
521.6184	Culvert Pipe Corrugated Steel Aluminum Coated 84-Inch	LF
521.6196	Culvert Pipe Corrugated Steel Aluminum Coated 96-Inch	LF
521.6717	Pipe Arch Corrugated Steel Aluminum Coated 17x13-Inch	LF
521.6721	Pipe Arch Corrugated Steel Aluminum Coated 21x15-Inch	LF
521.6724	Pipe Arch Corrugated Steel Aluminum Coated 24x18-Inch	LF
521.6728	Pipe Arch Corrugated Steel Aluminum Coated 28x20-Inch	LF
521.6735	Pipe Arch Corrugated Steel Aluminum Coated 35x24-Inch	LF
521.6742	Pipe Arch Corrugated Steel Aluminum Coated 42x29-Inch	LF
521.6749	Pipe Arch Corrugated Steel Aluminum Coated 49x33-Inch	LF
521.6757	Pipe Arch Corrugated Steel Aluminum Coated 57x38-Inch	LF
521.6764	Pipe Arch Corrugated Steel Aluminum Coated 64x43-Inch	LF
521.6771	Pipe Arch Corrugated Steel Aluminum Coated 71x47-Inch	LF
521.6777	Pipe Arch Corrugated Steel Aluminum Coated 77x52-Inch	LF
521.6783	Pipe Arch Corrugated Steel Aluminum Coated 83x57-Inch	LF
522.0112	Culvert Pipe Reinforced Concrete Class III 12-Inch	LF
522.0115	Culvert Pipe Reinforced Concrete Class III 15-Inch	LF
522.0118	Culvert Pipe Reinforced Concrete Class III 18-Inch	LF
522.0121	Culvert Pipe Reinforced Concrete Class III 21-Inch	LF
522.0124	Culvert Pipe Reinforced Concrete Class III 24-Inch	LF
522.0127	Culvert Pipe Reinforced Concrete Class III 27-Inch	LF
522.0130	Culvert Pipe Reinforced Concrete Class III 30-Inch	LF
522.0136	Culvert Pipe Reinforced Concrete Class III 36-Inch	LF
522.0142	Culvert Pipe Reinforced Concrete Class III 42-Inch	LF
522.0148	Culvert Pipe Reinforced Concrete Class III 48-Inch	LF
522.0154	Culvert Pipe Reinforced Concrete Class III 54-Inch	LF
522.0160	Culvert Pipe Reinforced Concrete Class III 60-Inch	LF
522.0166	Culvert Pipe Reinforced Concrete Class III 66-Inch	LF
522.0172	Culvert Pipe Reinforced Concrete Class III 72-Inch	LF
522.0178	Culvert Pipe Reinforced Concrete Class III 78-Inch	LF
522.0184	Culvert Pipe Reinforced Concrete Class III 84-Inch	LF
522.0190	Culvert Pipe Reinforced Concrete Class III 90-Inch	LF
522.0196	Culvert Pipe Reinforced Concrete Class III 96-Inch	LF

Bid Items

522.0202	Culvert Pipe Reinforced Concrete Class III 102-Inch	LF
522.0208	Culvert Pipe Reinforced Concrete Class III 108-Inch	LF
522.0412	Culvert Pipe Reinforced Concrete Class IV 12-Inch	LF
522.0415	Culvert Pipe Reinforced Concrete Class IV 15-Inch	LF
522.0418	Culvert Pipe Reinforced Concrete Class IV 18-Inch	LF
522.0421	Culvert Pipe Reinforced Concrete Class IV 21-Inch	LF
522.0424	Culvert Pipe Reinforced Concrete Class IV 24-Inch	LF
522.0427	Culvert Pipe Reinforced Concrete Class IV 27-Inch	LF
522.0430	Culvert Pipe Reinforced Concrete Class IV 30-Inch	LF
522.0436	Culvert Pipe Reinforced Concrete Class IV 36-Inch	LF
522.0442	Culvert Pipe Reinforced Concrete Class IV 42-Inch	LF
522.0448	Culvert Pipe Reinforced Concrete Class IV 48-Inch	LF
522.0454	Culvert Pipe Reinforced Concrete Class IV 54-Inch	LF
522.0460	Culvert Pipe Reinforced Concrete Class IV 60-Inch	LF
522.0466	Culvert Pipe Reinforced Concrete Class IV 66-Inch	LF
522.0472	Culvert Pipe Reinforced Concrete Class IV 72-Inch	LF
522.0478	Culvert Pipe Reinforced Concrete Class IV 78-Inch	LF
522.0484	Culvert Pipe Reinforced Concrete Class IV 84-Inch	LF
522.0512	Culvert Pipe Reinforced Concrete Class V 12-Inch	LF
522.0515	Culvert Pipe Reinforced Concrete Class V 15-Inch	LF
522.0518	Culvert Pipe Reinforced Concrete Class V 18-Inch	LF
522.0521	Culvert Pipe Reinforced Concrete Class V 21-Inch	LF
522.0524	Culvert Pipe Reinforced Concrete Class V 24-Inch	LF
522.0527	Culvert Pipe Reinforced Concrete Class V 27-Inch	LF
522.0530	Culvert Pipe Reinforced Concrete Class V 30-Inch	LF
522.0536	Culvert Pipe Reinforced Concrete Class V 36-Inch	LF
522.0542	Culvert Pipe Reinforced Concrete Class V 42-Inch	LF
522.0548	Culvert Pipe Reinforced Concrete Class V 48-Inch	LF
522.0554	Culvert Pipe Reinforced Concrete Class V 54-Inch	LF
522.0560	Culvert Pipe Reinforced Concrete Class V 60-Inch	LF
522.0566	Culvert Pipe Reinforced Concrete Class V 66-Inch	LF
522.0572	Culvert Pipe Reinforced Concrete Class V 72-Inch	LF
522.0584	Culvert Pipe Reinforced Concrete Class V 84-Inch	LF
522.1012	Apron Endwalls for Culvert Pipe Reinforced Concrete 12-Inch	EACH
522.1015	Apron Endwalls for Culvert Pipe Reinforced Concrete 15-Inch	EACH
522.1018	Apron Endwalls for Culvert Pipe Reinforced Concrete 18-Inch	EACH
522.1021	Apron Endwalls for Culvert Pipe Reinforced Concrete 21-Inch	EACH
522.1024	Apron Endwalls for Culvert Pipe Reinforced Concrete 24-Inch	EACH
522.1027	Apron Endwalls for Culvert Pipe Reinforced Concrete 27-Inch	EACH
522.1030	Apron Endwalls for Culvert Pipe Reinforced Concrete 30-Inch	EACH
522.1036	Apron Endwalls for Culvert Pipe Reinforced Concrete 36-Inch	EACH
522.1042	Apron Endwalls for Culvert Pipe Reinforced Concrete 42-Inch	EACH
522.1048	Apron Endwalls for Culvert Pipe Reinforced Concrete 48-Inch	EACH
522.1054	Apron Endwalls for Culvert Pipe Reinforced Concrete 54-Inch	EACH
522.1060	Apron Endwalls for Culvert Pipe Reinforced Concrete 60-Inch	EACH
522.1066	Apron Endwalls for Culvert Pipe Reinforced Concrete 66-Inch	EACH
522.1072	Apron Endwalls for Culvert Pipe Reinforced Concrete 72-Inch	EACH
522.1084	Apron Endwalls for Culvert Pipe Reinforced Concrete 84-Inch	EACH
522.1500	Pipe Cattle Pass Reinforced Concrete	LF
522.2314	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 14x23-Inch	LF
522.2319	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 19x30-Inch	LF
522.2324	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 24x38-Inch	LF
522.2329	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 29x45-Inch	LF
522.2334	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 34x53-Inch	LF

522.2338	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 38x60-Inch	LF
522.2343	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 43x68-Inch	LF
522.2348	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 48x76-Inch	LF
522.2353	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 53x83-Inch	LF
522.2358	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 58x91-Inch	LF
522.2363	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 63x98-Inch	LF
522.2368	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 68x106-Inch	LF
522.2414	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 14x23-Inch	LF
522.2419	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 19x30-Inch	LF
522.2424	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 24x38-Inch	LF
522.2429	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 29x45-Inch	LF
522.2434	Culvert Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 34x53-Inch	LF
522.2614	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 14x23-Inch	EACH
522.2619	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 19x30-Inch	EACH
522.2624	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 24x38-Inch	EACH
522.2629	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 29x45-Inch	EACH
522.2634	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 34x53-Inch	EACH
522.2638	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 38x60-Inch	EACH
522.2643	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 43x68-Inch	EACH
522.2648	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 48x76-Inch	EACH
522.2653	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 53x83-Inch	EACH
522.2658	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 58x91-Inch	EACH
522.2663	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 63x98-Inch	EACH
522.2668	Apron Endwalls for Culvert Pipe Reinforced Concrete Horizontal Elliptical 68x106-Inch	EACH
524.0112	Culvert Pipe Salvaged 12-Inch	LF
524.0115	Culvert Pipe Salvaged 15-Inch	LF
524.0118	Culvert Pipe Salvaged 18-Inch	LF
524.0121	Culvert Pipe Salvaged 21-Inch	LF
524.0124	Culvert Pipe Salvaged 24-Inch	LF
524.0127	Culvert Pipe Salvaged 27-Inch	LF
524.0130	Culvert Pipe Salvaged 30-Inch	LF
524.0133	Culvert Pipe Salvaged 33-Inch	LF
524.0136	Culvert Pipe Salvaged 36-Inch	LF
524.0142	Culvert Pipe Salvaged 42-Inch	LF
524.0148	Culvert Pipe Salvaged 48-Inch	LF
524.0154	Culvert Pipe Salvaged 54-Inch	LF
524.0160	Culvert Pipe Salvaged 60-Inch	LF
524.0166	Culvert Pipe Salvaged 66-Inch	LF
524.0172	Culvert Pipe Salvaged 72-Inch	LF
524.0178	Culvert Pipe Salvaged 78-Inch	LF
524.0184	Culvert Pipe Salvaged 84-Inch	LF
524.0190	Culvert Pipe Salvaged 90-Inch	LF
524.0196	Culvert Pipe Salvaged 96-Inch	LF
524.0202	Culvert Pipe Salvaged 102-Inch	LF
524.0208	Culvert Pipe Salvaged 108-Inch	LF
524.0612	Apron Endwalls for Culvert Pipe Salvaged 12-Inch	EACH
524.0615	Apron Endwalls for Culvert Pipe Salvaged 15-Inch	EACH
524.0618	Apron Endwalls for Culvert Pipe Salvaged 18-Inch	EACH
524.0621	Apron Endwalls for Culvert Pipe Salvaged 21-Inch	EACH
524.0624	Apron Endwalls for Culvert Pipe Salvaged 24-Inch	EACH
524.0627	Apron Endwalls for Culvert Pipe Salvaged 27-Inch	EACH
524.0630	Apron Endwalls for Culvert Pipe Salvaged 30-Inch	EACH
524.0633	Apron Endwalls for Culvert Pipe Salvaged 33-Inch	EACH
524.0636	Apron Endwalls for Culvert Pipe Salvaged 36-Inch	EACH

524.0642	Apron Endwalls for Culvert Pipe Salvaged 42-Inch	EACH
524.0648	Apron Endwalls for Culvert Pipe Salvaged 48-Inch	EACH
524.0654	Apron Endwalls for Culvert Pipe Salvaged 54-Inch	EACH
524.0660	Apron Endwalls for Culvert Pipe Salvaged 60-Inch	EACH
524.0666	Apron Endwalls for Culvert Pipe Salvaged 66-Inch	EACH
524.0672	Apron Endwalls for Culvert Pipe Salvaged 72-Inch	EACH
524.0678	Apron Endwalls for Culvert Pipe Salvaged 78-Inch	EACH
524.0684	Apron Endwalls for Culvert Pipe Salvaged 84-Inch	EACH
524.0800	Pipe Cattle Pass Salvaged	LF
524.0900	Pipe Arch Salvaged Corrugated Steel (rise x span)	LF
525.0112	Culvert Pipe Corrugated Aluminum 12-Inch	LF
525.0115	Culvert Pipe Corrugated Aluminum 15-Inch	LF
525.0118	Culvert Pipe Corrugated Aluminum 18-Inch	LF
525.0121	Culvert Pipe Corrugated Aluminum 21-Inch	LF
525.0124	Culvert Pipe Corrugated Aluminum 24-Inch	LF
525.0130	Culvert Pipe Corrugated Aluminum 30-Inch	LF
525.0136	Culvert Pipe Corrugated Aluminum 36-Inch	LF
525.0142	Culvert Pipe Corrugated Aluminum 42-Inch	LF
525.0148	Culvert Pipe Corrugated Aluminum 48-Inch	LF
525.0154	Culvert Pipe Corrugated Aluminum 54-Inch	LF
525.0160	Culvert Pipe Corrugated Aluminum 60-Inch	LF
525.0172	Culvert Pipe Corrugated Aluminum 72-Inch	LF
525.0184	Culvert Pipe Corrugated Aluminum 84-Inch	LF
525.0312	Apron Endwalls for Culvert Pipe Aluminum 12-Inch	EACH
525.0315	Apron Endwalls for Culvert Pipe Aluminum 15-Inch	EACH
525.0318	Apron Endwalls for Culvert Pipe Aluminum 18-Inch	EACH
525.0321	Apron Endwalls for Culvert Pipe Aluminum 21-Inch	EACH
525.0324	Apron Endwalls for Culvert Pipe Aluminum 24-Inch	EACH
525.0330	Apron Endwalls for Culvert Pipe Aluminum 30-Inch	EACH
525.0336	Apron Endwalls for Culvert Pipe Aluminum 36-Inch	EACH
525.0342	Apron Endwalls for Culvert Pipe Aluminum 42-Inch	EACH
525.0348	Apron Endwalls for Culvert Pipe Aluminum 48-Inch	EACH
525.0354	Apron Endwalls for Culvert Pipe Aluminum 54-Inch	EACH
525.0360	Apron Endwalls for Culvert Pipe Aluminum 60-Inch	EACH
525.0372	Apron Endwalls for Culvert Pipe Aluminum 72-Inch	EACH
525.0384	Apron Endwalls for Culvert Pipe Aluminum 84-Inch	EACH
526.0100	Temporary Structure (station)	LS
527.0160	Pipe Structural Plate 60-Inch	LF
527.0172	Pipe Structural Plate 72-Inch	LF
527.0184	Pipe Structural Plate 84-Inch	LF
527.0196	Pipe Structural Plate 96-Inch	LF
527.0208	Pipe Structural Plate 108-Inch	LF
527.0220	Pipe Structural Plate 120-Inch	LF
527.0232	Pipe Structural Plate 132-Inch	LF
527.0244	Pipe Structural Plate 144-Inch	LF
527.0256	Pipe Structural Plate 156-Inch	LF
527.0268	Pipe Structural Plate 168-Inch	LF
527.0280	Pipe Structural Plate 180-Inch	LF
527.0305	Pipe Arch Structural Plate 6-FT Span	LF
527.0310	Pipe Arch Structural Plate 7-FT Span	LF
527.0315	Pipe Arch Structural Plate 8-FT Span	LF
527.0320	Pipe Arch Structural Plate 9-FT Span	LF
527.0325	Pipe Arch Structural Plate 10-FT Span	LF
527.0330	Pipe Arch Structural Plate 11-FT Span	LF

Bid Items

527.0335	Pipe Arch Structural Plate 12-FT Span	LF
527.0340	Pipe Arch Structural Plate 13-FT Span	LF
527.0345	Pipe Arch Structural Plate 14-FT Span	LF
527.0350	Pipe Arch Structural Plate 15-FT Span	LF
527.0355	Pipe Arch Structural Plate 16-FT Span	LF
527.0360	Pipe Arch Structural Plate 16.5-FT Span	LF
530.0112	Culvert Pipe Corrugated Polyethylene 12-Inch	LF
530.0115	Culvert Pipe Corrugated Polyethylene 15-Inch	LF
530.0118	Culvert Pipe Corrugated Polyethylene 18-Inch	LF
530.0124	Culvert Pipe Corrugated Polyethylene 24-Inch	LF
530.0130	Culvert Pipe Corrugated Polyethylene 30-Inch	LF
530.0136	Culvert Pipe Corrugated Polyethylene 36-Inch	LF
530.1112	Culvert Pipe Corrugated Polypropylene 12-Inch	LF
530.1115	Culvert Pipe Corrugated Polypropylene 15-Inch	LF
530.1118	Culvert Pipe Corrugated Polypropylene 18-Inch	LF
530.1121	Culvert Pipe Corrugated Polypropylene 21-Inch	LF
530.1124	Culvert Pipe Corrugated Polypropylene 24-Inch	LF
530.1127	Culvert Pipe Corrugated Polypropylene 27-Inch	LF
530.1130	Culvert Pipe Corrugated Polypropylene 30-Inch	LF
530.1136	Culvert Pipe Corrugated Polypropylene 36-Inch	LF
550.0010	Pre-boring Unconsolidated Materials	LF
550.0020	Pre-Boring Rock or Consolidated Materials	LF
550.0500	Pile Points	EACH
550.0600	Pile Redriving	EACH
550.1100	Piling Steel HP 10-Inch X 42 Lb	LF
550.1120	Piling Steel HP 12-Inch X 53 Lb	LF
550.1125	Piling Steel HP 12-Inch X 74 Lb	LF
550.1140	Piling Steel HP 14-Inch X 73 Lb	LF
550.2102	Piling CIP Concrete 10 3/4 X 0.219-Inch	LF
550.2104	Piling CIP Concrete 10 3/4 X 0.25-Inch	LF
550.2106	Piling CIP Concrete 10 3/4 X 0.365-Inch	LF
550.2108	Piling CIP Concrete 10 3/4 X 0.50-Inch	LF
550.2122	Piling CIP Concrete 12 3/4 X 0.219-Inch	LF
550.2124	Piling CIP Concrete 12 3/4 X 0.25-Inch	LF
550.2126	Piling CIP Concrete 12 3/4 X 0.375-Inch	LF
550.2128	Piling CIP Concrete 12 3/4 X 0.50-Inch	LF
550.2142	Piling CIP Concrete 14 X 0.219-Inch	LF
550.2144	Piling CIP Concrete 14 X 0.25-Inch	LF
550.2146	Piling CIP Concrete 14 X 0.375-Inch	LF
550.2148	Piling CIP Concrete 14 X 0.50-Inch	LF
550.2162	Piling CIP Concrete 16 X 0.219-Inch	LF
550.2164	Piling CIP Concrete 16 X 0.25-Inch	LF
550.2166	Piling CIP Concrete 16 X 0.375-Inch	LF
550.2168	Piling CIP Concrete 16 X 0.50-Inch	LF
550.3100	Piling Precast Concrete 10-Inch	LF
550.3120	Piling Precast Concrete 12-Inch	LF
550.3140	Piling Precast Concrete 14-Inch	LF
550.3160	Piling Precast Concrete 16-Inch	LF
550.3810	Pile Splices Precast Concrete 10-Inch	LF
550.3812	Pile Splices Precast Concrete 12-Inch	LF
550.3814	Pile Splices Precast Concrete 14-Inch	LF
550.3816	Pile Splices Precast Concrete 16-Inch	LF

Part 6 Bid Items

601.0105	Concrete Curb Type A	LF

Bid Items

601.0110	Concrete Curb Type D	LF
601.0115	Concrete Curb Type G	LF
601.0120	Concrete Curb Type J	LF
601.0150	Concrete Curb Integral Type D	LF
601.0155	Concrete Curb Integral Type J	LF
601.0205	Concrete Gutter 24-Inch	LF
601.0319	Concrete Curb & Gutter 19-Inch	LF
601.0322	Concrete Curb & Gutter 22-Inch	LF
601.0331	Concrete Curb & Gutter 31-Inch	LF
601.0342	Concrete Curb & Gutter Integral 18-Inch	LF
601.0344	Concrete Curb & Gutter Integral 36-Inch	LF
601.0405	Concrete Curb & Gutter 18-Inch Type A	LF
601.0407	Concrete Curb & Gutter 18-Inch Type D	LF
601.0409	Concrete Curb & Gutter 30-Inch Type A	LF
601.0411	Concrete Curb & Gutter 30-Inch Type D	LF
601.0413	Concrete Curb & Gutter 6-Inch Sloped 30-Inch Type G	LF
601.0415	Concrete Curb & Gutter 6-Inch Sloped 30-Inch Type J	LF
601.0417	Concrete Curb & Gutter 30-Inch Type K	LF
601.0419	Concrete Curb & Gutter 30-Inch Type L	LF
601.0452	Concrete Curb & Gutter Integral 30-Inch Type D	LF
601.0454	Concrete Curb & Gutter Integral 30-Inch Type J	LF
601.0456	Concrete Curb & Gutter Integral 30-Inch Type L	LF
601.0501	Concrete Curb & Gutter Integral 4-Inch Sloped 36-Inch	LF
601.0511	Concrete Curb & Gutter Integral 6-Inch Sloped 36-Inch	LF
601.0551	Concrete Curb & Gutter 4-Inch Sloped 36-Inch Type A	LF
601.0553	Concrete Curb & Gutter 4-Inch Sloped 36-Inch Type D	LF
601.0555	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type A	LF
601.0557	Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type D	LF
601.0574	Concrete Curb & Gutter 4-Inch Sloped 30-Inch Type G	LF
601.0576	Concrete Curb & Gutter 4-Inch Sloped 30-Inch Type J	LF
601.0580	Concrete Curb & Gutter 4-Inch Sloped 36-Inch Type R	LF
601.0582	Concrete Curb & Gutter 4-Inch Sloped 36-Inch Type T	LF
601.0584	Concrete Curb & Gutter 4-Inch Sloped 30-Inch Type TBT	LF
601.0586	Concrete Curb & Gutter 4-Inch Sloped 30-Inch Type TBTT	LF
601.0588	Concrete Curb & Gutter 4-Inch Sloped 36-Inch Type TBT	LF
601.0590	Concrete Curb & Gutter 4-Inch Sloped 36-Inch Type TBTT	LF
601.0600	Concrete Curb Pedestrian	LF
602.0405	Concrete Sidewalk 4-Inch	SF
602.0410	Concrete Sidewalk 5-Inch	SF
602.0415	Concrete Sidewalk 6-Inch	SF
602.0420	Concrete Sidewalk 7-Inch	SF
602.0505	Curb Ramp Detectable Warning Field Yellow	SF
602.0510	Curb Ramp Detectable Warning Field White	SF
602.0515	Curb Ramp Detectable Warning Field Natural Patina	SF
602.0605	Curb Ramp Detectable Warning Field Radial Yellow	SF
602.0610	Curb Ramp Detectable Warning Field Radial White	SF
602.0615	Curb Ramp Detectable Warning Field Radial Natural Patina	SF
602.1000	Concrete Loading Zone	SF
602.1500	Concrete Steps	SF
602.2400	Concrete Safety Islands	SF
603.0105	Concrete Barrier Single-Faced 32-Inch	LF
603.0205	Concrete Barrier Double-Faced 32-Inch	LF
603.0405	Concrete Barrier Transition Section 32-Inch	LF
603.1132	Concrete Barrier Type S32	LF

603.1136	Concrete Barrier Type S36	LF
603.1142	Concrete Barrier Type S42	LF
603.1156	Concrete Barrier Type S56	LF
603.1232	Concrete Barrier Type S32A	LF
603.1236	Concrete Barrier Type S36A	LF
603.1242	Concrete Barrier Type S42A	LF
603.1256	Concrete Barrier Type S56A	LF
603.1332	Concrete Barrier Type S32B	LF
603.1336	Concrete Barrier Type S36B	LF
603.1342	Concrete Barrier Type S42B	LF
603.1356	Concrete Barrier Type S56B	LF
603.1432	Concrete Barrier Type S32C	LF
603.1436	Concrete Barrier Type S36C	LF
603.1442	Concrete Barrier Type S42C	LF
603.1456	Concrete Barrier Type S56C	LF
603.2132	Concrete Barrier Fixed Object Protection Type S32	LF
603.2136	Concrete Barrier Fixed Object Protection Type S36	LF
603.2142	Concrete Barrier Fixed Object Protection Type S42	LF
603.2156	Concrete Barrier Fixed Object Protection Type S56	LF
603.3111	Concrete Barrier Transition Type NJ32SF to S32	EACH
603.3113	Concrete Barrier Transition Type NJ32SF to S36	EACH
603.3155	Concrete Barrier Transition Type NJ42SF to S42	EACH
603.3175	Concrete Barrier Transition Type NJ51SF to S42	EACH
603.3211	Concrete Barrier Transition Type F32SF to S32	EACH
603.3213	Concrete Barrier Transition Type F32SF to S36	EACH
603.3255	Concrete Barrier Transition Type F42SF to S42	EACH
603.3275	Concrete Barrier Transition Type F51SF to S42	EACH
603.3279	Concrete Barrier Transition Type F51SF to S56	EACH
603.3311	Concrete Barrier Transition Type NJ32DF to S32	EACH
603.3313	Concrete Barrier Transition Type NJ32DF to S36	EACH
603.3355	Concrete Barrier Transition Type NJ42DF to S42	EACH
603.3375	Concrete Barrier Transition Type NJ51DF to S42	EACH
603.3411	Concrete Barrier Transition Type F32DF to S32	EACH
603.3413	Concrete Barrier Transition Type F32DF to S36	EACH
603.3455	Concrete Barrier Transition Type F42DF to S42	EACH
603.3475	Concrete Barrier Transition Type F51DF to S42	EACH
603.3513	Concrete Barrier Transition Type S32 to S36	EACH
603.3535	Concrete Barrier Transition Type S36 to S42	EACH
603.3559	Concrete Barrier Transition Type S42 to S56	EACH
603.3611	Concrete Barrier Transition Type V32 to S32	EACH
603.3613	Concrete Barrier Transition Type V32 to S36	EACH
603.3655	Concrete Barrier Transition Type V42 to S42	EACH
603.3675	Concrete Barrier Transition Type V51 to S42	EACH
603.3699	Concrete Barrier Transition Type V56 to S56	EACH
603.8000	Concrete Barrier Temporary Precast Delivered	LF
603.8125	Concrete Barrier Temporary Precast Installed	LF
603.8505	Anchoring Concrete Barrier on Bridge Decks	LF
604.0400	Slope Paving Concrete	SY
604.0500	Slope Paving Crushed Aggregate	SY
604.0600	Slope Paving Select Crushed Material	SY
606.0100	Riprap Light	CY
606.0200	Riprap Medium	CY
606.0300	Riprap Heavy	CY
606.0400	Riprap Extra-Heavy	CY

606.0500	Grouted Riprap Light	CY
606.0600	Grouted Riprap Medium	CY
606.0700	Grouted Riprap Heavy	CY
606.0800	Grouted Riprap Extra-Heavy	CY
608.0005	Storm Sewer Rock Excavation	CY
608.0106	Relaid Storm Sewer 6-Inch	LF
608.0108	Relaid Storm Sewer 8-Inch	LF
608.0110	Relaid Storm Sewer 10-Inch	LF
608.0112	Relaid Storm Sewer 12-Inch	LF
608.0115	Relaid Storm Sewer 15-Inch	LF
608.0118	Relaid Storm Sewer 18-Inch	LF
608.0121	Relaid Storm Sewer 21-Inch	LF
608.0124	Relaid Storm Sewer 24-Inch	LF
608.0127	Relaid Storm Sewer 27-Inch	LF
608.0130	Relaid Storm Sewer 30-Inch	LF
608.0136	Relaid Storm Sewer 36-Inch	LF
608.0142	Relaid Storm Sewer 42-Inch	LF
608.0148	Relaid Storm Sewer 48-Inch	LF
608.0154	Relaid Storm Sewer 54-Inch	LF
608.0160	Relaid Storm Sewer 60-Inch	LF
608.0166	Relaid Storm Sewer 66-Inch	LF
608.0172	Relaid Storm Sewer 72-Inch	LF
608.0178	Relaid Storm Sewer 78-Inch	LF
608.0184	Relaid Storm Sewer 84-Inch	LF
608.0190	Relaid Storm Sewer 90-Inch	LF
608.0196	Relaid Storm Sewer 96-Inch	LF
608.0212	Storm Sewer Pipe Reinforced Concrete Class II 12-Inch	LF
608.0215	Storm Sewer Pipe Reinforced Concrete Class II 15-Inch	LF
608.0218	Storm Sewer Pipe Reinforced Concrete Class II 18-Inch	LF
608.0221	Storm Sewer Pipe Reinforced Concrete Class II 21-Inch	LF
608.0224	Storm Sewer Pipe Reinforced Concrete Class II 24-Inch	LF
608.0227	Storm Sewer Pipe Reinforced Concrete Class II 27-Inch	LF
608.0230	Storm Sewer Pipe Reinforced Concrete Class II 30-Inch	LF
608.0236	Storm Sewer Pipe Reinforced Concrete Class II 36-Inch	LF
608.0242	Storm Sewer Pipe Reinforced Concrete Class II 42-Inch	LF
608.0248	Storm Sewer Pipe Reinforced Concrete Class II 48-Inch	LF
608.0254	Storm Sewer Pipe Reinforced Concrete Class II 54-Inch	LF
608.0260	Storm Sewer Pipe Reinforced Concrete Class II 60-Inch	LF
608.0266	Storm Sewer Pipe Reinforced Concrete Class II 66-Inch	LF
608.0272	Storm Sewer Pipe Reinforced Concrete Class II 72-Inch	LF
608.0278	Storm Sewer Pipe Reinforced Concrete Class II 78-Inch	LF
608.0284	Storm Sewer Pipe Reinforced Concrete Class II 84-Inch	LF
608.0290	Storm Sewer Pipe Reinforced Concrete Class II 90-Inch	LF
608.0296	Storm Sewer Pipe Reinforced Concrete Class II 96-Inch	LF
608.0297	Storm Sewer Pipe Reinforced Concrete Class II 102-Inch	LF
608.0298	Storm Sewer Pipe Reinforced Concrete Class II 108-Inch	LF
608.0312	Storm Sewer Pipe Reinforced Concrete Class III 12-Inch	LF
608.0315	Storm Sewer Pipe Reinforced Concrete Class III 15-Inch	LF
608.0318	Storm Sewer Pipe Reinforced Concrete Class III 18-Inch	LF
608.0321	Storm Sewer Pipe Reinforced Concrete Class III 21-Inch	LF
608.0324	Storm Sewer Pipe Reinforced Concrete Class III 24-Inch	LF
608.0327	Storm Sewer Pipe Reinforced Concrete Class III 27-Inch	LF
608.0330	Storm Sewer Pipe Reinforced Concrete Class III 30-Inch	LF
608.0336	Storm Sewer Pipe Reinforced Concrete Class III 36-Inch	LF

Bid Items

608.0342	Storm Sewer Pipe Reinforced Concrete Class III 42-Inch	LF
608.0348	Storm Sewer Pipe Reinforced Concrete Class III 48-Inch	LF
608.0354	Storm Sewer Pipe Reinforced Concrete Class III 54-Inch	LF
608.0360	Storm Sewer Pipe Reinforced Concrete Class III 60-Inch	LF
608.0366	Storm Sewer Pipe Reinforced Concrete Class III 66-Inch	LF
608.0372	Storm Sewer Pipe Reinforced Concrete Class III 72-Inch	LF
608.0378	Storm Sewer Pipe Reinforced Concrete Class III 78-Inch	LF
608.0384	Storm Sewer Pipe Reinforced Concrete Class III 84-Inch	LF
608.0390	Storm Sewer Pipe Reinforced Concrete Class III 90-Inch	LF
608.0396	Storm Sewer Pipe Reinforced Concrete Class III 96-Inch	LF
608.0397	Storm Sewer Pipe Reinforced Concrete Class III 102-Inch	LF
608.0398	Storm Sewer Pipe Reinforced Concrete Class III 108-Inch	LF
608.0412	Storm Sewer Pipe Reinforced Concrete Class IV 12-Inch	LF
608.0415	Storm Sewer Pipe Reinforced Concrete Class IV 15-Inch	LF
608.0418	Storm Sewer Pipe Reinforced Concrete Class IV 18-Inch	LF
608.0421	Storm Sewer Pipe Reinforced Concrete Class IV 21-Inch	LF
608.0424	Storm Sewer Pipe Reinforced Concrete Class IV 24-Inch	LF
608.0427	Storm Sewer Pipe Reinforced Concrete Class IV 27-Inch	LF
608.0430	Storm Sewer Pipe Reinforced Concrete Class IV 30-Inch	LF
608.0436	Storm Sewer Pipe Reinforced Concrete Class IV 36-Inch	LF
608.0442	Storm Sewer Pipe Reinforced Concrete Class IV 42-Inch	LF
608.0448	Storm Sewer Pipe Reinforced Concrete Class IV 48-Inch	LF
608.0454	Storm Sewer Pipe Reinforced Concrete Class IV 54-Inch	LF
608.0460	Storm Sewer Pipe Reinforced Concrete Class IV 60-Inch	LF
608.0466	Storm Sewer Pipe Reinforced Concrete Class IV 66-Inch	LF
608.0472	Storm Sewer Pipe Reinforced Concrete Class IV 72-Inch	LF
608.0478	Storm Sewer Pipe Reinforced Concrete Class IV 78-Inch	LF
608.0484	Storm Sewer Pipe Reinforced Concrete Class IV 84-Inch	LF
608.0512	Storm Sewer Pipe Reinforced Concrete Class V 12-Inch	LF
608.0515	Storm Sewer Pipe Reinforced Concrete Class V 15-Inch	LF
608.0518	Storm Sewer Pipe Reinforced Concrete Class V 18-Inch	LF
608.0521	Storm Sewer Pipe Reinforced Concrete Class V 21-Inch	LF
608.0524	Storm Sewer Pipe Reinforced Concrete Class V 24-Inch	LF
608.0527	Storm Sewer Pipe Reinforced Concrete Class V 27-Inch	LF
608.0530	Storm Sewer Pipe Reinforced Concrete Class V 30-Inch	LF
608.0536	Storm Sewer Pipe Reinforced Concrete Class V 36-Inch	LF
608.0542	Storm Sewer Pipe Reinforced Concrete Class V 42-Inch	LF
608.0548	Storm Sewer Pipe Reinforced Concrete Class V 48-Inch	LF
608.0554	Storm Sewer Pipe Reinforced Concrete Class V 54-Inch	LF
608.0560	Storm Sewer Pipe Reinforced Concrete Class V 60-Inch	LF
608.0566	Storm Sewer Pipe Reinforced Concrete Class V 66-Inch	LF
608.0572	Storm Sewer Pipe Reinforced Concrete Class V 72-Inch	LF\
608.2314	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 14x23-Inch	LF
608.2319	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 19x30-Inch	LF
608.2324	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 24x38-Inch	LF
608.2329	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 29x45-Inch	LF
608.2334	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 34x53-Inch	LF
608.2338	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 38x60-Inch	LF
608.2343	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 43x68-Inch	LF
608.2348	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 48x76-Inch	LF
608.2353	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 53x83-Inch	LF
608.2358	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 58x91-Inch	LF
608.2363	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 63x98-Inch	LF
608.2368	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-III 68x106-Inch	LF

608.2414	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 14x23-Inch	LF
608.2419	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 19x30-Inch	LF
608.2424	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 24x38-Inch	LF
608.2429	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 29x45-Inch	LF
608.2434	Storm Sewer Pipe Reinforced Concrete Horizontal Elliptical Class HE-IV 34x53-Inch	LF
608.3012	Storm Sewer Pipe Class III-A 12-Inch	LF
608.3015	Storm Sewer Pipe Class III-A 15-Inch	LF
608.3018	Storm Sewer Pipe Class III-A 18-Inch	LF
608.3021	Storm Sewer Pipe Class III-A 21-Inch	LF
608.3024	Storm Sewer Pipe Class III-A 24-Inch	LF
608.3027	Storm Sewer Pipe Class III-A 27-Inch	LF
608.3030	Storm Sewer Pipe Class III-A 30-Inch	LF
608.3036	Storm Sewer Pipe Class III-A 36-Inch	LF
608.3612	Storm Sewer Pipe Class III-B 12-Inch	LF
608.3615	Storm Sewer Pipe Class III-B 15-Inch	LF
608.3618	Storm Sewer Pipe Class III-B 18-Inch	LF
608.3621	Storm Sewer Pipe Class III-B 21-Inch	LF
608.3624	Storm Sewer Pipe Class III-B 24-Inch	LF
608.3627	Storm Sewer Pipe Class III-B 27-Inch	LF
608.3630	Storm Sewer Pipe Class III-B 30-Inch	LF
608.3636	Storm Sewer Pipe Class III-B 36-Inch	LF
608.6006	Storm Sewer Pipe Composite 6-Inch	LF
608.6008	Storm Sewer Pipe Composite 8-Inch	LF
608.6010	Storm Sewer Pipe Composite 10-Inch	LF
608.6012	Storm Sewer Pipe Composite 12-Inch	LF
608.6015	Storm Sewer Pipe Composite 15-Inch	LF
611.0410	Reconstructing Catch Basins	EACH
611.0420	Reconstructing Manholes	EACH
611.0430	Reconstructing Inlets	EACH
611.0530	Manhole Covers Type J	EACH
611.0535	Manhole Covers Type J-Special	EACH
611.0540	Manhole Covers Type K	EACH
611.0545	Manhole Covers Type L	EACH
611.0550	Manhole Covers Type M	EACH
611.0552	Manhole Covers Type M-Communications	EACH
611.0555	Manhole Covers Type Q	EACH
611.0557	Manhole Covers Type Q-Communications	EACH
611.0600	Inlet Covers Type A	EACH
611.0603	Inlet Covers Type A-S	EACH
611.0606	Inlet Covers Type B	EACH
611.0609	Inlet Covers Type B-A	EACH
611.0610	Inlet Covers Type BW	EACH
611.0612	Inlet Covers Type C	EACH
611.0615	Inlet Covers Type F	EACH
611.0624	Inlet Covers Type H	EACH
611.0627	Inlet Covers Type HM	EACH
611.0630	Inlet Covers Type HM-GJ	EACH
611.0633	Inlet Covers Type HM-GJ-S	EACH
611.0636	Inlet Covers Type HM-S	EACH
611.0639	Inlet Covers Type H-S	EACH
611.0642	Inlet Covers Type MS	EACH
611.0645	Inlet Covers Type MS-A	EACH
611.0648	Inlet Covers Type R	EACH
611.0651	Inlet Covers Type S	EACH

611.0652	Inlet Covers Type T	EACH
611.0654	Inlet Covers Type V	EACH
611.0657	Inlet Covers Type W	EACH
611.0660	Inlet Covers Type WM	EACH
611.0663	Inlet Covers Type X	EACH
611.0666	Inlet Covers Type Z	EACH
611.1003	Catch Basins 3-FT Diameter	EACH
611.1004	Catch Basins 4-FT Diameter	EACH
611.1005	Catch Basins 5-FT Diameter	EACH
611.1006	Catch Basins 6-FT Diameter	EACH
611.1230	Catch Basins 2x3-FT	EACH
611.1253	Catch Basins 2.5x3-FT	EACH
611.2003	Manholes 3-FT Diameter	EACH
611.2004	Manholes 4-FT Diameter	EACH
611.2005	Manholes 5-FT Diameter	EACH
611.2006	Manholes 6-FT Diameter	EACH
611.2007	Manholes 7-FT Diameter	EACH
611.2008	Manholes 8-FT Diameter	EACH
611.2033	Manholes 3x3-FT	EACH
611.2044	Manholes 4x4-FT	EACH
611.2055	Manholes 5x5-FT	EACH
611.2066	Manholes 6x6-FT	EACH
611.2104	Manholes Communication 4-FT Diameter	EACH
611.2504	Manholes Variable Tee 4-FT Diameter	EACH
611.2604	Manholes Variable Special 4-FT Diameter	EACH
611.3003	Inlets 3-FT Diameter	EACH
611.3004	Inlets 4-FT Diameter	EACH
611.3220	Inlets 2x2-FT	EACH
611.3225	Inlets 2x2.5-FT	EACH
611.3230	Inlets 2x3-FT	EACH
611.3253	Inlets 2.5x3-FT	EACH
611.3901	Inlets Median 1 Grate	EACH
611.3902	Inlets Median 2 Grate	EACH
611.3903	Inlets Median 3 Grate	EACH
611.3904	Inlets Median 4 Grate	EACH
611.8105	Adjusting Catch Basin Covers	EACH
611.8110	Adjusting Manhole Covers	EACH
611.8115	Adjusting Inlet Covers	EACH
611.9705	Salvaged Manhole Covers	EACH
611.9710	Salvaged Inlet Covers	EACH
612.0104	Pipe Underdrain 4-Inch	LF
612.0106	Pipe Underdrain 6-Inch	LF
612.0108	Pipe Underdrain 8-Inch	LF
612.0110	Pipe Underdrain 10-Inch	LF
612.0112	Pipe Underdrain 12-Inch	LF
612.0115	Pipe Underdrain 15-Inch	LF
612.0118	Pipe Underdrain 18-Inch	LF
612.0121	Pipe Underdrain 21-Inch	LF
612.0204	Pipe Underdrain Unperforated 4-Inch	LF
612.0206	Pipe Underdrain Unperforated 6-Inch	LF
612.0208	Pipe Underdrain Unperforated 8-Inch	LF
612.0210	Pipe Underdrain Unperforated 10-Inch	LF
612.0212	Pipe Underdrain Unperforated 12-Inch	LF
612.0215	Pipe Underdrain Unperforated 15-Inch	LF

Bid Items

612.0218	Pipe Underdrain Unperforated 18-Inch	LF
612.0221	Pipe Underdrain Unperforated 21-Inch	LF
612.0404	Pipe Underdrain Wrapped 4-Inch	LF
612.0406	Pipe Underdrain Wrapped 6-Inch	LF
612.0408	Pipe Underdrain Wrapped 8-Inch	LF
612.0410	Pipe Underdrain Wrapped 10-Inch	LF
612.0412	Pipe Underdrain Wrapped 12-Inch	LF
612.0415	Pipe Underdrain Wrapped 15-Inch	LF
612.0504	Pipe Underdrain Wrapped and Plowed 4-Inch	LF
612.0506	Pipe Underdrain Wrapped and Plowed 6-Inch	LF
612.0600	Underdrain Trench	LF
612.0700	Drain Tile Exploration	LF
612.0804	Apron Endwalls for Underdrain Reinforced Concrete 4-Inch	EACH
612.0806	Apron Endwalls for Underdrain Reinforced Concrete 6-Inch	EACH
614.0010	Barrier System Grading Shaping Finishing	EACH
614.0115	Anchorages for Steel Plate Beam Guard Type 2	EACH
614.0150	Anchor Assemblies for Steel Plate Beam Guard	EACH
614.0200	Steel Thrie Beam Structure Approach	LF
614.0212	Steel Thrie Beam Structure Approach Retrofit Cantilever Blunt End	EACH
614.0213	Steel Thrie Beam Structure Approach Retrofit Cantilever Sloped End	EACH
614.0215	Steel Thrie Beam Structure Approach Retrofit Span	EACH
614.0216	Steel Thrie Beam Structure Approach Retrofit Post	EACH
614.0220	Steel Thrie Beam Bullnose Terminal	EACH
614.0230	Steel Thrie Beam	LF
614.0250	Steel Thrie Beam Structure Approach Temporary	LF
614.0305	Steel Plate Beam Guard Class A	LF
614.0340	Steel Plate Beam Guard Over Low-Fill Culverts Class A	LF
614.0345	Steel Plate Beam Guard Short Radius	LF
614.0360	Steel Plate Beam Guard Temporary	LF
614.0370	Steel Plate Beam Guard Energy Absorbing Terminal	EACH
614.0380	Steel Plate Beam guard Energy Absorbing Terminal Temporary	EACH
614.0390	Steel Plate Beam Guard Short Radius Terminal	EACH
614.0395	Guardrail Mow Strip Concrete	SY
614.0396	Guardrail Mow Strip Asphalt	SY
614.0397	Guardrail Mow Strip Emulsified Asphalt	SY
614.0400	Adjusting Steel Plate Beam Guard	LF
614.0510	Guardrail Stiffened NW	LF
614.0515	Guardrail Stiffened LHW	LF
614.0700	Sand Barrel Arrays	EACH
614.0800	Crash Cushions Permanent	EACH
614.0805	Crash Cushions Permanent Low Maintenance	EACH
614.0905	Crash Cushions Temporary	EACH
614.0920	Salvaged Rail	LF
614.0925	Salvaged Guardrail End Treatments	EACH
614.0930	Salvaged Crash Cushions	EACH
614.0935	Salvaged Sand Barrels	EACH
614.0950	Replacing Guardrail Posts and Blocks	EACH
614.0951	Replacing Guardrail Rail and Hardware	LF

Add a Replacing Guardrail Reflectors bid item.

614.0952	Replacing Guardrail Reflectors	EACH
614.1000	MGS Guardrail Temporary	LF
614.1100	MGS Guardrail Temporary Thrie Beam Transition	LF
614.1200	MGS Guardrail Temporary Terminal EAT	EACH
614.2300	MGS Guardrail 3	LF

614.2310	MGS Guardrail 3 HS	LF
614.2320	MGS Guardrail 3 QS	LF
614.2330	MGS Guardrail 3 K	LF
614.2340	MGS Guardrail 3 L	LF
614.2350	MGS Guardrail Short Radius	LF
614.2500	MGS Thrie Beam Transition	LF
614.2610	MGS Guardrail Terminal EAT	EACH
614.2620	MGS Guardrail Terminal Type 2	EACH
614.2630	MGS Guardrail Short Radius Terminal	EACH
614.8010	Anchor Post Assembly Top Mount	EACH
615.0100	Guard Fence Timber Rail	LF
615.0200	Curbs Treated Timber	EACH
615.0300	Guard Posts Timber	EACH
615.0400	Marker Posts Rustic	EACH
615.1000	Wisconsin Historical Marker (project)	LS
616.0100	Fence Woven Wire (height)	LF
616.0204	Fence Chain Link 4-FT	LF
616.0205	Fence Chain Link 5-FT	LF
616.0206	Fence Chain Link 6-FT	LF
616.0207	Fence Chain Link 7-FT	LF
616.0208	Fence Chain Link 8-FT	LF
616.0210	Fence Chain Link 10-FT	LF
616.0329	Gates Chain Link (width)	EACH
616.0404	Fence Chain Link Salvaged 4-FT	LF
616.0405	Fence Chain Link Salvaged 5-FT	LF
616.0406	Fence Chain Link Salvaged 6-FT	LF
616.0407	Fence Chain Link Salvaged 7-FT	LF
616.0408	Fence Chain Link Salvaged 8-FT	LF
616.0410	Fence Chain Link Salvaged 10-FT	LF
617.0100	Hauling (material)	CYMI
618.0100	Maintenance and Repair of Haul Roads (project)	EACH
619.1000	Mobilization	EACH
620.0100	Concrete Corrugated Median	SF
620.0200	Concrete Median Blunt Nose	SF
620.0300	Concrete Median Sloped Nose	SF
621.0100	Landmark Reference Monuments	EACH
621.1100	Landmark Reference Monuments and Cast Iron Covers	EACH
621.1200	Landmark Reference Monuments and Aluminum Covers	EACH
623.0200	Dust Control Surface Treatment	SY
624.0100	Water	MGAL
625.0100	Topsoil	SY
625.0105	Topsoil	CY
625.0500	Salvaged Topsoil	SY
626.0200	Peat Humus	SY
627.0200	Mulching	SY
627.0205	Mulching	TON
628.1104	Erosion Bales	EACH
628.1504	Silt Fence	LF
628.1520	Silt Fence Maintenance	LF
628.1550	Silt Screen	LF
628.1905	Mobilizations Erosion Control	EACH
628.1910	Mobilizations Emergency Erosion Control	EACH
628.1920	Cleaning Sediment Basins	CY
628.2002	Erosion Mat Class I Type A	SY

628.2004	Erosion Mat Class I Type B	SY
628.2006	Erosion Mat Urban Class I Type A	SY
628.2008	Erosion Mat Urban Class I Type B	SY
628.2021	Erosion Mat Class II Type A	SY
628.2023	Erosion Mat Class II Type B	SY
628.2027	Erosion Mat Class II Type C	SY
628.2031	Erosion Mat Class III Type A	SY
628.2033	Erosion Mat Class III Type B	SY
628.2037	Erosion Mat Class III Type C	SY
628.2039	Erosion Mat Class III Type D	SY
628.5505	Polyethylene Sheeting	SY
628.6005	Turbidity Barriers	SY
628.6505	Soil Stabilizer Type A	ACRE
628.6510	Soil Stabilizer Type B	ACRE
628.7005	Inlet Protection Type A	EACH
628.7010	Inlet Protection Type B	EACH
628.7015	Inlet Protection Type C	EACH
628.7020	Inlet Protection Type D	EACH
628.7504	Temporary Ditch Checks	LF
628.7555	Culvert Pipe Checks	EACH
628.7560	Tracking Pads	EACH
628.7570	Rock Bags	EACH
629.0205	Fertilizer Type A	CWT
629.0210	Fertilizer Type B	CWT
629.1100	Agricultural Limestone Treatment	TON
630.0110	Seeding Mixture No. 10	LB
630.0120	Seeding Mixture No. 20	LB
630.0130	Seeding Mixture No. 30	LB
630.0140	Seeding Mixture No. 40	LB
630.0160	Seeding Mixture No. 60	LB
630.0170	Seeding Mixture No. 70	LB
630.0171	Seeding Mixture No. 70A	LB
630.0175	Seeding Mixture No. 75	LB
630.0180	Seeding Mixture No. 80	LB
630.0200	Seeding Temporary	LB
630.0300	Seeding Borrow Pit	LB
630.0400	Seeding Nurse Crop	LB
631.0300	Sod Water	MGAL
631.1000	Sod Lawn	SY
631.1100	Sod Erosion Control	SY
631.1200	Sod Erosion Control Sandy Soil	SY
632.0101	Trees (species, root, size)	EACH
632.0201	Shrubs (species, root, size)	EACH
632.0301	Vines (species, root, size)	EACH
632.9101	Landscape Planting Surveillance and Care Cycles	EACH
633.0100	Delineator Posts Steel	EACH
633.0200	Delineators Flexible	EACH
633.0500	Delineator Reflectors	EACH
633.1000	Delineator Brackets	EACH
633.1100	Delineators Temporary	EACH
633.5100	Markers ROW	EACH
633.5200	Markers Culvert End	EACH
633.5300	Markers Crossover	EACH

Bid Items

Add a new bid item for flexible median markers.

633.5400	Markers Median	EACH
633.9010	Salvaged Delineator Steel	EACH
634.0410	Posts Wood 4x4-Inch x 10-FT	EACH
634.0412	Posts Wood 4x4-Inch x 12-FT	EACH
634.0414	Posts Wood 4x4-Inch x 14-FT	EACH
634.0416	Posts Wood 4x4-Inch x 16-FT	EACH
634.0418	Posts Wood 4x4-Inch x 18-FT	EACH
634.0612	Posts Wood 4x6-Inch x 12-FT	EACH
634.0614	Posts Wood 4x6-Inch x 14-FT	EACH
634.0616	Posts Wood 4x6-Inch x 16-FT	EACH
634.0618	Posts Wood 4x6-Inch x 18-FT	EACH
634.0620	Posts Wood 4x6-Inch x 20-FT	EACH
634.0622	Posts Wood 4x6-Inch x 22-FT	EACH
634.0624	Posts Wood 4x6-Inch x 24-FT	EACH
634.0801	Posts Tubular Steel 2x2-Inch x 1.5-FT	EACH
634.0803	Posts Tubular Steel 2x2-Inch x 3-FT	EACH
634.0805	Posts Tubular Steel 2x2-Inch x 5-FT	EACH
634.0808	Posts Tubular Steel 2x2-Inch x 8-FT	EACH
634.0809	Posts Tubular Steel 2x2-Inch x 9.5-FT	EACH
634.0810	Posts Tubular Steel 2x2-Inch x 10-FT	EACH
634.0811	Posts Tubular Steel 2x2-Inch x 11-FT	EACH
634.0812	Posts Tubular Steel 2x2-Inch x 12-FT	EACH
634.0814	Posts Tubular Steel 2x2-Inch x 14-FT	EACH
634.0816	Posts Tubular Steel 2x2-Inch x 16-FT	EACH
634.0818	Posts Tubular Steel 2x2-Inch x 18-FT	EACH
634.0885	Posts Tubular Steel 2x2-Inch x 8.5-FT	EACH
635.0200	Sign Supports Structural Steel HS	LB
635.0300	Sign Supports Replacing Base Connection Bolts	EACH
636.0100	Sign Supports Concrete Masonry	CY
636.0500	Sign Supports Steel Reinforcement	LB
636.1000	Sign Supports Steel Reinforcement HS	LB
636.1500	Sign Supports Steel Coated Reinforcement HS	LB
637.0620	Sign Flags Permanent Type II	EACH
637.1210	Signs Type I Reflective H	SF
637.1220	Signs Type I Reflective SH	SF
637.1230	Signs Type I Reflective F	SF
637.2110	Signs Type II Non Reflective	SF
637.2115	Signs Type II Non Reflective Folding	SF
637.2210	Signs Type II Reflective H	SF
637.2215	Signs Type II Reflective H Folding	SF
637.2220	Signs Type II Reflective SH	SF
637.2225	Signs Type II Reflective SH Folding	SF
637.2230	Signs Type II Reflective F	SF
637.2235	Signs Type II Reflective F Folding	SF
637.5453	Barricades Permanent Type III	EACH
638.2101	Moving Signs Type I	EACH
638.2102	Moving Signs Type II	EACH
638.2601	Removing Signs Type I	EACH
638.2602	Removing Signs Type II	EACH
638.3000	Removing Small Sign Supports	EACH
638.3100	Removing Structural Steel Sign Supports	EACH
638.3150	Removing Overhead Sign Supports Cantilever (structure)	EACH
638.3155	Removing Overhead Sign Supports Full Span (structure)	EACH

Bid Items

638.3210	Revising Signs Type I Demountable	EACH
638.3215	Revising Signs Type I Non-Removable	EACH
638.3610	Erecting State Owned Signs Type I	EACH
638.3620	Erecting State Owned Signs Type II	EACH
638.4000	Moving Small Sign Supports	EACH
638.4100	Moving Structural Steel Sign Supports	EACH
639.0106	Drill Hole in Earth 6-Inch	LF
639.0108	Drill Hole in Earth 8-Inch	LF
639.0110	Drill Hole in Earth 10-Inch	LF
639.0112	Drill Hole in Earth 12-Inch	LF
639.0504	Drill Hole in Rock 4-Inch	LF
639.0506	Drill Hole in Rock 6-Inch	LF
639.0508	Drill Hole in Rock 8-Inch	LF
639.0510	Drill Hole in Rock 10-Inch	LF
639.0512	Drill Hole in Rock 12-Inch	LF
639.1004	Well Casing Pipe 4-Inch	LF
639.1006	Well Casing Pipe 6-Inch	LF
639.1008	Well Casing Pipe 8-Inch	LF
639.1010	Well Casing Pipe 10-Inch	LF
639.1012	Well Casing Pipe 12-Inch	LF
639.1700	Well Screen	LF
639.2100	Grout for Sealing Well Casing	CF
639.2500	Pump and Well Platform	EACH
639.3000	Wayside Well Shelter	EACH
639.4000	Test Pumping	EACH
641.0100	Sign Bridge Single Pole Sign Support One Sign (structure)	LS
641.0600	Sign Bridge Single Pole Sign Support Two Signs (structure)	LS
641.1200	Sign Bridge Cantilevered (structure)	LS
641.5100	Sign Bridge Structure Mounted (structure)	LS
641.6600	Sign Bridge (structure)	LS
641.8100	Overhead Sign Support (structure)	LS
642.5001	Field Office Type B	EACH
642.5201	Field Office Type C	EACH
642.5401	Field Office Type D	EACH
642.6001	Field Laboratory	EACH
643.0300	Traffic Control Drums	DAY
643.0405	Traffic Control Barricades Type I	DAY
643.0410	Traffic Control Barricades Type II	DAY
643.0420	Traffic Control Barricades Type III	DAY
643.0500	Traffic Control Flexible Tubular Marker Posts	EACH
643.0600	Traffic Control Flexible Tubular Marker Bases	EACH
643.0705	Traffic Control Warning Lights Type A	DAY
643.0710	Traffic Control Warning Lights Type B	DAY
643.0715	Traffic Control Warning Lights Type C	DAY
643.0800	Traffic Control Arrow Boards	DAY
643.0900	Traffic Control Signs	DAY
643.0910	Traffic Control Covering Signs Type I	EACH
643.0920	Traffic Control Covering Signs Type II	EACH
643.1000	Traffic Control Signs Fixed Message	SF
643.1050	Traffic Control Signs PCMS	DAY
643.1051	Traffic Control Signs PCMS with Cellular Communications	DAY
643.1070	Traffic Control Cones 42-Inch	DAY
643.5000	Traffic Control	EACH
645.0105	Geotextile Type C	SY

Bid Items

645.0111	Geotextile Type DF Schedule A	SY
645.0112	Geotextile Type DF Schedule B	SY
645.0113	Geotextile Type DF Schedule C	SY
645.0115	Geotextile Type ES	SY
645.0120	Geotextile Type HR	SY
645.0125	Geotextile Type MS	SY
645.0130	Geotextile Type R	SY
645.0135	Geotextile Type SR	SY
645.0140	Geotextile Type SAS	SY
645.0220	Geogrid Type SR	SY
645.0240	Geogrid Type MR	SY
645.0260	Geogrid Type SSR	SY
646.1005	Marking Line Paint 4-Inch	LF
646.1020	Marking Line Epoxy 4-Inch	LF
646.1040	Marking Line Grooved Wet Ref Epoxy 4-Inch	LF
646.1050	Marking Line Grooved Permanent Tape 4-Inch	LF
646.1545	Marking Line Grooved Wet Ref Contrast Epoxy 4-Inch	LF
646.1555	Marking Line Grooved Contrast Permanent Tape 4-Inch	LF
646.3005	Marking Line Paint 8-Inch	LF
646.3020	Marking Line Epoxy 8-Inch	LF
646.3040	Marking Line Grooved Wet Ref Epoxy 8-Inch	LF
646.3050	Marking Line Grooved Permanent Tape 8-Inch	LF
646.3545	Marking Line Grooved Wet Ref Contrast Epoxy 8-Inch	LF
646.3555	Marking Line Grooved Contrast Permanent Tape 8-Inch	LF
646.4505	Marking Line Same Day Paint 4-Inch	LF
646.4520	Marking Line Same Day Epoxy 4-Inch	LF
646.4605	Marking Line Same Day Paint 8-Inch	LF
646.4620	Marking Line Same Day Epoxy 8-Inch	LF
646.5005	Marking Arrow Paint	EACH
646.5020	Marking Arrow Epoxy	EACH
646.5105	Marking Word Paint	EACH
646.5120	Marking Word Epoxy	EACH
646.5205	Marking Symbol Paint	EACH
646.5220	Marking Symbol Epoxy	EACH
646.5305	Marking Railroad Crossing Paint	EACH
646.5320	Marking Railroad Crossing Epoxy	EACH
646.5420	Marking Aerial Enforcement Bar Epoxy	EACH
646.5520	Marking Outfall Epoxy	EACH
646.6005	Marking Stop Line Paint 12-Inch	LF
646.6020	Marking Stop Line Epoxy 12-Inch	LF
646.6105	Marking Stop Line Paint 18-Inch	LF
646.6120	Marking Stop Line Epoxy 18-Inch	LF
646.6205	Marking Yield Line Paint 18-Inch	EACH
646.6220	Marking Yield Line Epoxy 18-Inch	EACH
646.6305	Marking Dotted Extension Paint 18-Inch	LF
646.6320	Marking Dotted Extension Epoxy 18-Inch	LF

Add Cold Weather Marking Epoxy 4-Inch and Cold Weather Marking Epoxy 8-Inch standard bid items.

646.6464	Cold Weather Marking Epoxy 4-Inch	LF
646.6468	Cold Weather Marking Epoxy 8-Inch	LF
646.7005	Marking Diagonal Paint 6-Inch	LF
646.7020	Marking Diagonal Epoxy 6-Inch	LF
646.7105	Marking Diagonal Paint 12-Inch	LF
646.7120	Marking Diagonal Epoxy 12-Inch	LF
646.7205	Marking Chevron Paint 24-Inch	LF

Bid Items

646.7220	Marking Chevron Epoxy 24-Inch	LF
646.7405	Marking Crosswalk Paint Transverse Line 6-Inch	LF
646.7420	Marking Crosswalk Epoxy Transverse Line 6-Inch	LF
646.7505	Marking Crosswalk Paint Ladder Pattern 24-Inch	LF
646.7520	Marking Crosswalk Epoxy Ladder Pattern 24-Inch	LF
646.8005	Marking Corrugated Median Paint	SF
646.8020	Marking Corrugated Median Epoxy	SF
646.8105	Marking Curb Paint	LF
646.8120	Marking Curb Epoxy	LF
646.8205	Marking Island Nose Paint	EACH
646.8220	Marking Island Nose Epoxy	EACH
646.8305	Marking Parking Stall Paint	LF
646.8320	Marking Parking Stall Epoxy	LF
646.9000	Marking Removal Line 4-Inch	LF
646.9010	Marking Removal Line Water Blasting 4-Inch	LF
646.9100	Marking Removal Line 8-Inch	LF
646.9110	Marking Removal Line Water Blasting 8-Inch	LF
646.9200	Marking Removal Line Wide	LF
646.9210	Marking Removal Line Water Blasting Wide	LF
646.9300	Marking Removal Special Marking	EACH
646.9310	Marking Removal Special Marking Water Blasting	EACH
646.9400	Marking Removal Plowable Raised Pavement Markers	EACH
648.0100	Locating No-Passing Zones	MI
649.0105	Temporary Marking Line Paint 4-Inch	LF
649.0120	Temporary Marking Line Epoxy 4-Inch	LF
649.0150	Temporary Marking Line Removable Tape 4-Inch	LF
649.0155	Temporary Marking Line Removable Contrast Tape 4-Inch	LF
649.0205	Temporary Marking Line Paint 8-Inch	LF
649.0220	Temporary Marking Line Epoxy 8-Inch	LF
649.0250	Temporary Marking Line Removable Tape 8-Inch	LF
649.0255	Temporary Marking Line Removable Contrast Tape 8-Inch	LF
649.0505	Temporary Marking Arrow Paint	EACH
649.0520	Temporary Marking Arrow Epoxy	EACH
649.0550	Temporary Marking Arrow Removable Tape	EACH
649.0605	Temporary Marking Word Paint	EACH
649.0620	Temporary Marking Word Epoxy	EACH
649.0650	Temporary Marking Word Removable Tape	EACH
649.0760	Temporary Marking Raised Pavement Marker Type I	EACH
649.0770	Temporary Marking Raised Pavement Marker Type II	EACH
649.0805	Temporary Marking Stop Line Paint 18-Inch	LF
649.0820	Temporary Marking Stop Line Epoxy 18-Inch	LF
649.0850	Temporary Marking Stop Line Removable Tape 18-Inch	LF
649.0905	Temporary Marking Diagonal Paint 12-Inch	LF
649.0920	Temporary Marking Diagonal Epoxy 12-Inch	LF
649.0950	Temporary Marking Diagonal Removable Tape 12-Inch	LF
649.0960	Temporary Marking Removable Mask Out Tape 6-Inch	LF
649.0970	Temporary Marking Removable Mask Out Tape 10-Inch	LF
650.4000	Construction Staking Storm Sewer	EACH
650.4500	Construction Staking Subgrade	LF
650.5000	Construction Staking Base	LF
650.5500	Construction Staking Curb Gutter and Curb & Gutter	LF
650.6000	Construction Staking Pipe Culverts	EACH
650.6500	Construction Staking Structure Layout (structure)	LS
650.7000	Construction Staking Concrete Pavement	LF

Bid Items

650.7500	Construction Staking Concrete Barrier	LF
650.8000	Construction Staking Resurfacing Reference	LF
650.8500	Construction Staking Electrical Installations (project)	LS
650.9000	Construction Staking Curb Ramps	EACH
650.9910	Construction Staking Supplemental Control (project)	LS
650.9920	Construction Staking Slope Stakes	LF
652.0105	Conduit Rigid Metallic 3/4-Inch	LF
652.0110	Conduit Rigid Metallic 1-Inch	LF
652.0115	Conduit Rigid Metallic 1 1/4-Inch	LF
652.0120	Conduit Rigid Metallic 1 1/2-Inch	LF
652.0125	Conduit Rigid Metallic 2-Inch	LF
652.0130	Conduit Rigid Metallic 2 1/2-Inch	LF
652.0135	Conduit Rigid Metallic 3-Inch	LF
652.0140	Conduit Rigid Metallic 3 1/2-Inch	LF
652.0145	Conduit Rigid Metallic 4-Inch	LF
652.0205	Conduit Rigid Nonmetallic Schedule 40 3/4-Inch	LF
652.0210	Conduit Rigid Nonmetallic Schedule 40 1-Inch	LF
652.0215	Conduit Rigid Nonmetallic Schedule 40 1 1/4-Inch	LF
652.0220	Conduit Rigid Nonmetallic Schedule 40 1 1/2-Inch	LF
652.0225	Conduit Rigid Nonmetallic Schedule 40 2-Inch	LF
652.0230	Conduit Rigid Nonmetallic Schedule 40 2 1/2-Inch	LF
652.0235	Conduit Rigid Nonmetallic Schedule 40 3-Inch	LF
652.0240	Conduit Rigid Nonmetallic Schedule 40 4-Inch	LF
652.0305	Conduit Rigid Nonmetallic Schedule 80 3/4-Inch	LF
652.0310	Conduit Rigid Nonmetallic Schedule 80 1-Inch	LF
652.0315	Conduit Rigid Nonmetallic Schedule 80 1 1/4-Inch	LF
652.0320	Conduit Rigid Nonmetallic Schedule 80 1 1/2-Inch	LF
652.0325	Conduit Rigid Nonmetallic Schedule 80 2-Inch	LF
652.0330	Conduit Rigid Nonmetallic Schedule 80 2 1/2-Inch	LF
652.0335	Conduit Rigid Nonmetallic Schedule 80 3-Inch	LF
652.0340	Conduit Rigid Nonmetallic Schedule 80 4-Inch	LF
652.0405	Conduit Reinforced Thermosetting Resin 2-Inch	LF
652.0410	Conduit Reinforced Thermosetting Resin 3-Inch	LF
652.0415	Conduit Reinforced Thermosetting Resin 4-Inch	LF
652.0605	Conduit Special 2-Inch	LF
652.0610	Conduit Special 2 1/2-Inch	LF
652.0615	Conduit Special 3-Inch	LF
652.0620	Conduit Special 3 1/2-Inch	LF
652.0625	Conduit Special 4-Inch	LF
652.0690	Conduit Special (inch)	LF
652.0800	Conduit Loop Detector	LF
652.0900	Loop Detector Slots	LF
653.0105	Pull Boxes Steel 12x24-Inch	EACH
653.0110	Pull Boxes Steel 12x30-Inch	EACH
653.0115	Pull Boxes Steel 12x36-Inch	EACH
653.0120	Pull Boxes Steel 18x24-Inch	EACH
653.0125	Pull Boxes Steel 18x30-Inch	EACH
653.0130	Pull Boxes Steel 18x36-Inch	EACH
653.0135	Pull Boxes Steel 24x36-Inch	EACH
653.0140	Pull Boxes Steel 24x42-Inch	EACH
653.0145	Pull Boxes Steel 24x48-Inch	EACH
653.0154	Pull Boxes Non-Conductive 24x36-Inch	EACH
653.0164	Pull Boxes Non-Conductive 24x42-Inch	EACH
653.0180	Pull Boxes Steel Communications (inch)	EACH

Bid Items

653.0208	Junction Boxes 8x8x8-Inch	EACH
Add a 10" X 10" X 6" junction box bid item.		
653.0210	Junction Boxes 10x10x6-Inch	EACH
653.0220	Junction Boxes 18x6x6-Inch	EACH
653.0222	Junction Boxes 18x12x6-Inch	EACH
653.0900	Adjusting Pull Boxes	EACH
653.0905	Removing Pull Boxes	EACH
654.0101	Concrete Bases Type 1	EACH
654.0102	Concrete Bases Type 2	EACH
654.0105	Concrete Bases Type 5	EACH
654.0106	Concrete Bases Type 6	EACH
654.0107	Concrete Bases Type 7	EACH
654.0108	Concrete Bases Type 8	EACH
654.0110	Concrete Bases Type 10	EACH
654.0111	Concrete Bases Type 11	EACH
654.0113	Concrete Bases Type 13	EACH
654.0200	Concrete Control Cabinet Bases Type 6	EACH
654.0205	Concrete Control Cabinet Bases Type 7	EACH
654.0210	Concrete Control Cabinet Bases Type 8	EACH
654.0215	Concrete Control Cabinet Bases Type 9	EACH
654.0217	Concrete Control Cabinet Bases Type 9 Special	EACH
654.0220	Concrete Control Cabinet Bases Type 10	EACH
654.0224	Concrete Control Cabinet Bases Type L24	EACH
654.0230	Concrete Control Cabinet Bases Type L30	EACH
654.1130	Concrete Bases Camera Pole 30-FT	EACH
654.1150	Concrete Bases Camera Pole 50-FT	EACH
654.1180	Concrete Bases Camera Pole 80-FT	EACH
654.1239	Concrete Control Cabinet Bases ITS	EACH
655.0102	Cable In Duct 2-2 AWG	LF
655.0104	Cable In Duct 2-4 AWG	LF
655.0106	Cable In Duct 2-6 AWG	LF
655.0108	Cable In Duct 2-8 AWG	LF
655.0110	Cable In Duct 2-10 AWG	LF
655.0122	Cable In Duct 3-2 AWG	LF
655.0124	Cable In Duct 3-4 AWG	LF
655.0126	Cable In Duct 3-6 AWG	LF
655.0128	Cable In Duct 3-8 AWG	LF
655.0130	Cable In Duct 3-10 AWG	LF
655.0144	Cable In Duct 4-4 AWG	LF
655.0146	Cable In Duct 4-6 AWG	LF
655.0148	Cable In Duct 4-8 AWG	LF
655.0150	Cable In Duct 4-10 AWG	LF
655.0205	Cable Traffic Signal 3-12 AWG	LF
655.0210	Cable Traffic Signal 3-14 AWG	LF
655.0215	Cable Traffic Signal 4-12 AWG	LF
655.0220	Cable Traffic Signal 4-14 AWG	LF
655.0223	Cable Traffic Signal 5-10 AWG	LF
655.0225	Cable Traffic Signal 5-12 AWG	LF
655.0230	Cable Traffic Signal 5-14 AWG	LF
655.0233	Cable Traffic Signal 7-10 AWG	LF
655.0235	Cable Traffic Signal 7-12 AWG	LF
655.0240	Cable Traffic Signal 7-14 AWG	LF
655.0243	Cable Traffic Signal 9-10 AWG	LF
655.0245	Cable Traffic Signal 9-12 AWG	LF

Bid Items

655.0250	Cable Traffic Signal 9-14 AWG	LF
655.0253	Cable Traffic Signal 12-10 AWG	LF
655.0255	Cable Traffic Signal 12-12 AWG	LF
655.0260	Cable Traffic Signal 12-14 AWG	LF
655.0263	Cable Traffic Signal 15-10 AWG	LF
655.0265	Cable Traffic Signal 15-12 AWG	LF
655.0270	Cable Traffic Signal 15-14 AWG	LF
655.0273	Cable Traffic Signal 19-10 AWG	LF
655.0275	Cable Traffic Signal 19-12 AWG	LF
655.0280	Cable Traffic Signal 19-14 AWG	LF
655.0285	Cable Traffic Signal 21-12 AWG	LF
655.0290	Cable Traffic Signal 21-14 AWG	LF
655.0305	Cable Type UF 2-12 AWG Grounded	LF
655.0320	Cable Type UF 2-10 AWG Grounded	LF
655.0325	Cable Type UF 2-8 AWG Grounded	LF
655.0400	Communication Cable Plowed	LF
655.0405	Communication Cable Trenched	LF
655.0410	Communication Cable Installed in Conduit	LF
655.0505	Electrical Wire Traffic Signals 14 AWG	LF
655.0510	Electrical Wire Traffic Signals 12 AWG	LF
655.0515	Electrical Wire Traffic Signals 10 AWG	LF
655.0520	Electrical Wire Traffic Signals 8 AWG	LF
655.0525	Electrical Wire Traffic Signals 6 AWG	LF
655.0530	Electrical Wire Traffic Signals 4 AWG	LF
655.0535	Electrical Wire Traffic Signals 2 AWG	LF
655.0610	Electrical Wire Lighting 12 AWG	LF
655.0615	Electrical Wire Lighting 10 AWG	LF
655.0620	Electrical Wire Lighting 8 AWG	LF
655.0625	Electrical Wire Lighting 6 AWG	LF
655.0630	Electrical Wire Lighting 4 AWG	LF
655.0635	Electrical Wire Lighting 2 AWG	LF
655.0640	Electrical Wire Lighting 1 AWG	LF
655.0645	Electrical Wire Lighting 1/0 AWG	LF
655.0700	Loop Detector Lead In Cable	LF
655.0800	Loop Detector Wire	LF
655.0900	Traffic Signal EVP Detector Cable	LF
656.0100	Electrical Service Meter Socket (location)	LS
656.0200	Electrical Service Meter Breaker Pedestal (location)	LS
656.0300	Electrical Service Unmetered (location)	LS
656.0400	Electrical Service Main Lugs Only Meter Pedestal (location)	LS
656.0500	Electrical Service Breaker Disconnect Box (location)	LS
657.0100	Pedestal Bases	EACH
657.0205	Transformer Bases Breakaway 13-15 Inch Bolt Circle	EACH
657.0210	Transformer Bases Breakaway 15-17 Inch Bolt Circle	EACH
657.0255	Transformer Bases Breakaway 11 1/2-Inch Bolt Circle	EACH
657.0305	Poles Type 2	EACH
657.0310	Poles Type 3	EACH
657.0315	Poles Type 4	EACH
657.0321	Poles Type 5-Steel	EACH
657.0322	Poles Type 5-Aluminum	EACH
657.0326	Poles Type 6-Steel	EACH
657.0327	Poles Type 6-Aluminum	EACH
657.0330	Poles Type 7	EACH
657.0336	Poles Type 17-Steel	EACH

657.0337	Poles Type 17-Aluminum	EACH

Add new bid items for contractor-provided poles typically used with monotube and steel luminaire arms.

657.0345	Poles Type 9	EACH
657.0346	Poles Type 9-Over Height	EACH
657.0350	Poles Type 10	EACH
657.0351	Poles Type 10-Over Height	EACH
657.0355	Poles Type 12	EACH
657.0356	Poles Type 12-Over Height	EACH
657.0360	Poles Type 13	EACH
657.0361	Poles Type 13-Over Height	EACH
657.0375	Poles Type A	EACH
657.0380	Poles Type E	EACH
657.0405	Traffic Signal Standards Aluminum 3.5-FT	EACH
657.0410	Traffic Signal Standards Aluminum 9-FT	EACH
657.0415	Traffic Signal Standards Aluminum 11-FT	EACH
657.0420	Traffic Signal Standards Aluminum 13-FT	EACH
657.0425	Traffic Signal Standards Aluminum 15-FT	EACH
657.0430	Traffic Signal Standards Aluminum 10-FT	EACH

Add new bid items for contractor provided monotube arms.

657.0515	Monotube Arms 15-FT	EACH
657.0520	Monotube Arms 20-FT	EACH
657.0525	Monotube Arms 25-FT	EACH
657.0530	Monotube Arms 30-FT	EACH
657.0535	Monotube Arms 35-FT	EACH
657.0540	Monotube Arms 40-FT	EACH
657.0545	Monotube Arms 45-FT	EACH
657.0550	Monotube Arms 50-FT	EACH
657.0555	Monotube Arms 55-FT	EACH
657.0590	Trombone Arms 20-FT	EACH
657.0595	Trombone Arms 25-FT	EACH
657.0605	Luminaire Arms Single Member 4 1/2-Inch Clamp 4-FT	EACH
657.0609	Luminaire Arms Single Member 4-Inch Clamp 6-FT	EACH
657.0610	Luminaire Arms Single Member 4 1/2-Inch Clamp 6-FT	EACH
657.0614	Luminaire Arms Single Member 4-Inch Clamp 8-FT	EACH
657.0615	Luminaire Arms Single Member 4 1/2-Inch Clamp 8-FT	EACH
657.0620	Luminaire Arms Single Member 6-Inch Clamp 4-FT	EACH
657.0625	Luminaire Arms Single Member 6-Inch Clamp 6-FT	EACH
657.0630	Luminaire Arms Single Member 6-Inch Clamp 8-FT	EACH
657.0635	Luminaire Arms Single Member 6-Inch Clamp 10-FT	EACH
657.0640	Luminaire Arms Single Member 6-Inch Clamp 15-FT	EACH
657.0704	Luminaire Arms Truss Type 4-Inch Clamp 10-FT	EACH
657.0705	Luminaire Arms Truss Type 4 1/2-Inch Clamp 10-FT	EACH
657.0709	Luminaire Arms Truss Type 4-Inch Clamp 12-FT	EACH
657.0710	Luminaire Arms Truss Type 4 1/2-Inch Clamp 12-FT	EACH
657.0714	Luminaire Arms Truss Type 4-Inch Clamp 15-FT	EACH
657.0715	Luminaire Arms Truss Type 4 1/2-Inch Clamp 15-FT	EACH
657.0720	Luminaire Arms Truss Type 6-Inch Clamp 20-FT	EACH
657.0725	Luminaire Arms Truss Type 6-Inch Clamp 15-FT	EACH
657.0730	Luminaire Arms Truss Type 6-Inch Clamp 12-FT	EACH
657.0735	Luminaire Arms Truss Type 6-Inch Clamp 10-FT	EACH

Add new bid items for contractor provided steel luminaire arms.

657.0806	Luminaire Arms Steel 6-FT	EACH
657.0808	Luminaire Arms Steel 8-FT	EACH
657.0810	Luminaire Arms Steel 10-FT	EACH

Bid Items

657.0812	Luminaire Arms Steel 12-FT	EACH
657.0815	Luminaire Arms Steel 15-FT	EACH

Retire the various install bid items for poles and arms.

657.6005	Anchor Assemblies Light Poles on Structures	EACH
658.0170	Traffic Signal Face 1S 8-Inch	EACH
658.0171	Traffic Signal Face 1S 12-Inch	EACH
658.0172	Traffic Signal Face 2S 12-Inch	EACH
658.0173	Traffic Signal Face 3S 12-Inch	EACH
658.0174	Traffic Signal Face 4S 12-Inch	EACH
658.0175	Traffic Signal Face 5S 12-Inch	EACH
658.0412	Pedestrian Signal Face 12-Inch	EACH
658.0416	Pedestrian Signal Face 16-Inch	EACH
658.0500	Pedestrian Push Buttons	EACH
658.1133	Programmable Traffic Signal Face 3S 12-Inch	EACH
658.1134	Programmable Traffic Signal Face 4S 12-Inch	EACH
658.1135	Programmable Traffic Signal Face 5S 12-Inch	EACH
658.5069	Signal Mounting Hardware (location)	LS
659.0400	Luminaires High Mast Lighting LED	EACH
659.0600	Underdeck Lighting (location)	LS
659.0700	Lighting Units Walkway	EACH
659.1115	Luminaires Utility LED A	EACH
659.1120	Luminaires Utility LED B	EACH
659.1125	Luminaires Utility LED C	EACH
659.1130	Luminaires Utility LED D	EACH
659.1205	Luminaires Underdeck LED A	EACH
659.1210	Luminaires Underdeck LED B	EACH
659.1215	Luminaires Underdeck LED C	EACH
659.2124	Lighting Control Cabinets 120/240 24-Inch	EACH
659.2130	Lighting Control Cabinets 120/240 30-Inch	EACH
659.2230	Lighting Control Cabinets 240/480 30-Inch	EACH
660.0100	High Mast Foundation (location)	LS
660.0200	High Mast Lighting Tower (location)	LS
661.0100	Temporary Traffic Signals for Bridges (structure)	LS
661.0200	Temporary Traffic Signals for Intersections (location)	LS
661.0300	Generators	DAY
661.0700	Temporary Ramp Meter (location)	LS
670.0100	Field System Integrator	LS
670.0200	ITS Documentation	LS
671.0100	Conduit HDPE 4-Duct 1 1/4-Inch	LF
671.0112	Conduit HDPE 1-Duct 2-Inch	LF
671.0122	Conduit HDPE 2-Duct 2-Inch	LF
671.0132	Conduit HDPE 3-Duct 2-Inch	LF
671.0142	Conduit HDPE 4-Duct 2-Inch	LF
671.0200	Conduit HDPE Directional Bore 4-Duct 1 1/4-Inch	LF
671.0212	Conduit HDPE Directional Bore 1-Duct 2-Inch	LF
671.0222	Conduit HDPE Directional Bore 2-Duct 2-Inch	LF
671.0232	Conduit HDPE Directional Bore 3-Duct 2-Inch	LF
671.0242	Conduit HDPE Directional Bore 4-Duct 2-Inch	LF
671.0244	Conduit HDPE Directional Bore 4-Duct 4-Inch	LF
671.0300	Fiber Optic Cable Marker	EACH
673.0105	Communication Vault Type 1	EACH
673.0110	Communication Vault Type Round	EACH
673.0200	Tracer Wire Marker Posts	EACH
674.0106	Cable ITS Communication 6 Pair	LF

Bid Items

674.0112	Cable ITS Communication 12 Pair	LF
674.0125	Cable ITS Communication 25 Pair	LF
674.0200	Cable Microwave Detector	LF
674.0300	Remove Cable	LF
674.0400	Reinstall Cable	LF
675.0100	Install Controller Ramp Meter Processor Assembly	EACH
675.0200	Install Controller Detector Processor Assembly	EACH
675.0300	Install Mounted Controller Microwave Detector Assembly	EACH
677.0130	Install Camera Pole 30-FT	EACH
677.0150	Install Camera Pole 50-FT	EACH
677.0180	Install Camera Pole 80-FT	EACH
677.0200	Install Camera Assembly	EACH
678.0006	Install Fiber Optic Cable Outdoor Plant 6-CT	LF
678.0012	Install Fiber Optic Cable Outdoor Plant 12-CT	LF
678.0024	Install Fiber Optic Cable Outdoor Plant 24-CT	LF
678.0036	Install Fiber Optic Cable Outdoor Plant 36-CT	LF
678.0048	Install Fiber Optic Cable Outdoor Plant 48-CT	LF
678.0072	Install Fiber Optic Cable Outdoor Plant 72-CT	LF
678.0096	Install Fiber Optic Cable Outdoor Plant 96-CT	LF
678.0144	Install Fiber Optic Cable Outdoor Plant 144-CT	LF
678.0200	Fiber Optic Splice Enclosure	EACH
678.0300	Fiber Optic Splice	EACH
678.0400	Fiber Optic Termination	EACH
678.0500	Communication System Testing	LS
678.0600	Install Ethernet Switches	EACH
678.0700	Install Wireless Antennas	EACH
678.0800	Install Cellular Modems	EACH
690.0150	Sawing Asphalt	LF
690.0250	Sawing Concrete	LF

Part 7 Bid Items

715.0415	Incentive Strength Concrete Pavement	DOL
715.0502	Incentive Strength Concrete Structures	DOL

Add incentive items for IRI ride now in standard spec 740.

740.0440	Incentive IRI Ride	DOL
740.0502	Incentive IRI Ride Bridge	DOL

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Appendix
Conversion Table U.S. Standard Measure to SI Metric

TO CONVERT	FROM U.S STANDARD UNIT	TO SI METRIC UNIT	MULTIPLY BY
Length	inch	millimeter	25.4
	linear foot	millimeter	304.8
	linear foot	meter	0.3048
	station	meter	30.48
	station	40 meter unit	0.762
	mile	kilometer	1.609344
Area	square inch	square millimeter	645.16
	square foot	square meter	0.092903
	square yard	square meter	0.836127
	acre	square meter	4046.87
	acre	hectare	0.404687
Volume	fluid ounce	millimeter	29.57353
	gallon	liter	3.785412
	1000 gallons	kiloliter	2.785412
	cubic foot	cubic meter	0.028317
	cubic yard	cubic meter	0.764555
	1000 board feet	cubic meter	2.359737
Weight	ounce	gram	28.350
	pound	kilogram	0.453592
	hundredweight	kilogram	45.359237
	ton	megagram	0.907185
Wt./unit length	pound/linear foot	kilogram/meter	1.48816
Wt./unit area	pound/square foot	kilogram/square meter	4.88243
Density	pound/cubic foot	kilogram/cubic meter	16.0185
Force	pound	newton	4.44822
Force/unit length	pound/linear foot	newton/meter	14, 5939
Work	foot pound force	joule	1.35582
Pressure	pound/square foot	pascal	47.8803
	kip/square foot	kilopascal	47.8803
	pound/square inch	kilopascal	6.89476
	kip/square inch	megapascal	6.89476
Temperature	degree fahrenheit	degree celsius	(F-32)x5/9
Bending moment	foot pound	newton meter	1.35582
Plane angle	degree	degree	1
Electrical	ampere	ampere	1
	volt	volt	1
	watt	watt	1
Illuminance	footcandle	lux	10.7639
Miscellaneous:			
Clear/grub	inch diameter	25 mm diameter unit	1.016
Hauling	cubic yard mile	cubic meter kilometer	1.230432
Overhaul	yard mile	cubic meter kilometer	1.230432
Speed	mile/hour	kilometer/hour	1.609344

Appendix

Standard Sieve Sizes

U.S. STANDARD	SI METRIC
5 inch	125 millimeters
3 inch	75 millimeters
2 inch	50 millimeters
1 1/2 inch	37.5 millimeters
1 inch	25.0 millimeters
3/4 inch	19.0 millimeters
1/2 inch	12.5 millimeters
3/8 inch	9.5 millimeters
No. 4	4.75 millimeters
No. 8	2.36 millimeters
No. 10	2.00 millimeters
No. 16	1.18 millimeters
No. 30	600 microns[1]
No. 40	425 microns
No. 50	300 microns
No. 100	150 microns
No. 200	75 microns
No. 325	45 microns

[1] 1 micron = 1/1000 millimeter

Bid Item Unit Abbreviations

ACRE	acre	MGAL	1000 gallon unit
AD	arrow day	MI	mile
BBL	barrel	MKFT	board foot
BD	board day	MON	month
CD	calendar day	NONE	none
CF	cubic foot	OZ	ounce
CWT	hundredweight	PD	person day
CY	cubic yard	PH	person hour
CYMI	cubic yard mile	PR	pair
DAY	day	SACK	sack
DD	drum day	SD	sign day
DOL	dollar	SF	square foot
EACH	each	STA	station
FA	Fuel cost adjustments	STYD	station yard
GAL	gallon	SY	square yard
HRS	hours	TD	ton day
ID	Inch diameter	TM	ton mile
LB	pound	TON	ton
LF	linear foot	TF	track foot
LM	linear mile	VF	vertical feet
LOT	lot	WD	working day
LS	lump sum	WK	week
MBM	1000 foot board measure	YDMI	yard mile

Appendix

Conversion Table SI Metric to U.S. Standard Measure

TO CONVERT	FROM SI METRIC UNIT	TO U.S. STANDARD UNIT	MULTIPLY BY
Length	millimeter	inch	0.039370
	millimeter	linear foot	0.0032808
	meter	linear foot	3.280840
	meter	station	0.032808
	40 meter unit	station	1.312336
	kilometer	mile	0.621371
Area	square millimeter	square inch	0.001550
	square meter	square foot	10.763910
	square meter	square yard	1.195990
	square meter	acre	0.0002471
	hectare	acre	2.471044
Volume	milliliter	fluid ounce	0.033814
	liter	gallon	0.264172
	kiloliter	1000 gallons	0.264172
	cubic meter	cubic foot	35.314667
	cubic meter	cubic yard	1.307951
	cubic meter	1000 board feet	0.423776
Mass	gram	ounce	0.035274
	kilogram	pound	2.204622
	kilogram	hundredweight	0.022046
	megagram	ton	1.102311
Mass/unit length	kilogram/meter	pound/linear foot	0.671971
Mass/unit area	kilogram/square meter	pound/square foot	0.671971
Mass density	kilogram/cubic meter	pound/cubic foot	0.062428
Force	newton	pound	0.224809
Force/unit length	newton/meter	pound/linear foot	0.068522
Work	joule	foot pound force	0.737561
Pressure	pascal	pound/square foot	0.020885
	kilopascal	kip/.square foot	0.020885
	kilopascal	pound/square inch	0.145038
	megapascal	kip/square inch	0.145038
Temperature	degree celsius	degree fahrenheit	(C x 9/5) + 32
Bending moment	newton meter	foot-pound	0.737561
Plane angle	degree	degree	1
Electrical	ampere	ampere	1
	volt	volt	1
	watt	watt	1
Illuminance	lux	footcandle	0.092903
Miscellaneous:			
Clear/grub	25 mm diameter unit	inch diameter	0.984252
Hauling	cubic meter kilometer	yard mile	0.812723
Overhaul	cubic meter kilometer	cubic yard mile	0.812723
Speed	kilometer/hour	mile/hour	0.621371

Appendix

SI Metric Abbreviations

A	ampere	mm	millimeter
C	degrees celsius	mm^2	square millimeter
g	gram	m2, m^2	square meter
h	hour	m3, m^3	cubic meter
ha	hectare	m3km	cubic meter kilometer
J	joule	Mg	megagram (metric ton)
kg	kilogram	MPa	megapascal
kL	kiloliter	N	newton
km	kilometer	Nm	newton meter
kPa	kilopascal	P	pascal
L	liter	s	second
lx	lux	V	volt
m	meter	W	watt
m	meter	25mm	25 millimeter diameter unit
mg	milligram	40m	40 meter unit
mL	milliliter	µm	micron